

The Benefits of Inland Waterways

Final Report



**Defra and the Inland Waterways
Advisory Council**

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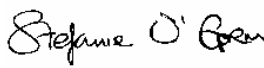



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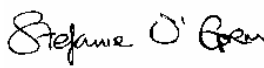
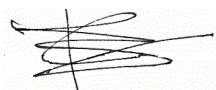


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Executive Summary

The Executive Summary presents the key messages and finding of this study first, along with the recommendations made as a result of these findings.

It then provides the background to the study, the benefits of inland waterways which were identified, the literature reviewed, the valuation framework developed and the gaps and limitations encountered.

Results and key messages

There are a **wide range of benefits provided by inland waterways**. These are both private benefits, realised through the creation of business opportunities and jobs, and public benefits, provided for instance by recreation or education opportunities.

Table A below summarises the results of this study; noting for each benefit whether benefit transfer values are available; the level of confidence in the available values for the use specified, the context in which their use is recommended, and the remaining gaps in the quantitative data where possible.

Monetary estimates are available to value many of these benefits using the benefits transfer valuation approach. The inclusion of these benefits within the decision making processes should result in more socially beneficial decisions being made and assist in the identification of the beneficiaries of these decisions. The most significant benefits for which values are available are the **premium on properties** close to the waterways and **recreation benefits**.

However there are **gaps**. These gaps come in two forms; the first relates to limited information on and understanding of how to quantify some benefits – for instance community benefits; the second relates to there being no suitable monetary valuation data available for example in the case of the ‘well-being’ benefits from volunteering.

The monetary units provided for the benefits need to be combined with appropriate **physical units** to complete the valuation exercise (for example, the value of informal recreation is multiplied by the appropriate number of visitors). In many cases better scientific evidence of the bio-physical relationships between the ecosystem service and related benefit provided is required. A physical or quantitative assessment of inland waterways benefits was outside the scope of this study; therefore it is not always clear to what extent the physical information is available to complete the valuation. However, a key gap is considered to be a clear definition and quantification of the benefits provided by the drainage and water conveyance services provided by inland waterways.

Table A Overview table

Ecosystem Service Category	Benefit	Values in Framework	Confidence (H,M,L)	Context for use and Gaps
Provisioning Services	Creation of business opportunities	GAP	N / A	The indicator 'job creation arising from expenditure' is used to value this benefit. Useful multipliers are identified, but not captured in the framework explicitly as it is focused on welfare values only. These multipliers are not specific to expenditures on inland waterways.
	Property premium	Yes	M / H	The premiums presented have been developed for properties in or adjacent to waterside locations. A range of premiums have been provided depending on the type and exact location of the property.
	Renewable energy (financial gains)	GAP	N / A	Only anecdotal evidence of these benefits is available. The associated carbon savings from the generation of renewable energy is addressed separately. See below.
	Transport	Yes	H	Values are provided for the combined benefits (environmental, financial cost savings etc) of commuters changing transport modes from road to bicycles or walking, and for freight movement from road to rail or water. These value are applied to cycling or walking along waterways, or the movement of freight along waterways, however they can also be applied to commuter movements in other locations (e.g. through parks) or freight movements via rail. The values are therefore not restricted in application to inland waterways. Physical data is required on the miles displaced from car journeys to walking and cycling for commuter purposes or freight transport and the level of congestion on the route. Depending on the scale of the assessment it may be difficult to estimate the volume of displaced road journeys, especially in the case of commuters, as there may be a large number of variables to consider.
	Provision of water	Yes	H	These values are based on the value of the water abstracted directly from British Waterways managed waters. It is assumed that the value of this water to other navigation authorities is likely to be similar and therefore that these value are applicable across all navigable waterways. Confidence in the market value data is high; but low in relation to the CS values presented due to a lack of information into how this value was estimated.
	Volunteering	Yes	H	These values were developed specifically for inland waterways by British Waterways, but are also applicable to non-navigation authority organisations. They represent the cost savings to the organisation benefiting from volunteer work. The number of labour hours worked by volunteers is required in order to estimate the full value of these benefits. These data are not necessarily collated by all navigation authorities so gaps may exist in the physical data.

Regulating Services	Carbon savings (renewable energy and transport)	Yes	H	<p>The valuation data come from Government Guidance and confidence in these estimates is high.</p> <p>The values can be applied to carbon savings associated with navigable and non-navigable waterways.</p> <p>Aggregation is dependant on the savings in energy or tonne kilometres and the value of those savings in terms of carbon reductions. Some evidence of the associated carbon reductions savings in energy or tonne kilometres is provided however this is largely site specific so gaps still exist.</p>
	Drainage, water conveyance, flood protection and alleviation	Partial	L / M	<p>The values presented are associated with the flood protection benefits provided by wetland habitats. These benefits may in reality be only partially provided by inland waterways and so they are only applicable where a habitat along the waterway is providing a flood protection benefit to adjacent properties and environments or where a scheme will provide such a habitat. The significance of these benefits for England and Wales' inland waterways is likely to be low.</p> <p>The most significant gap relates to the lack of any clear understanding of the benefits provided by drainage and water conveyance service and the extent to which these are currently provided.</p>
	Water regulation and pollution dilution	Yes	M	<p>Value loss due to eutrophication of the water course is used as proxy for the benefit of reversing this process. The values presented can only be applied where the value-lost from eutrophication, or the reduction in value-lost (e.g. the benefits resulting from a reduction in eutrophication) can be shown to result from a scheme or project.</p> <p>A significant gap therefore remains in estimating the value of water quality services provided by inland waterways.</p> <p>The values presented can be applied to both navigable and non navigable waterways where eutrophication is a significant problem.</p>
	Water quality	Yes	M	<p>The values presented are thought to be broadly attributable to the protection of the water environment and associated range of regulating services. While the quality of this study is considered to be high, the overall confidence in using these values in the framework is medium (or possible medium to high) due to the uncertainty around what exactly the respondent is providing a willingness to pay for.</p> <p>The values can be applied to value benefits from both navigable and non-navigable waterways. The physical data is required on the number of beneficiaries. The study found that the population living within a 17-36 miles radius were the relevant population to consider.</p>

Cultural Services	Recreation (all forms)	Yes	M	<p>Estimates are provided for the CS and expenditure value for a range of recreational activities undertaken in or along waterways. There is a mix in the primary studies between those specifically considering inland waterways and those applicable to all types of waterways. The data is old and public preferences are likely to have changed significantly since the early nineties when some of these studies were published.</p> <p>Physical data required to aggregate these benefits is available from a number of sources however there appears to be no centralised point to access these data and collation of data is likely to be inconsistent across navigation authorities.</p>
	Visual amenity	Yes	M	<p>Values reflect the marginal change (improvement or loss) in visual amenity as a result of increasing / decreasing the number of service structures around waterways. These values are specific to inland waterways as the original research was carried at five English canal sites. The values are not useful for estimating the current impacts of structures on the visual amenity provided by inland waterways and therefore, using the aggregate value of WTP to remove all services as a proxy for visual amenity may not be methodologically robust.</p>
	Heritage aspects	Yes	L	<p>Values reflect the preservation value of canals for those who "view canals as heritage resource" and represent respondents' use value for the heritage benefits of the canals they live nearest to or visit. This use value may also contain some element of the user's non-use. The primary study is considered to be of good quality, however the sample size of the group responding to the question on heritage resources was very low and therefore the results are unlikely to be robust.</p> <p>Estimating the physical data requirements for aggregation requires an understanding of the heritage importance of the sites being assessed and any known data on visitors.</p>
	Education	GAP	N / A	<p>Information is currently restricted to anecdotal evidence, no valuation data available. The key difficulty is on how to define and quantify the final benefits of education provided by inland waterways.</p>
	Volunteering	GAP	N / A	<p>No valuation data available for the 'well being' benefit of volunteering. The cost saving benefits provided by volunteers is discussed above.</p>
	Community benefits	GAP	N / A	<p>Information is currently restricted to anecdotal evidence, no valuation data available. It is clear however from the evidence presented that community improvement and cohesion benefits realised through the regeneration and restoration of inland waterways can be significant and often provides sufficient justification for investment in the waterways.</p>
	Non-use values	Yes	M / H	<p>Non-use values are provided for the continued maintenance of the canal system for boating, heritage and tow paths; biodiversity improvements and water quality improvements. These values are all specific to inland waterways however they can be applied in relation to both navigable and non-navigable waterways.</p> <p>Care is required in applying these values to ensure that they are appropriate to the policy site being assessed.</p>

Recommendations

As a first step in the development of the evidence base on the benefits of inland waterways it is recommended to **test the valuation framework** developed here on a specific project. This would assess its usefulness as a tool - whether the benefits identified in the framework indeed match with those realised 'on the ground', the applicability of the values presented, suitable aggregation data and how user-friendly the framework and guidance are.

Some of the key benefits provided by inland waterways may lie in those areas which are currently not quantified and valued, such as **drainage and community benefits** (including increased social capital and a sense of civic pride which may be wholly or partially attributed to the waterways). Further evidence on the benefits of **green transport opportunities** is also required as these may prove to play a significant role in reducing travel carbon emissions as well as increase physical activity – both of which are high on the Government's agenda. Such impacts may be particularly important in terms of the benefits they provide to disadvantaged groups.

Given the gaps, one of the key recommendations drawn out of this study is to **conduct further primary valuation work** in order to provide more up-to-date values for a selection of benefits. A primary valuation study could be designed to answer what are thought to be the most important questions with regard to how the public perceive and value the benefits of inland waterways.

It is also recommended that a **centralised collation point for physical data** is designed and used given the importance of the physical units to the accuracy of the valuation results.

Background

Inland waterways make a valuable contribution to peoples' quality of life. The benefits they provide are diverse and include transport, recreation opportunities, drainage services, regeneration benefits and non-use values¹. The full range of benefits is rarely considered in decisions over the use or development of inland waterways and their surrounding areas; this can result in incorrect or inappropriate decisions being made.

Where the wider value of inland waterways is not fully appreciated there is a risk that opportunities to realise important benefits are missed and / or that other benefits provided by the waterways network are compromised. It is important therefore, that the **benefits provided by inland waterways are identified so that they may be maximised**.

This study was undertaken to:

- (i) attempt to provide an indication of the value of inland waterways;
- (ii) provide evidence for future cost-benefit assessments of projects or proposals² and,
- (iii) aid in the assessment of the level of public sector funding.

¹ Non-use values are values that are not associated with actual use, or even the option to use a good or service. They are made up of (a) altruistic value (derived from the knowledge that something exists for others to use), (b) existence value (derived from knowing that something exists) and (c) bequest value (knowing that future generations will have the option to enjoy something).

² This study does *not* consider the environmental and social *disbenefits* arising from inland waterways, or the costs to society of maintaining them. That is the study only covers the benefit side of the cost-benefit equation.

The study focussed on the identification and monetisation of the full range of inland waterway benefits, in order to:

- Allow benefits to be compared to costs using the same indicator of value (money);
- Provide interested parties (e.g. Government, private organisations or the general public) with an estimate of the value of inland waterway's benefits that they can easily understand and compare with other natural and man-made systems;
- Indicate the relative importance of benefits (in a monetary sense), which can inform prioritisation of the benefits in terms of management and evaluation of priorities; and
- Facilitate an understanding of the beneficiaries and the development of appropriate funding and financing of the waterways.

This is the first study in a joint Research and Development Programme on the benefits of inland waterways of England and Wales, recently launched by The Department of Environment, Food and Rural Affairs (Defra) and the Inland Waterways Advisory Council (IWAC). As such, this project will underpin and inform future policy making across Government Departments in this area. The specific objective of this first stage is to **identify the range of benefits provided by inland waterways and the extent to which these can be quantified and valued and to provide guidance to users on valuing these benefits.**

The Benefits

A comprehensive list of inland waterways benefits was derived for the project using an Ecosystem Service Approach (ESA). The ESA identifies four categories of services and benefits: provisioning, regulating, cultural and supporting.

Provisioning services include food, water, resources and other economic benefits; regulating services include climate and flood alleviation; and cultural services provide recreational and aesthetic benefits.

Underpinning these are supporting services such as soil formation and nutrient cycling. In applying an ESA categorisation to the benefits provided by inland waterways, the inland waterways are taken to represent the 'ecosystem'.

As well as being commended in both practice and the academic literature as promoting an holistic approach to sustainable resource management, the ESA help to reduce the risk of double counting, allowing for a list of discrete, non-overlapping benefits to be generated. The final list of inland waterways benefits and their definition is presented in Table B.

Table B The benefits of inland waterways

Provisioning Services	
Provisioning services result in products being provided by the environment (ecosystems) such as food, fibre, fuel and natural medicines. In relation to inland waterways, provisioning services relate mainly to the provision of economic benefits such as:	
Creation of business opportunities	Creation of business opportunities (e.g. marinas, restaurants and shops)
Property premium	Property / land price premium on commercial and domestic property in proximity to inland waterways
Renewable energy	The provision of renewable energy opportunities
Transport	Transport routes (e.g. freight, commuters)
Provision of Water	The provision of water for supply for abstraction
Volunteering	The availability of volunteers
Regulating Services	
Regulating services provide benefits obtained from the regulation of ecosystems processes. One reason why regulating services are important is that they provide 'infrastructure' and 'insurance' values. In many cases it is necessary to maintain at least a minimum set of these services in order to ensure a reliable and sustainable flow of the resulting benefits. The regulating benefits identified for inland waterways are:	
Carbon savings (renewable energy and transport)	Climate regulation and carbon savings (e.g. from freight, walking / cycling which displaces other more carbon-intensive modes of travel)
Drainage, water conveyance, flood protection and alleviation	Drainage and the conveyance of water away from populated areas, thereby possibly providing flood protection and alleviation benefits along with other benefits
Water regulation and pollution dilution	Water cycling and pollution removal and dilution
Water quality	Water quality improvements
Cultural Services	
Cultural services provide the non-material benefits people obtain from the environment through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences. This category therefore includes both direct non-consumptive uses and non-use values as follows:	
Recreation (all forms)	Land based recreation, including informal users, walking / running / dog walking, cycling, bird watching, events / festivals, visiting heritage sites; Water based recreation, including angling, boating (hired and owned), canoeing / kayaking, waterskiing, sailing, rowing and jet skiing
Visual amenity	Visual amenity of navigable waterways
Heritage aspects	Heritage and cultural benefits of the canals, lock structures, buildings and windmills.
Education	Well being impacts, including community regeneration / capacity building and volunteering. Regeneration may lead on to other benefits including reduced crime and vandalism, improved community image and heritage benefits; education and training opportunities and quality of life improvement
Volunteering	
Community benefits	
Non-use values	Non-use values, including benefits from habitat restoration and provision that are not captured elsewhere.

In addition to the benefits noted above, there are a number of benefits provided by inland waterways which are cross-cutting in nature, in that they are typically realised through a complex interaction between many ecosystem services. These include:

- **Physical health**, including benefits related to exercise and mental health associated with green spaces;
- **Tourism** benefits including branding of a location and the subsequent attraction of visitors;
- **Air quality** which relies on the links between sources of air pollution and the ability of the waterway environment to absorb or remove these pollutants; and
- **Habitat connectivity** which is necessary to regulate certain natural processes and to facilitate the movement of flora and fauna.

These cross-cutting benefits are recognised for their importance; however they are not considered explicitly in the valuation framework as to do so is likely result in double counting.

Literature Review

An extensive literature review was undertaken to identify relevant valuation data. The review incorporated over 50 studies presenting willingness-to-pay figures for environmental goods; of these 30 are primary (original) valuation studies. The remaining studies comprised economic impact assessments, meta-analyses and other literature reviews. Over 150 studies were considered in total.

A monetary transfer value was identified for the 12 out of the 17 of the benefits to be valued; however, as noted above there are a number of gaps remaining due to a lack of primary valuation data and concerns over the age or robustness of some of the values which are presented.

In addition to the gaps in the valuation data, several issues arise around the transferability of the available estimates to inland waterways. Many of the existing valuation studies were designed to assess the benefits of a particular location or project without considering their transferability for use in other assessments. Furthermore, the level of reporting varies considerably across studies – resulting in a limited understanding of the context in which the values were derived (e.g. the socio-economic characteristics of the sample population, the environmental attributes and conditions present at the site and the degree to which these attributes would increase or decrease as a result of a policy scenario).

What is clear is that the literature largely centres on **marginal changes** in the provision of benefits as a result of an increase or decrease of an environmental attribute, as opposed to a total value of the existing benefits provided a project or natural ecosystem.

This project has focussed on presenting marginal valuation estimates. Total valuation is more challenging for a number of reasons. For example, it is very difficult to identify the total extent of regulatory services such as water purification and pollution dilution, as they will depend on the natural carrying capacity of the system as well as peoples' perceptions of its current status. However, considering the benefits in terms of changes at the margin (for example a stepped improvement in water quality status) is conceptually more straightforward to grasp as well as being supported by a greater degree of scientific understanding.

A detailed literature review is provided in Annex C of the report. A literature matrix was also developed for this project that records all the studies identified, the type of

benefits they consider and details of the studies used to assess their suitability for benefits transfer and their inclusion in the valuation framework, details are which are presented below.

The Framework

A **valuation framework** was developed, which presents the best available transfer values for the full range of benefits offered by inland waterways. Guidance on how these estimates may be used is also provided³.

The framework provides **high level estimates** to feed into cost benefit analyses or economic impact assessments, which may be used, for example, to inform planning and land use decisions. Where an understanding of the benefits is a central aspect of the decision, more robust and site specific values will be required and a primary valuation study should be considered.

Some of the values presented in the framework are not dependent on the navigation function of inland waterways and can also be applied to the benefits realised by non-navigable waterways. For example, the generation of carbon savings from renewable hydro power scheme can be achieved on both navigable and non-navigable waterways.

Gaps

The benefits, by category, that are not valued are:

- Provisioning – creation of business opportunities. The indicator ‘job creation arising from expenditure’ is used to value this benefit. This has not been included within the framework as the framework is focused on welfare values only;
- Provisioning – renewable energy generation. Only anecdotal evidence is available; the benefit derived is likely to be very site / project specific and depends on a number of variables;
- Regulating – drainage, water conveyance, flood protection and alleviation. The only aspect of this service valued is the wetland habitat adjacent to waterways which offers flood protection benefits to adjacent land and properties. The drainage and conveyance of water services by waterways themselves is not sufficiently understood to identify the final benefits these services provide.
- Cultural – education. Information is restricted to anecdotal evidence and is qualitative in nature; no valuation data available;
- Cultural – volunteering. No valuation data available for the ‘well being’ aspect derived by the individual volunteer however values are provided for the savings to organisations through the use of volunteers; and
- Cultural – community benefits. Information is restricted to anecdotal evidence and is qualitative in nature; no valuation data available.

Limitations

The level of **confidence** in the values presented is low to medium in some cases. While the best primary studies are included in the framework, issues around sample size and a clear definition of the valued good raises concerns over the confidence that can be placed on many values and their transferability. Ranges are provided where possible and can be used to assess the sensitivity of the outcomes to the inclusion of specific benefits.

³ No primary valuation work has been undertaken as part of this study.

Some of the valuation data included in the framework is very old and could be considered to be out of date. Due to the high costs of commissioning new valuation work, many secondary assessments refer to the same small number of primary studies, some of which are now over 20 years old. There is a risk therefore that the values do not accurately capture peoples' current preferences – especially given the notable increase in environmental awareness as well as increasing pressure on the natural resource base over recent years.

The framework and guidance developed for this project provides **gross benefit estimates**. It *does not* facilitate consideration of costs, potential dis-benefits or trade-offs (where the provision of one benefit, such as navigation, reduces the provision of another benefit such as water abstraction). In order to understand whether a particular project or policy is *economically viable* information on costs, dis-benefits and trade-offs is necessary.

To accurately estimate the value of these benefits, it is necessary to isolate the benefits which are dependant on the presence of the inland waterways from those that might be realised anyway as **benefits are not always 100% dependant or attributable to the waterway**. This has not been done, but depending on the exact nature of the assessment being carried out should be considered.

In addition to the scope limitations noted above, it has not been possible to consider in any detail the impact of **climate change** on these benefits or how the waterways can play a role in climate change adaptation. For instance, what role inland waterways could play as flood risk increases or how the range of benefits provided by inland waterways might be affected by a need to abstract more water from a waterway? See Box 4 on page 93 of the main report for a short discussion on this.



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1 Introduction

1.1 Background

The waterways of England and Wales are “national, regional and local cultural and natural assets, linking historic buildings and structures with the wider landscape and forming key strategic wildlife corridors. The waterways help to stimulate regional and local economies by acting as a catalyst for urban and rural regeneration and inward investment. They are playing an increasingly important role in the tourism industry and there is a growing national awareness of the added value and commercial betterment deriving from the presence of waterways in developments” (British Waterways, 2003).

Inland waterways make a valuable contribution to peoples’ quality of life. They are an important component of the rural and urban landscapes of England and Wales and are areas rich in biodiversity and cultural heritage. They also promote economic regeneration through development and the provision of recreation facilities.

The inland waterways of England and Wales contribute to a range of national, regional and local priorities and objectives. At the national level, Defra’s investment in inland waterways contributes to two of its Intermediate Outcomes⁴ – Sustainable Living Landscapes and Enjoyment of the Natural Environment. These in turn contribute to Defra’s Natural Environment Public Service Agreement (PSA)⁵ with the Treasury. Vibrant inland waterways also contribute to a number of other Government Departments’ priorities and targets, including those in regional economic performance, regeneration of the local economy, reduction of congestion and CO₂ emissions via freight transport, heritage, tourism and health.

The contributions individual waterways can make to delivering specific objectives are well documented; however there is no agreed view on the additional wider contribution made by inland waterways.

Inland waterways provide a diverse range of benefits such as transport, recreation opportunities, flood protection, regeneration benefits and non-use values⁶. The full range of benefits is rarely considered in decisions over the use or development of inland waterways and their surrounding areas; this can result in incorrect or sub-optimal decisions being made. Where the wider value of inland waterways is not fully appreciated there is a risk that opportunities to realise important benefits are missed and / or that other benefits provided by the waterways network are compromised.

⁴ Intermediate Outcomes are set to monitor the performance of Government Policy.

⁵ The Natural Environment PSA will be measured against the following indicators:

- Water - improving water quality as measured by parameters assessed by Environment Agency river water quality monitoring programmes;
- Biodiversity - as measured by data on bird populations in England as a proxy for the health of wider biodiversity;
- Air quality - improving air quality by meeting the Air Quality Strategy targets for eight air pollutants
- Marine - Clean, healthy, safe, productive and biologically diverse oceans and seas as indicated by proxy measurements of fish stocks, sea pollution and plankton status;
- Land management - the positive and negative impacts of agricultural land management to the natural environment.

⁶ Non-use values are values that are not associated with actual use, or even the option to use a good or service. They are made up of (a) altruistic value (derived from the knowledge that something exists for others to use), (b) existence value (derived from knowing that something exists) and (c) bequest value (knowing that future generations will have the option to enjoy something).

Recent Government reviews highlight the diverse benefits provided by waterways beyond their traditional use as a means of commercial transport and the anticipated trend towards capitalising on the wider use of the waterways in future investments (see Box 1).

Box 1: Waterways for Tomorrow

The Transport Act as far back as 1968 set out the importance of the wider benefits of inland waterways acknowledging that the future for most British Waterways canals and rivers lay in their use for amenity and recreation, with only 20% of their system designated as commercial waterways.

Waterways for Tomorrow (WfT) 2000 was a comprehensive Government review of the whole of the inland waterways systems in England and Wales building on the Department of the Environment, Transport and the Regions, 1998 White paper 'A New Deal for Transport'. The aims of WfT were:

- An improved quality of infrastructure;
- A better experience for users through more co-operation between navigation authorities; and
- Increased opportunities for everyone through sustainable development.

These aims were to be achieved by:

- Implementation by British Waterways of the 1999 Government decision to increase public investment in its waterways and create a new framework to help it maintain and develop its assets, develop a closer relationship with its users, work with the voluntary sector and establish a new public / private partnership;
- Encouragement of all navigation authorities to work together on issues of mutual interest; and
- More effective integration of the waterways into other Government policies for leisure, recreation, tourism and sport; for increased inclusion, use and access; for conservation of the built and natural environment; for education; for urban and rural regeneration; for freight, public transport, cycling and walking; and for planning.

WfT is currently being reviewed with an update due to be published in December 2009.

Huw Irranca-Davies, Waterways Minister, stated in November of 2008 that "[the] living landscape, whether urban or rural, is made most special by boating which directly connects us with our industrial heritage and gives a strong sense of place. But the waterways provide a much wider range of activities and benefits to communities than navigation. They are one of the nation's greatest tourist attractions which provide an accessible outdoors environment that contributes to healthy lifestyles and our well being. And I feel sure that they can also help us address the challenges of the future as we will be setting out in our refreshed Waterways for Tomorrow"⁷.

The Government's aim is "to promote the waterways, encouraging a modern, integrated and sustainable approach to their use. This involves conserving the waterways, while at the same time maximizing the opportunities they offer for leisure and recreation, urban and rural regeneration, the environment, and for freight transport"⁸.

⁷ <http://www.defra.gov.uk/corporate/ministers/speeches/irranca-davies/hid081106b.htm>
⁸ <http://www.defra.gov.uk/ENVIRONMENT/water/iw/>

To date the explicit incorporation of the full range of benefits occurring at a given site has been restricted by the lack of a cohesive and widely accepted **framework of the benefits** of inland waterways⁹. This project seeks to address this shortcoming.

This study is the first in a joint Research and Development (R&D) Programme on the benefits of the inland waterways of England and Wales, recently launched by Defra and the Inland Waterways Advisory Council (IWAC). As such, this project will underpin and inform future policy making across Government Departments in this area.

The objectives of the R&D Programme are to:

- Provide confidence that Government investment is achieving value for money and is appropriately targeted;
- Improve investment decision making for tidal and non-tidal waterways;
- Inform policy and decision making by Government, Regional Development Agencies, Local Authorities and funding bodies;
- Provide evidence of potential social, economic and environmental benefits to give confidence to third party investors;
- Identify the wider benefits of investing in both existing and new inland waterways; and
- Identify the beneficiaries of funding, i.e. the scale and the ways in which beneficiaries benefit, to inform allocation of investment and appropriate sources of further funding.

The Programme will also seek to generate a national value for the inland waterways sector, including the return on public investment and / or the identification of where the main benefits lie. If there are fundamental theoretical problems in developing a national value, as was found to be the case when attempting to derive a total national value of England's ecosystems services (see O'Gorman and Bann, 2008), then the monetary loss to the economy of England and Wales arising from the absence of the inland waterways will be derived.

1.2 Objectives and Scope of Study

1.2.1 Project objectives

The project objectives, as specified in the Terms of Reference, are to:

1. Undertake a full evaluation of existing literature on the tidal and non-tidal inland waterways, including non peer-reviewed and grey literature;
2. Establish the range of potential analogues (i.e. transferable values and approaches to measurement) for different beneficiaries and receptors;
3. Identify the likely median and upper and lower bounds of the analogues (transferable values), taking into account the double counting issues which often arise;
4. Identify those areas where more data may be needed to augment what is currently available; and
5. Establish a BT - based valuation framework, taking into account the social, environmental and economic benefits of the inland waterways.

⁹ AINA (2003) 'Demonstrating the Value of Waterways' provides a good practice guide to the appraisal of restoration and regeneration projects, but does *not* facilitate the inclusion of *all* the benefits of inland waterways in decision making.

This project will fulfil these objectives through the completion of a set of tasks, outlined in Section 2. In addition the project will provide the foundations for answering the questions posed by the Programme within which this project sits.

1.2.2 Project scope

Inland waterways are defined for the purposes of this study as ‘**navigable tidal and non-tidal inland waterways**’. While the vast majority of inland waterways in England and Wales are non-tidal (see Appendix A), estuaries and other tidal stretches of inland waterways represent an important element of the network. They provide significant benefits, in particular the international trading opportunities they offer.

As noted above, a stated Programme aim is to generate a national value for the inland waterway sector. This project however, is **focussed on determining the best available transfer values** to be used in *marginal* assessments. A note is made of values suitable for use in a ‘*total*’¹⁰ valuation in Section 6.

While an understanding of the trends in the use of inland waterways would be useful, the project is **focused on collating and analysing the current evidence rather than information on trends**. In addition, the project is focused on the identification of unit monetary values for use in valuation and not on the collation of physical data which is required to aggregate these unit values up to estimate the full benefits of a project or policy.

The Benefits Transfer Valuation Framework (hereafter “the framework”) includes **values derived from economic welfare studies**. Welfare economics is based on the premise that the purpose of economic activity is to increase the well-being of individuals and that the individuals are the best judges of their own welfare. Well-being is based on what people prefer.

Values derived from Economic Impact Assessments (EclAs) are discussed separately, and provide supporting evidence on the benefits provided by inland waterways. The purpose of an economic impact assessment is to evaluate, both qualitatively and quantitatively, the benefits to the economy that are associated with a project or scheme. These benefits could be local, regional or national.

There are fundamental differences between these two types of assessments. Welfare values are underpinned by individuals’ preferences or their willingness-to-pay (WTP) for a good or service, while an economic impact assessment typically looks at the net contribution of an investment to the local or regional economy or a specific sector of society in terms of jobs created and local expenditure.

Further, consideration must be given to whether the effects are merely re-distributional in nature or whether they represent real changes in peoples’ well being. For example, an EclA¹¹ of a specific project may include the value of impacts which represent the benefits at a local or even regional level; however, these

¹⁰ Total valuation involves valuing all of the existing benefits provided; for instance the current value of the towpath network. This is different to a marginal valuation which might seek to determine the *additional* value of 3km of new towpath for instance.

¹¹ These assessment are supported by the availability of standard multipliers to account for this effect in terms of employment (leakage and displacement factors) but not with regards to other benefit categories (for example examining whether a project will result in a real increase in recreation activity or whether the majority of the visitors will be displaced from another site or indeed from a different form of recreation activity).

impacts may not result in a net gain at a larger scale of analysis - i.e. the national level, when things like leakage and displacement are considered. Welfare analysis, as presented in the valuation framework, captures real changes in society's well-being.

In many cases an EcIA will not consider non-market benefits. Non market benefits are derived from goods or services not traded in the market place, for example the use of tow path for recreation. The data from an EcIA cannot necessarily be used in a Cost Benefit Analysis (CBA), as CBA looks at all costs and benefits from a welfare perspective.

Importantly, **this project is not expected to answer all the questions posed**, but to set out a framework which can be used and developed by a range of stakeholder over time. An important contribution of the project is therefore the framework, which provides a comprehensive list of benefits, an indication of the limitations on the use of the available data and the data gaps.

There are a range of users and beneficiaries associated with inland waterways; some users and beneficiaries directly contribute towards the services they receive, others do not. The value of the benefits realised by those who pay for their usage, such as boat users, can be gauged to a certain extent through the price mechanism (such as boating permit fees). However, policy makers also require evidence on the benefits of the inland waterways to those who do not pay directly and perhaps cannot be made to pay, and for those benefits for which no market exists (see Box 2).

Box 2. Multifunctional Benefits, Beneficiaries and Funders

An understanding of the full range of benefits provided by inland waterways facilitates a mapping of benefits to beneficiaries and an overview of what benefits are currently paid for and by whom. Such an analysis provides the basis for considering alternative finance options for the sustainable development and maintenance of the inland waterways.

Many of the beneficiaries of the services of inland waterways are not the people who pay for their provision. In some cases this is due to the fact that the multifunctional nature of the waterways is not factored into their management and a range of benefits are made available as a result of a core management service provided by a responsible body (for instance British Waterways or the Broads Authority).

For example, dredging of navigable areas in the Broads is largely paid for by the navigation users, but also results in other public benefits, such as improved water quality. Without dredging activities in this area the waterways would not survive in the form they are in today. Arguably, because of the wider public benefits provided by dredging activities, the costs should be more equitably distributed amongst all beneficiaries and should not just be the responsibility of the local users.

An understanding of the beneficiaries and the magnitude of benefits realised may also present more appropriate cost - sharing arrangements among Public Sector authorities. For example the navigation authorities could be responsible for the waterway channel, but other authorities could pay for the maintenance of tow paths which provide other benefits.

1.3 Report Outline

The remainder of this report is organised as follows:

Section 2 sets out the **methodology** applied including the overall study approach, details of the tasks undertaken and the development of the framework.

Section 3 presents a qualitative description of the full list of **benefits** associated with inland waterways categorised using an ESA (provisioning, regulating and cultural services).

Section 4 provides an evaluation of the welfare valuation and EcIA literature which was reviewed in order to inform the development of the framework and guidance. This section is supported by Appendices C and D; a review of the benefits transfer (BT) literature and a full valuation literature review, respectively.

Sections 5 and 6 present the **guidance** to be used alongside the framework presented in Appendix E.

Section 7 discusses the **key issues** faced by the study, both outstanding and resolved.

Section 8 **concludes** and **sets out recommendations** for future work.

Appendix A presents a map of the inland waterways of England and Wales.

Appendix B presents the structure of the Literature Matrix developed for this study. The full Literature Matrix is provided as a separate Excel file for convenience.

Appendix C presents the full literature review.

Appendix D introduces the valuation framework which is provided as a separate file.

2 Methodology

2.1 Study Approach

The study approach is based around the completion of a series of tasks, which have allowed an iterative development of the framework and understanding of the key issues. The key project tasks are summarised in Table 1, with reference to the section of the report where more detail can be found.

Table 1 Summary of Project Tasks

Task Number	Brief Description
Task 1	Project start-up meeting to define the scope of the project and the expectations of the Project Steering Group (PSG). This is covered in Section 1.
Task 2	Identification and collation of relevant literature. This involved meetings and discussions with key stakeholders to identify data sources. This task is discussed in Section 4 and Appendix C.
Task 3	Draft framework for early review by the PSG (in parallel with Task 2). The literature collated under Task 2 was used to inform this process. See Sections 2.2 and 5.
Task 4	Literature Evaluation. A literature review matrix was developed to consistently review studies. See Section 4 for an analysis of the available literature, Appendix B for an overview of this matrix and Appendix C for the full literature review. Based on the literature review the framework was populated as discussed in Section 5.
Task 5	Production of interim report, reviewed along with the framework produced in Task 3 and the literature matrix produced in Task 4.
Task 6	PSG meeting to review outputs to date.
Task 7	Online seminars with key stakeholders in order to share interim outputs, gain buy-in and provide the opportunity to contribute to the development of the work. The feedback of these seminars has been incorporated in this report as appropriate.
Task 8	Draft final report incorporating comments on the interim outputs from the PSG and stakeholder seminars.
Task 9	Development of a dissemination strategy for all stakeholders. Presented as a separate document.
Task 10	PSG meeting to discuss draft final outputs and dissemination strategy.
Task 11	Dissemination of the studies outputs and findings to a wider audience.
Task 12	Delivery of final report and framework, which incorporate PSG comments. This report specifies how the actual values can be used in the framework and provides clear guidance on what types of data adjustments are necessary and acceptable. The report identifies key data gaps and makes recommendations for filling these gaps. Approaches for reflecting key non-monetised benefits in the decision process are also set out. See Section 5.

2.2 Approach to Benefit Categorisation

The benefits provided by inland waterways have been categorised using an **Ecosystem Services Approach (ESA)** which provides a framework for considering whole ecosystems in decision making and for valuing the services they provide to ensure that we can maintain a healthy and resilient natural environment, now and for future generations.

The ESA identifies four categories of services and benefits: provisioning, regulating, cultural and supporting. Provisioning services include food, water resources and other economic benefits; regulating services may include climate and disease control and flood alleviation; and cultural services provide recreational and aesthetic benefits. Underpinning these are supporting services such as soil formation and nutrient cycling.

The ESA has been commended in both practice and the academic literature as promoting a holistic approach to sustainable resource management. It forms part of Defra's efforts to fulfil its requirements under the Natural Environment PSA from 2008 to 2011.

As ecosystem functions and services are inherently dynamic and integrated, the principles of ESA are intended to advance a greater level of "integrated policy and management at a landscape-scale and be more firmly directed towards the needs of the people" (Haines-Young and Potschin, 2008).

From a more scientific perspective, the ESA recognises the inherently dynamic nature of ecosystems and the uncertainties involved in any attempt to manage them. Thus the principles seek to promote a holistic, adaptive and flexible approach to natural resource management. This approach therefore helps focus decision makers on longer-term, more sustainable perspectives rather than on short-term fixes that may ultimately fail to deliver lasting, cost-effective socio-economic and environmental benefits.

In applying an ESA categorisation to the benefits provided by inland waterways, the inland waterways are taken to represent the 'ecosystem'. In reality, part of the inland waterways that provides these benefits are not natural ecosystems in the true sense of the word. However the methodology is considered equally applicable.

It is important to note that the term 'benefits' is taken to mean the 'final benefits' or 'outcomes' realised by society from the services inland waterways provide. Intermediate benefits are not explicitly valued here as doing so would result in double counting. For instance, some might consider brownfield restoration as a benefit of inland waterway restoration. However, within the framework brownfield restoration is an intermediate benefit. The final benefits this provides could include habitat improvement / restoration and associated non use values, and increased property premiums, depending on the location. The benefits generated by supporting services are not valued independently as they are intermediate benefits which contribute to the provision of a range of final benefits¹².

Therefore for the purpose of economic analysis, the list of benefits presented in Section 3 is intended to capture 'final benefits' where possible. Ecosystem services are mapped onto the final benefits in order to avoid double counting. For example, a biophysical structure or process such as an inland waterway has several functions

¹² See O'Gorman and Bann (2008) for a more detailed discussion on final and intermediate benefits and valuation.

including collection and passage of water, which in turn provides services such as flood alleviation. The benefits obtained from flood alleviation represent the final benefits. In this case the benefits are the avoided damage costs (market) and / or willingness to pay (WTP) for reduced flood risk (non-market).

Biophysical structure / process → Function → Service → *Benefit*

While every attempt has been made to ensure that the final benefits listed do not double count benefits, there is still a risk that this could happen. For instance, property prices often reflect the level of flood protection and perhaps some recreation value. It is therefore difficult to be sure that the premiums associated with living on or adjacent to inland waterways reflect only the presence of the waterway and not these additional benefits.

In addition, while the list of benefits presented here was developed to avoid double counting and allow multiple benefit values to be combined together, the valuation literature, from which the transfer values have been derived, does not necessarily follow the same logic. Therefore some values presented in the benefits transfer framework are for a combination of benefits rather than for a single benefit. The benefits transfer framework (Appendix D) and Section 6 present details on where this is the case.

The literature review, discussions with stakeholders and a review of Glaves *et al.* (2007) facilitated the identification of benefits provided by inland waterways in England and Wales. These benefits are described in Section 3 and their values presented and discussed in Sections 4 and 5.

2.3 Literature Review and Evaluation

Literature was initially gathered from Jacobs' in-house library of environment valuation studies and from publically available sources and journals. In addition, key stakeholders and potential data users were contacted in order to identify relevant grey literature sources. An email request for data was also circulated on the RESECON list server, which is a global email list of resource economists.

While the focus of the literature search was on UK data sources, as far as possible the search also identified suitable studies from overseas.

The literature collated covers:

- The academic literature on benefits transfer (BT) in order to draw out best practice in benefits transfer, pitfalls and limitations and to help develop an approach for evaluating the valuation studies for the purpose of this project; and,
- Valuation studies, covering both economic welfare studies and Economic Impact Assessments, in order to determine the best transfer values.

The BT literature is discussed in Appendix C. The valuation studies are recorded in a **literature matrix** (see Appendix B and separate excel file) which facilitates a consistent review of all available studies and is designed to capture, to the extent possible, the aspects of these studies that influence their transferability and have implications for the adjustments to be made to the values estimated.

The **framework** was developed early in the project to ensure that all benefits were identified and adequately considered through the project. The framework served as a key tool in guiding the literature review process and significantly reduced the risk

of double counting or missing benefits. The literature matrix sits behind the benefits transfer framework and provides a greater level of detail on the studies than is reported in the framework. While the matrix includes summaries of all the literature reviewed for this project, only those data sources that contain transferable values are presented in the framework. Appendix B presents the structure of the literature matrix and a description of the information it contains.

The information captured within the literature matrix is reviewed and analysed by benefit type in Appendix C. A summary is presented in Section 4.

2.4 Benefits Transfer Methodology

Based on a review of the academic literature a four step approach to BT was set out for the project, as described below. This sets out the ideal approach to be applied; however given limitations in the literature available and the detail provided within some literature sources, it was not always possible to fully implement this approach for all benefits.

2.4.1 Step 1 - Evaluation of the quality of the original study

The success of a BT depends on the quality and type of information in the original study. In order to minimise errors in BT the primary research study should be scientifically defensible, that is, based on adequate data and a theoretically sound approach.

Step 1 assesses whether the study is of sufficient quality to be used in a BT exercise, noting any potential concerns / shortcomings.

Assessment criteria:

- Date of study. In BT results are typically used from studies carried out many years ago due to a lack of more recent studies. It is necessary to consider the extent to which the estimated values stand the test of time. Brouwer and Bateman (2005) argue that there is no reason to assume that preferences and values for non-market goods should remain constant over extended periods of time.
- Is the study published or unpublished, i.e. was it peer reviewed?
- Is the study methodology based on best practice?
 - survey method / design - survey size and sample, WTP elicitation method;
 - analysis - econometric modelling, treatment of biases and income constraints, inclusion of core economic variables (price, income, quality, substitutes, and household characteristics);
- Statistical confidence in the results.

In 2007 Jacobs completed an assessment of the quality of a range of stated preference studies which valued nature conservation benefits in the UK for Natural England (Jacobs, 2007). This assessment identified the criteria which should be considered in developing, testing, completing and analysing a stated preference study, according to best practice guidance. The results of the Natural England assessment are reported here for the studies also covered by this study.

The results of step 1 are presented in the framework under the title 'Quality of the Study' and discussed for each study presented in Section 6.1.

2.4.2 Step 2 - Preliminary assessment of 'benefit consistency'

This is a preliminary screening to ensure that the benefit estimated in the original study can be 'matched' to a benefit in the framework.

Assessment criteria:

- How closely the benefit estimated matches a benefit identified in the benefits transfer framework;
- How closely the population's characteristics (social make-up) match those of the study site; and
- Geographical location of original study (e.g. UK / European / US)¹³.

The results of step 2 are presented in the framework under the title 'Benefit Consistency' and discussed by study in Section 6.1.

2.4.3 Step 3 - Detailed assessment of study for benefit transfer purposes

Step 3 draws out all the key factors and information needed to successfully carry out the transfer exercise, assessing in more detail criteria considered in steps 1 and 2.

Step 3a Commodity definition comparability

An important factor affecting the validity of BT is the degree of similarity between the study site and the policy site.

Key factors to be documented are:

- Site definition, physical characteristics and location of study: As discussed above, the location of the study is important. Lower transfer errors are evident for within region transfers compared to between regions transfers (Loomis, 1992 as in Bateman *et al.*, 2000; Loomis *et al.*, 1995 and Vandenberg *et al.*, 2001, both as in Rosenberger and Stanley, 2006). This is likely due to the fact that intra-region sites are likely to share many attributes, thus making them similar in structure and function. Other factors for consideration here include: site characteristics (e.g. size, facilities and other objectively measured characteristics) and site location features (e.g. availability of and distance to substitutes, information on access).
- Reference condition: how closely does the baseline at the study site match the baseline at the policy site? Starting point biases¹⁴ can influence the final values estimated.
- Proposed change in the provision of the service: the magnitude of the change should be specified. In addition whether the valuation is of a change in the quantity or the quality of an attribute should be noted. When values associated with incremental changes are sought, then the resource change measured at the study site should correspond to the expected change at the policy site (Desvousages *et al.*, 1992 as in Loomis and Rosenberger, 2006). Given that valuation responses are non-linear, interpolating values for similar percentage changes occurring at different points on the response curve may lead to significant error (Smith *et al.*, 2002 as in Bergstrom and Taylor, 2006).

¹³ The geographical location of the study is taken as a high level indicator of consistency. Ready *et al.* (2004) showed that transfers across countries in Europe were unreliable. However, Shrestha and Loomis (2001) demonstrated that outdoor recreation use values, in general, were highly transferable between North America and Europe.

¹⁴ When the final valuation estimate shows dependence on the starting point used.

- The range / scale of the commodity being valued: for instance, was one site or many sites valued, what is the physical area being valued?
- Timing of data collection for sites that have distinct peak and off peak seasons that influence the demand for benefits and therefore may influence the values estimated.
- Methodological attributes such as study type (e.g. contingent valuation (CV), choice experiment (CE), EcIA), survey implementation method (e.g. telephone, mail survey, face-to-face), response rate, question format, treatment of outliers and protest votes and econometric factors.

Step 3b Market area compatibility

The same benefits realised in two separate geographical areas can have distinct values due to the differences in socioeconomic characteristics of the relevant population and their cultural preferences.

Key factors to be documented are:

- Physical size of area and size of population. This gives an indication of how densely populated an area is.
- Socio-economic characteristics of the population of interest - it is important that definition and measures of relevant socio-economic variables for the study site match what is available for the policy site. If income categories do not match UK census data then it will be difficult to determine whether the demographics of the study site are different to those of the policy site. Consistent definition and measurement of demographic data are also a necessary input for benefits functions calibration.
- Cultural differences can be quite distinct from socio-economic characteristics of the population. It is therefore possible that two sets of the population, with similar socio-economic profiles, could have quite different tastes and preferences; for example between different regions in England.

Step 3c Welfare and empirical benefit measure compatibility

Consideration here is given to the appropriateness of transferring the specific measure of value (e.g. mean WTP or Willingness to Accept (WTA)). For instance, if a policy analysis requires an estimate of WTP for an improvement in a good or service, it is unlikely to be appropriate to use a WTA value for a loss in that same good or service as a reasonable proxy in BT.

The aspects considered within this step are captured where possible in the literature matrix. Based on this step, appropriate studies were selected for inclusion in the framework. Guidance is also given in Section 5 relating to some of the key considerations identified above.

2.4.4 Step 4 - Guidance on adjustments required

Step 4 involves adjusting the unit values presented in the primary research study. Adjustments may be required to account for differences in the value of money over time, difference between the nature of the study site and the policy site or distance decay effects¹⁵.

¹⁵ These effects arise where values are found to decrease with distance from the site.

The specific adjustments to be made to the unit or aggregated value vary by study and benefit. The adjustments are focussed on the key factors driving the valuation estimate and might include site characteristics, the nature of the commodity valued, the availability of substitutes, and the population to which the unit values should be applied to.

While the BT approach set out for the project requires the collation of a lot of detail for each study, only simple / key adjustments are recommended in the framework due to:

- the potentially difficult technical issues associated with some adjustments;
- the fact that the BT literature presents no concrete evidence to suggest that complex adjustments reduce transfer errors (see Section 4 and Appendix C); and
- the capabilities of users in relation to BT and economic analysis, which are likely to vary significantly, and the objective of making the framework user friendly.

3 The Benefits of Inland Waterways

3.1 Benefit Categories

The benefits realised through the presence of inland waterways in England and Wales are organised and described below according to the ESA. As noted in Section 2, the focus for economic analysis is to identify the final benefits for valuation purposes. It is for this reason that supporting services are not captured explicitly here.

In addition to provisioning, regulating and cultural benefits, a number of 'other' benefits are discussed. These either do not fit within the categories presented here or are considered to be 'cross-cutting' in nature and realised through a range of final benefits.

3.1.1 Provisioning, regulating and cultural services

Table 2 presents the benefits provided by inland waterways categorised using the ecosystem services framework of provisioning, regulating and cultural services.

Table 2 The benefits of inland waterways

Provisioning Services Provisioning services result in products being provided by the environment (ecosystems) such as food, fibre, fuel and natural medicines. In relation to inland waterways, provisioning services relate mainly to the provision of economic benefits. These are outlined below by name with a description as appropriate:	
Creation of business opportunities	Creation of business opportunities (e.g. marinas, restaurants and shops)
Property premium	Property / land price premium on commercial and domestic property in proximity to inland waterways
Renewable energy	The provision of renewable energy opportunities
Transport	Transport routes (e.g. freight, commuters)
Provision of water	The provision of water for supply for abstraction
Volunteering	The availability of volunteers
Regulating Services Regulating services provide benefits obtained from the regulation of ecosystems processes. One reason why regulating services are important is that they provide 'infrastructure' and 'insurance' values. In many cases it is necessary to maintain at least a minimum set of these services in order to ensure a reliable and sustainable flow of the resulting benefits. The regulating benefits identified for inland waterways are:	
Carbon savings (renewable energy and transport)	Climate regulation and carbon savings (e.g. from freight, walking / cycling which displaces other more carbon-intensive modes of travel)
Drainage, water conveyance, flood protection and alleviation	Drainage and the conveyance of water away from populated areas, thereby providing possible flood protection and alleviation and other benefits
Water regulation and pollution dilution	Water cycling and pollution removal and dilution
Water quality	Water quality improvements
Cultural Services Cultural services provide the non-material benefits people obtain from the environment through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences. This category therefore includes both direct non-consumptive uses and non-use values (NUVs) as follows:	
Recreation (all forms)	Land based recreation, including informal users, walking / running / dog walking, cycling, bird watching, events / festivals, visiting heritage sites; Water based recreation, including angling, boating (hired and owned), canoeing / kayaking, waterskiing, sailing, rowing and jet skiing
Visual amenity	Visual amenity of navigable waterways
Heritage aspects	Heritage and cultural benefits of the canals, lock structures, buildings and windmills.
Education	Well being impacts, including community regeneration / capacity building and volunteering. Regeneration may lead on to other benefits including reduced crime and vandalism, improved community image and heritage benefits; education and training opportunities and quality of life improvement
Volunteering	
Community benefits	
Non-use values	Non-use values, including benefits from habitat restoration and provision that are not captured elsewhere.

3.1.2 Other benefits

In addition to the benefits noted above, there are a number of benefits provided by inland waterways which are cross-cutting in nature and typically realised through a complex interaction of a number of ecosystem services. These are identified as:

- Physical health including benefits related to exercise and mental health associated with green spaces; and
- Tourism benefits including branding of a location and the subsequent attraction of visitors.

These cross-cutting benefits are recognised to be important and are discussed separately in Sections 6. They are not identified within the framework as to do so is likely to result in double counting. They are however identified within the literature matrix.

Another possible cross-cutting benefit is **air quality** where the benefits relate to the relationship the waterway environment has with sources of air pollution and how it interacts and absorbs or removes these pollutants. However as a result of the difficulties in isolating the role inland waterways play in air quality levels, this is not considered further.

Habitat connectivity is necessary to sustain certain natural processes and to facilitate movement of fauna. Its final benefits are particularly difficult to quantify. The benefits inland waterways provide in terms of connecting habitats along a water corridor could feed into a range of other benefits, such as flood attenuation where there is a continuous corridor of natural vegetation along the waterway, or non-use values in terms of biodiversity protection and natural species behaviour. The value provided by the habitat provision and connectivity (both intermediate benefits) is captured within a number of non-use value estimates noted within the framework.

In order to estimate the net benefits provided by inland waterway it is necessary to take into account both the benefits and the costs (or dis-benefits) provided by these sites or activities on them. The dis-benefits of inland waterways are *not* identified in the framework. Therefore any assessment based on the framework would be one-sided and not provide the necessary cost considerations which form part of standard cost benefit analysis. The importance of considering these dis-benefits is also noted in Section 6.

Dis-benefits might be associated with increased exposure of properties to flood risks or health and safety concerns such as deaths due to drowning and increased potential for associated crime related to improved access. Regeneration and restoration projects largely mitigate against these potential impacts; for example restoration can often lead to provision of additional water capacity, thereby decreasing flood risk and can also improve health and safety along navigable waterways. Ecological damage may be an indirect result of restoration activity; however, these impacts can be managed as part of the restoration process.

Trade-offs should also be considered where a project improves some benefits but reduces others; for instance a regeneration scheme may improve the recreation benefits provided by a particular stretch of waterway, however any additional demand for water sourced from the waterway itself could reduce other benefits provided by the waterway (for instance ecological benefits or amenity values).

4 Literature Evaluation

4.1 Introduction

A comprehensive review of the literature was undertaken for the project. The literature search focussed on UK data sources, however suitable overseas studies have also been included.

As discussed in Section 2.3 the valuation studies are recorded in a literature matrix. Appendix B presents the structure of the literature matrix and a description of the information it contains. Appendix C provides the detailed literature review. This Section summarises and analyses the literature reviewed in Appendix C.

The literature review covered both economic welfare studies and economic impact studies. As noted in Section 1.2.2 there are fundamental differences between these two types of assessments and data from an economic impact assessment cannot necessarily be used in a CBA, as CBA looks at all costs and benefits from a welfare perspective.

This section focuses on the *welfare valuation* literature reviewed. It discusses the number of available studies and the general quality of those studies and why some studies are not suitable for use within the framework.

For each category of services (provisioning, regulating and cultural) this Section focuses on the benefit values provided in the framework.

4.2 General Findings

Over 50 studies which report welfare values have been reviewed. The majority of these studies are primary valuation studies (around 30) however a number of EcIA are also included, as these studies sometimes report welfare values suitable for use in CBA. In addition 6 meta-analyses¹⁶ of primary studies were identified and reviewed.

The primary studies cover a range of benefits such as biodiversity, habitat provision and non-use values, flood protection, erosion control; water quality and the provision of water for abstraction, recreation, visual amenity, property price premiums and heritage benefits.

Table 3 provides an overview of the number and type of studies identified for each benefit that meet the criteria for benefits consistency.

¹⁶ A meta-analysis combines the results of several studies addressing similar research areas.

Table 3 Overview of the literature relating to the benefits provided by inland waterways

Benefit category	Number of primary studies	Number of secondary studies	Comments
Creation of business opportunities	5	11	These consist of EclAs and literature reviews – EclAs for specific restoration projects are considered primary studies in relation to this benefit category as they generally do not rely on estimates or multipliers from other studies.
Property premium	7 (2 not available)	11	The primary studies consist of WTP studies and EclAs (where the EclA does not borrow values from other studies).
Provision of water	1	2	The primary study identified (British Waterways, 2008) is largely a literature review, but does include some primary valuation work for a small number of benefit categories.
Volunteering	0	4	All use standard multipliers for the provisioning benefit of volunteering. No studies identified relating to the 'well being' benefit.
Renewable energy (provisioning benefit)	0	0	No studies identified; only anecdotal evidence presented.
Transport (provisioning benefit)	0	2	Studies are Government guidance reports on the estimation of the environmental benefits of changing transport modes.
Carbon savings (renewable energy)	0	0	No studies identified; only anecdotal evidence presented.
Carbon savings (transport)	0	1	Values relate to freight transport only. No studies identified for green transport options.
Water regulation and pollution dilution	0	1	Available study looks at the total economic cost of eutrophication. The study is primarily a literature review, with small amounts of primary valuation undertaken.
Water quality	2	1	Primary studies look at different categories of use / non-use values associated with water quality improvements.
Recreation (all forms)	8 (2 not available)	9	The available primary valuation studies rely on varying survey methodologies (hedonic pricing, travel cost method, contingent valuation and choice experiments). The secondary studies consist of EclAs and literature reviews. EclAs are considered secondary studies in relation to this benefit as they rely on BT from other primary studies.
Heritage aspects	1	6	The primary study relates to the preservation value of canals. The secondary studies are primarily literature reviews considering the recreational / use values of specific heritage sites.
Non-use values	3	5 (1 not available)	Primary studies relate to non-use values of heritage aspects, biodiversity and water quality. The majority of secondary studies attempt to aggregate estimates in order to calculate a total non-use value.
Other (health)	0	4	Secondary studies primarily concern the economic impacts of physical inactivity (thought to be NHS costs, loss of working days); however it is not always clear what is being valued.

Only 9 of the 30 primary valuation studies are used within the framework. These cover benefits from recreation, visiting heritage sites, visual amenity, water quality and non-use values. In addition recreation expenditure estimates were taken from a number of other literature sources including EclAs and literature reviews (where the original source could not be reviewed).

The principal reasons for not using primary valuation studies in the framework are:

- There were multiple primary studies available valuing the same benefit category. In some cases, two or more studies are incorporated to form a value range, in other cases the best study is selected based on previously set out selection criteria;
- The primary study or studies available were not thought to be sufficiently robust or suitable for BT; and
- The primary study or studies available did not meet the criteria for benefits consistency – e.g. there are insufficient links drawn between the benefit valued in the study and the services provided by inland waterways.

Table 4 provides an overview of the studies included in the valuation framework against each benefit category, identifying gaps where no values were available for recommendation.

Table 4 Studies recommended for use in the valuation framework and gap analysis

Ecosystem Service Category	Benefits	Sub Benefits	Values presented	Reference(s) used in Framework	Comments
Provisioning	Economic	Creation of business opportunities (e.g. marinas, rest, pubs, shops etc)	GAP	N / A	Indicators such as job creation as a result of expenditure are used to value this benefit. Useful multiplier are identified, but not captured in the framework explicitly.
		Property price premium	Yes	British Waterways (2008) Powe <i>et al.</i> (2000) Willis and Garrod (1994) DTZ (2001) GHK (2007) Jacobs Gibb (2001)	Figures used to reflect different types property types, e.g. depending on age of property (new or existing) and to form sensitivity ranges.
		Renewable energy generation	GAP	N / A	Only anecdotal evidence available. See regulating services for valuing carbon savings.
		Transport (freight / green transport)	Yes	DfT, NATA Refresh (2009a) and Benefits of Modal Shift (2009b)	These reports provide values for use in valuing modal shift benefits, the first from moving commuters from road to bicycles or walking, the second for freight movement from road to rail or water.
		Provision of water	Yes	British Waterways (2008)	Water supply charges plus estimated Consumer Surplus (CS) ¹⁷ value.
		Volunteering	Yes	British Waterways (2008)	Value of cost savings to organisation(s) benefiting from volunteer work.

¹⁷ Consumer surplus is the difference between what they are willing to pay for an output and what they will be charged with the project.

Ecosystem Service Category	Benefits	Sub Benefits	Values presented	Reference(s) used in Framework	Comments
Regulating	Environment	Carbon savings associated with renewable energy	Yes	British Waterways (2008) DECC (2008)	Information regarding physical quantities (savings in tonnes) is limited to anecdotal evidence. Value per tonne as per government guidance.
		Carbon savings associated with transport (freight / green transport)	Yes	IWAC (2007) DECC (2008)	Information regarding physical quantities (savings in tonnes) is available for freight transport only. Value per tonne as per government guidance.
		Drainage, water conveyance, -flood protection and alleviation	Partial	Woodward and Wui (2001)	Only applicable where habitat along the waterway is providing a flood protection benefit to adjacent properties and environments or where a scheme will provide such a habitat.
		Water regulation and pollution dilution	Yes	Pretty <i>et al.</i> (2002)	Value loss due to eutrophication used as proxy for the benefit of reversing this process.
		Water quality	Yes	Georgiou <i>et al.</i> (2000)	Captures the environmental values associated with water quality improvements.
		Habitat provision	Yes	N / A	Captured under non-use values (see below)

Ecosystem Service Category	Benefits	Sub Benefits	Values presented	Reference(s) used in Framework	Comments
Cultural	Recreation (general land and water based)	General recreation (day and overnight visitors)	Yes	Willis and Garrod (1991) Ecotec (2006) Glaves <i>et al.</i> (2007)	Both expenditure and CS values available.
		Walking / running / dog-walking	Yes	Willis and Garrod (1991) GHK (2005)	Both expenditure and CS values available. No information found for running, specifically.
		Short cut taking	Yes	Willis and Garrod (1991)	CS value only.
		Cycling	Yes	Willis and Garrod (1991) GHK (2005) Ecotec (2006)	Both expenditure and CS values available.
		Boating (hired and privately owned)	Yes	Willis and Garrod (1991) Jacobs Gibb (2001) GHK (2005)	Both expenditure and CS values available. No values for sailing.
		Canoeing / kayaking	Yes	Ecotec (2006) GHK (2005)	Expenditure value only.
		Informal recreation improvements	Yes	British Waterways (2008)	Captures the value of marginal changes informal recreation (access and landscaping improvements)
	Recreation (specialised)	Angling	Yes	Spurgeon <i>et al.</i> (2001)	Total WTP (expenditure + CS)
		Bird watching	Yes	Dickie <i>et al.</i> (2006)	Expenditure value only.
	Heritage, cultural and well being values	Visual amenity	Yes	Willis and Garrod (1998)	Values reflect the marginal change (improvement or loss) in visual amenity as a result of increasing / decreasing the number of service structures around waterways.
		Heritage aspects	Yes	Adamowicz <i>et al.</i> (1995)	Values reflect the preservation value of canals for those who "view canals as heritage resource"
		Education	GAP	N / A	Information is currently restricted to anecdotal evidence, no valuation data available.
		Volunteering	GAP	N / A	No valuation data available for the 'well being' benefit of volunteering.
		Community benefits	GAP	N / A	Information is currently restricted to anecdotal evidence, no valuation data available.
	Non-use values	Non-use values	Yes	Adamowicz <i>et al.</i> (1995) Spash <i>et al.</i> (2004) Msharafieh <i>et al.</i> (unpublished)	Non-use values included for combined heritage, boating and tow path aspects, habitat provision and water quality.

Ecosystem Service Category	Benefits	Sub Benefits	Values presented	Reference(s) used in Framework	Comments
	Cross-cutting	Physical health	N / A	N / A	Only anecdotal evidence available which links health impacts with inland waterways.
		Tourism	N / A	N / A	Tourism benefits are considered to be captured under creation of business opportunities and recreation expenditures.
		Air Quality	N / A	N / A	The role inland waterways play in providing this benefit is not clearly understood.

4.3 Provisioning Services

4.3.1 Definition

Provisioning services are those that result in products being provided by the environment (ecosystems). In relation to inland waterways, provisioning benefits refer mainly to economic benefits such as the creation of business opportunities; the provision property price premiums; the provision of renewable energy generation capabilities; transport opportunities and associated cost savings; the provision of water for abstraction and the provision of volunteers. Job creation is also considered separately where these jobs arise directly from regeneration or restoration¹⁸ expenditure.

4.3.2 Data sources and values

The studies reviewed are all inland waterways specific, some relating to restoration or regeneration projects, others looking more widely at the benefits from inland waterways. They contain estimates for a range of 'indicators of value'. 'Indicators of value' refer to both financial and economic values and physical estimates such as increased visitor numbers or jobs created. These physical estimates can be used as indicators of future financial or economic benefits, especially with regard to regeneration and restoration projects.

The value estimates presented in the framework originate from a range of sources including WTP studies, EcIAs, and directly from organisations such as British Waterway or Government Departments.

The largest number of values identified relate to the 'creation or support for business opportunities'. These values come mainly from EcIA studies which cover a range of specific activities relating to both bank-side and water based businesses (e.g. boating hire companies, shops and restaurants). Where these values relate to recreation expenditures they have been considered under 'recreation' in the framework and Section 6. Where they relate to job creation, they have been considered under 'estimating job creation' in Section 6.2.

Some of the benefits listed within this category also appear under regulating or cultural service categories. For these, the provisioning benefits are associated with an ability to make money or to realise cost savings (green transport routes for instance) however there are also other benefits associated with climate regulation (carbon reductions) or cultural benefits. It is often the case that no valuation data are provided under the provisioning section as the nature and extent of financial savings or profits are dependant on a large number of variables that are not readily available.

4.3.3 Approaches to considering benefits

The provisioning benefits have been estimated using a range of valuation approaches, as discussed below.

For **property price premiums** the literature provides a range of values depending on the type and location of the property, the degree of improvement or change in the adjacent waterway and whether the properties are new or existing. The premium estimates have been generated over the last 20 years and show a great deal of

¹⁸ Restoration meaning the renewal and refurbishment of an existing building or structure; regeneration meaning investment in areas in order to reverse economic and socio-economic decline.

variation. These values were reviewed and have been presented in the framework as ranges relating to properties of certain characteristics. Given that the estimates presented in the framework come from a good range of studies, confidence in the values presented in the framework is considered to be reasonably high. That said, there are typically many aspects of a location influencing property prices and isolating the premium attributable specifically to the waterways is complex, so sensitivity testing is important.

Government guidance is available from the Department for Transport (DfT) to estimate the benefits of displacing road traffic. These benefits are presented here under the title of **transport**. Guidance is available to estimate both the benefits of commuters getting out of their cars and travelling by bicycle and for the displacement of road freight by water freight. The values presented in the government guidance include a wide range of benefits such as; congestion reduction, health, carbon savings, accidents, infrastructure saving and pollution reductions. Both sets of guidance referred to (DfT, 2009 a and b) were updated in April 2009 and so represent the latest thinking on the valuation of transport related costs and benefits.

Literature on the **value of water for abstraction** is scarce, comprising of scoping and evaluation reports, a meta-analysis and a WTP study. The WTP study actually looks at the angling and general public benefits of reducing low flows so is not considered directly relevant here. The values presented in the framework are taken from British Waterways (2008) and estimate the revenue they generate from water abstracted from their network. On average across the country these are thought to be accurate at the time of publication but may be variable if applied to water abstraction from non-British Waterways waters. Data are also available on the cost of abstraction licences from the Environment Agency; however these values do not reflect the social value of the water.

Volunteers generate two distinct types of benefits. The first is the cost savings that organisations gain from having, essentially free, labour available to them. The second is the personal benefit received by the volunteer, in terms of well being, health and possibly a feel good factor from doing something good for their community or a cause they feel strongly about. The literature presents a number of methodologies that can be used to estimate the cost saving benefits provided by volunteers. The first is simply based on the value of their time. This is not the opportunity cost but rather what they might realistically be expected to be paid for this work. This is the information that appears in the framework. An alternative approach is based on the concept called 'Volunteer Investment and Value Audit' (VIVA). This assessment tool allows for consideration of the 'outputs' of the volunteer programme (the value of the volunteers time) against the 'input' (the resources used to support the volunteers). This approach could therefore be assumed to provide a more accurate net value provided by the volunteers. It is not presented in the framework but users are guided to it should they wish to complete such an assessment.

No values are provided for the provisioning benefits associated with renewable / green energy in the framework because they are dependant on a large number of variables and often commercially confidential. See Box 3 for a discussion on renewable energy benefits and inland waterways.

Box 3 Renewable Energy and the Waterways

Renewable energy technologies linked to inland waterways can contribute to the UK's climate change commitment to reduce greenhouse gas (GHG) emissions by 80% by 2050 and to the UK's obligation to meet the EU's target of 20% of final energy consumption from renewable sources, and further secure energy supplies. British Waterways is promoting both hydro power and wind power. The income from both these initiatives will be used to maintain the waterways.

Hydro Power Development

The British Waterways and The Small Hydro Company partnership plans to invest £120 million over the next three years in a project aimed at generating enough renewable energy to power thousands of homes. The initiative is backed by the Climate Change Ventus Fund, one of the largest funds specifically targeted at the UK renewable energy sector.

The initiative will develop 25 hydro-electricity schemes along British waterways' 2,200-mile network of canals, rivers, docks and reservoirs.

The plan is estimated to create 150 construction jobs, and will generate 210,000 mega watt hours of renewable energy a year (enough to power about 40,000 homes). The initiative is estimated to save an annual 110,000 tonnes of CO₂.

The proposals will also enhance **waterway biodiversity** as well as providing improved **flood mitigation** for local communities.

Wind turbines

In October 2008, British Waterways announced an initiative to set up 50 wind turbines on canal-side land over the next 5 years, with the annual capacity to generate 219,000 mega watt hours of renewable energy.

The Renewables Obligation (RO) already supports renewable electricity generation and from 2010 the Government will be introducing a feed in tariff which will reward initiatives with guaranteed cash payments.

4.4 Regulating Services

4.4.1 Definition

Regulating services provide benefits from the regulation of ecosystem processes. Specifically, inland waterway ecosystems might provide benefits such as flood protection and alleviation; water regulation, pollution dilution and reduction in carbon and air pollution associated with transport of freight and green transport routes. As previously discussed, regulating services provide 'infrastructure' and 'insurance' values, requiring that a minimum set of these services are maintained in order ensure a sustainable flow of the resulting benefits.

Natural systems are complex and dynamic with multiple roles and multiple stressors, which tend to behave in non-linear ways. This makes the regulating services from inland waterways particularly challenging to value due to the need to specify and quantify the role inland waterways play in regulating natural systems, such as air or water.

4.4.2 Data source and values

There are many sources of data for a range of benefits provided by regulating services. These include air quality and climate regulation; biodiversity, habitat provision and non-use values; erosion control and flood alleviation; and water

provision and regulation. The type of literature available on these benefits is a mix of scoping and evaluation studies, which review a range of benefits and provide data from a range of sources; EcIAs, damage cost and replacement cost studies; meta-analyses and WTP studies.

A number of studies were *not* selected for the framework for a variety of reasons including:

- the original study was either not available for review, was considered out of date or not directly relevant to the benefits as they are realised by inland waterways;
- the values presented were for a range of benefits or it was not clear what was being valued; or
- the study's authors rejected the use of their results in benefit transfer, for example because preferences and values differed significantly across the two samples site considered (see Hanley *et al.*, 2006).

4.4.3 Approaches to considering benefits

All the values presented in the framework are from primary WTP studies or meta-analyses, with the exception of carbon which is based on the market price of carbon credits under the European Emissions Trading Scheme (EU ETS) or the Shadow Price of Carbon as estimated by Defra.

Carbon savings are categorised under 'climate regulation' as carbon release plays a significant role in climate change. The figures presented to value a reduction in carbon are presented as CO₂ equivalents and can be equally applied to a reduction in other green house gases which contribute to global climate change. These values are from recent Department of Energy and Climate Change (DECC) guidance and relate to the value of carbon credits on the EU ETS and the Shadow Price of Carbon which reflects its damage cost.

Carbon savings can be realised through the development of renewable energy along the waterways (e.g. hydro-power), the use of the waterways for the transportation of commercial freight that displaces road transport and the use of tow paths as short-cut or access routes used by commuters (walkers or cyclists) instead of travel by road or rail. The value of carbon savings from transport (commuter and freight) related benefits is captured under Section 6.1.1 as it forms an integral part of the total value estimates presented in DfT guidance. Section 6.1.2 does provide guidance on how to value carbon savings in isolation from other benefits, should that be required.

It should be noted that it is possible that the development and marketing of waterways could result in increased carbon emissions by generating road traffic to visitor destinations in the countryside, for example. Or the overall carbon impact could be neutral if the increased car use is balanced by the availability of recreational opportunities close to where people live that can be accessed by walking / cycling as opposed to use of a car. Section 8 recommends further research to gain a better understanding of the likely impacts of green transport opportunities linked to the waterways.

Any potential final benefits provided by waterways **drainage and water conveyance** services such as erosion control or flood alleviation benefits are likely to relate to the assets protected (e.g. houses and agricultural land). To estimate this, a range of variables need to be considered including; location and population present, the value of the properties or the land protected, along with the frequency

and extent of any potential flood event. The valuation literature centres on a number of meta-analyses, WTP studies and methodologies.

The methodologies identified allow for the valuation of all impact associated with flood risk management schemes. Firstly, the Multi Coloured Manual (FHRC, 2005) provides a method to value and assess the tangible losses associated with flooding. This methodology is complex and so not presented here. In addition a methodology is provided in Eftic (2007) which provides guidance on estimation of the non-market benefits afforded by these schemes, specially relating to habitat provision. However, applying these methodologies directly to value the benefits provided by inland waterways is difficult, unless detailed analysis is completed. It may also double count the value of some other benefits presented in the framework.

The values selected for the framework come from Woodward and Wui (2001) and relate to the combined flood protection benefits provided by a hectare of wetland habitat. This might be most relevant in transitional and coastal environments, however can be applied in all cases where wetlands provide flood protection services to adjacent land and property. It is clear that instances where this benefit might be provided by navigable waterways may be limited; however it was considered worthy of inclusion nonetheless. The overall confidence in these values and their transferability is also low, as they are now old and are based on a meta-analysis of a large number of US based studies.

In addition to the provision of water for drinking, water interacts with habitats and species in number of other roles within ecosystems. The consideration of **water regulation and pollution dilution services** provided by inland waterways can also be complex. Inland waterways facilitate the transport of water and have a role to play in the water cycle. It is however difficult to separate out the role that inland waterways play in this process from that of other elements of the natural environment. Benefits can include health related benefits, visual and aesthetic benefits and non-use benefits. The extent to which these benefits are provided is dependant on the current water quality and the habitats, species and human populations which rely on it.

The valuation literature provides values for non-use benefits associated with water quality and water flows, as discussed under the 'non-use values' section below. The only suitable values for these benefits for use in the framework capture the recreation and property related benefits associated with the avoidance of eutrophication of the waterways based on Pretty *et al.* (2002). This study assessed the environmental and social costs of eutrophication in freshwaters in England and Wales by conducting a series of loss-value estimates based on benefit transfers.

This damage cost approach could be applied in cases where a scheme (e.g. regeneration or restoration) would result in reduced frequency of eutrophic events. These values are recommended for use only where it is possible to quantify the role inland waterways might play in avoiding eutrophication problems. For example, the unit expenditure values per visitor day could be used within the value-loss relationship functions provided to estimate the reduced value of recreation from eutrophication or conversely, the benefits provided by reducing eutrophication in waterways used for abstraction and recreation.

Water quality is not an end benefit as described in Section 2.2; rather benefits arise from the use and non-use values facilitated by good water quality (e.g. recreational opportunities, amenity values, existence and bequest values of wildlife populations supported).

The valuation literature tends to elicit a value of a specific use which is dependant on good water quality or a non-use value related to the environmental dependencies between water quality and biodiversity for instance. There are four WTP studies which have been categories under 'non-use' but which in fact are focused on water quality related valuation. These are discussed under the 'non-use' section below and in Appendix C.

Georgiou *et al.* (2000) conducted a CV study on WTP for river water quality improvement related to fishing, plants and wildlife, and boating and swimming in the River Tame in Birmingham.

At the time of the assessment, the condition of the River Tame was very poor. Fish stocks were virtually non-existent, plant growth, insects, birds and animal life were limited, and the river was unsuitable for boating and swimming. Three improvement scenarios were described covering changes in fish population, plant and animal communities and the suitability for boating and swimming. It is inferred that these values are broadly representative of WTP for general environmental quality and the protection of a range of regulating services therein. These values may however have some element of use value embedded within them, so care is needed to avoid double counting.

4.5 Cultural Services

4.5.1 Definition

Cultural services provide the non-material benefits people obtain from the environment through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences.

4.5.2 Data source, values and approaches

There is a large amount of data available on the value of the **recreational use** of inland waterways. Values for *water based* recreation are all inland waterways specific, and many are from reasonably recent studies, making them likely candidates for transfer. *Land based* recreation is also well covered in the literature with studies providing both CS and expenditure values along with total WTP values.

The direct non-consumptive uses provide benefits through a range of recreational activities from visitors enjoying the general setting (i.e. informal users), to more serious sporting enthusiasts canoeing / kayaking on the inland waterways. The primary valuation literature reviewed for recreation benefits is old (for instance Willis and Garrod, 1991), nevertheless this work is regularly quoted in recent studies. Values are provided for both general use of the waterways and also for specialist activities. The confidence in these values is low. This is not because the study is considered to be of a poor quality, but rather because modelling techniques have become more accurate and because public preferences for waterway recreation activities are very likely to have changed significantly since the original study was completed.

Expenditure data on recreation benefits is more recent and often derived from economic impact studies that attempt to estimate the significance of this expenditure on the local and regional economy. A number of these studies have been used within the framework to provide ranges where possible for expenditure levels.

Angling is an important recreation activity on inland waterways for two reasons; because of the number of people involved in it throughout England and Wales and because it can contribute significantly to the local economies in areas where good fishing is available. There has been a number of primary valuation studies carried out in the UK to elicit WTP values for angling benefits, which demonstrate a high WTP from participants. In addition there are a number of studies in the literature which provide expenditure estimates for angling.

Only one study was selected however for inclusion within the framework as it provides consumer surplus and expenditure values, split out by type of angling being undertaken and by water body type (river, canal and lake). Other studies were excluded for a number of reasons such as their age, inappropriate scope or because the original report could not be found to review.

The literature on WTP for **bird watching** is very limited. No literature was found that considered bird watching and inland waterways specifically. The literature is restricted to data on ECIAs where the value of the expenditure by bird watches is assessed in terms of the number of jobs it supports or the multiplier effects it has on the local economy.

The framework contains an expenditure value from Dickie *et al.* (2006) for the watching of spectacular or high profile bird species. This value should only be applied to inland waterways where there is confidence that bird watchers are travelling to the location to see high profile species. It is likely that the expenditure of bird watchers viewing less spectacular species would be significantly lower than the estimate presented in the framework.

There are gaps in the framework where the literature does not provide WTP values for some specialist recreation services; such as canoeing or sailing.

Inland waterways are visually appealing to many. People may therefore have a WTP to avoid a loss in this **amenity value** or to gain an improvement in it. There are two studies of note here. The most recent being Hanley *et al.* (2006) which elicited a WTP per household per frequency of water bill for improvements in aesthetics of two rivers; from 'fair' to 'good'. However as this study was testing the validity of BT between two rivers and rejected it, the values estimated have not been used within the framework.

The values in the framework are taken from an older study by Garrod and Willis (1998) who looked at respondents WTP for a reduction in the number of utility service structures running along side and across canals. These values are useful in estimating a marginal change that might be provided by a project but not in the WTP for a 100% reduction in these structures.

The main gaps in the literature (and as a result in the framework) are in the '**softer**' **cultural benefits**, relating to heritage values, education and training and community and well-being benefits. This is an unsurprising finding as these benefits are often difficult to quantify and thus value.

Heritage values of the canal structures and buildings¹⁹ may result from the use of the waterways or from the non-use values held by the beneficiaries. While there are a number of valuation studies which attempt to estimate the heritage value of buildings, such as cathedrals and monuments, or the value for the restoration of

¹⁹ British Waterways is the third largest owner of listed buildings in the UK (British Waterways, 2008).

these structures, there is no valuation data suitable for use within the context of the inland waterways and the heritage values provided by them.

The framework contains a WTP value for the informal recreation along the waterways where the beneficiaries viewed the waterway as a heritage site (see Section 6.1.3). The valuation was completed as part of a larger study which is considered to be of good quality, if old (1995), however the values presented in the framework are derived from a very small sample size. Confidence in these values is therefore very low.

Non-consumptive use also covers benefits such as those gained from **education and training** (including volunteering) conducted in association with inland waterways. The literature on these benefits is limited to evaluation reports and EclAs, and while these benefits are often noted in a variety of sources, no data on the extent to which they are provided is available.

Glaves *et al.* (2007) highlight that inland waterways provide educational (and behavioural) benefits through activities such as angling for disadvantaged or problem young people. The literature also presents evidence in support of outdoor education contributing to children's creative development and ability to cope in real-life situations. O'Gorman and Bann (2008) considered these benefits as they are received from ecosystems in general. This assessment confirms the findings of Glaves *et al.* (2007) that data to enable quantification of the value of education benefits is not currently available.

As discussed in Section 2, the framework captures the final benefits realised by the services provided by inland waterways. However there are theoretical and methodological issues in identifying the appropriate 'final products' from education and training. As benefits can manifest themselves in a number of ways, from an individual's ability to appreciate and care for their environment, through to the ability to conduct experiments and gain a detailed understanding of specific ecosystem processes or historical values provided by inland waterways, there can be difficulties in delineating the actual products or final benefits being realised.

There is limited literature available to quantify the **benefits realised by the communities** around waterways, especially where regeneration of the waterways provides enhanced benefits. The same applies to the personal benefits realised by **volunteers**.

The available literature on **non-use values** is primarily couched within valuation studies concerning other final benefits. It is necessary, therefore, to read between the lines in order to decipher values relating primarily to use benefits versus non-use benefits. For example, Adamowicz *et al.* (1995) conducted a study on the "passive use benefits" of inland waterways by surveying respondents' WTP for maintaining boating activity, heritage aspects and tow paths. Respondents' who indicated that they had not visited a canal within 5 years were deemed to be non-visitors; therefore their WTP bids can be assumed to largely comprise non-use values²⁰. WTP responses from the 'canal visitors' sub-group may comprise both use and non-use values; as such care must be taken in aggregating both types of value across a relevant population.

²⁰ Non-visitors WTP may also contain an element of 'option use' – i.e. value attached to the option to use the canals in the future; however, the conclusion is drawn that non-visitors WTP is predominantly if not entirely comprised of non-use value.

Similarly, Spash *et al.* (2004) reported the results of a CV study on biodiversity improvements in the Tummel catchment in Scotland. The majority of respondents indicated that they were unfamiliar with the study area, suggesting that they had not visited previously or had any immediate intention to visit. The mean WTP, therefore, can be extrapolated to represent the non-use value of biodiversity improvements. These improvements may be directly associated with the navigable waterways or its restoration, or may be in areas linked to it either directly or indirectly (for example where the navigable waterways provides a food source for a species which resides in another location). Similarly, in a choice experiment conducted by Msharafieh (2008) on the benefits of general water quality improvements, approximately 10% of the sample (consisting of 602 respondents) indicated that they had visited the study site (although 77% expressed knowledge of its existence). It can be inferred, therefore, that the results are broadly representative of the non-use value of water quality improvement.

See Section 6 and Appendix C for a further discussion on the available literature for these and cross cutting benefits including **health** and **tourism**.

5 The Benefits Transfer Framework and Guidance for Use

5.1 Introduction

This section and Section 6 form a stand alone *user guide*, which can be applied without reference to earlier sections of the report. Reference should however be made to the Benefits Transfer Framework shown in Appendix D.

The Benefits Transfer Framework (here after referred to as ‘the framework’) is a tool designed to enable users to identify appropriate welfare values for the full range of inland waterways benefits. It does **not** facilitate the consideration of costs or dis-benefits which may be associated with the inland waterways²¹.

Some of the benefits included in the framework and discussed in detail in the next section, such as water quality improvements, renewable energy development or walking could equally be attributed to other environments or ecosystems such as non-navigable rivers or urban parks or woodlands. The framework and the studies within it are focussed on inland waterways maintained for navigation purposes. Inland waterways provide specific benefits not provided by other waterways or natural areas. The guidance presented in Section 6 notes where benefits and their associated values are specific to inland waterways and where they could also be applicable to benefits realised from other ecosystems.

The benefits identified include **use values**, which are related to direct and indirect use of the good and services, and the **non-use values** which arise irrespective of any such use.

The framework attempts to estimate the Total Economic Value (TEV) of each inland water benefit. TEV (or total WTP) is equal to the market value (MV) plus CS of a good / service (equation 1). Market value can be represented by market price or expenditure. CS is the difference between what the person is willing to pay for a good / service and what he or she actually pays²².

$$TEV \text{ (total WTP)} = MV + CS \text{ (equation 1)}$$

The overriding objective behind deriving monetary values of the benefits of inland waterways is to help inform and improve decisions on the development and management of the waterways. The main advantages and uses of benefit assessments are to:

- **Allow benefits to be compared to costs using the same indicator of value (money).** It is not always straightforward to translate different indicators of value into meaningful comparators. For instance where you wish to compare the provision of cycle ways around the country (km) with the natural support for fish populations (fish population size) in a given river and increased property price premiums due to proximity to inland waterways (% increase in property price);

²¹ In order to undertake a cost benefit analysis an understanding of the costs of a project or policy would need to be determined.

²² See O’Gorman and Bann (2008) for a more detailed discussion of the economic theory underlying this.

- **Provide interested parties** (e.g. Government, private organisations or the general public) **with an estimate of the value of inland waterway's benefits** that they can easily understand and compare with other natural and man-made systems;
- **Indicate the relative importance of benefits** (in a monetary sense), which can inform prioritisation of the benefits in terms of management and evaluation of priorities; and
- **Facilitate an understanding** of the beneficiaries and the development of appropriate funding and financing of the waterways.

The framework provides **high level estimates** of the benefits of inland waterways to feed into decision making processes such as cost benefit analyses, ECIAs or planning and land use decisions. Where an understanding of the benefits is a central aspect of the decision, more robust and site specific values will be required and a primary valuation study should be considered.

The framework is designed for marginal assessments. However, it can be used to estimate the total value of a limited number of current benefits provided by inland waterways. The total value of current benefits refers to those benefits provided by inland waterways today, unrelated to the benefits provided as a result of a restoration or regeneration scheme or any other project which might generate additional benefits to society. The additional benefits these projects generate are referred to as 'marginal' benefits. For example existing recreation benefits can be valued using the framework in the same way a small (or marginal) recreational change, resulting from a project or scheme, can be.

The suitability of using the unit values presented in the framework to estimate 'total' values will depend on how the estimate was generated and the policy / research question posed by the valuation study. This is discussed for each benefit below as appropriate.

Care is required when using the framework to avoid **double counting** of the benefits. This is of particular concern where the framework values are likely to contain elements of a number of benefits; for instance where use values contain some element of the user's non-use value. The framework notes where values may contain elements of other benefits

5.2 Benefits Transfer Process

The framework is populated with unit transfer values for the benefits of inland waterway. For some benefits transfer values are not available and qualitative / quantitative information is provided to help the user demonstrate their significance. The selection of the framework values is based on a four step 'BT process' developed for this study from published protocols and the literature on BT. The four step process is as follows:

Step 1. Evaluation of the quality of the original study, based on a set of criteria. The results of this step are presented in the framework under the title 'Quality of the Study' and discussed by study in Section 6.

Step 2. Preliminary assessment of 'Benefit Consistency'. This step reviews the benefits valued in the original study for consistency with the benefits in the

framework for inland waterways. The results are presented in the framework under the title 'Benefit Consistency' and discussed by study in Section 6.

Step 3. Detailed assessment of study for BT purposes, and selection of appropriate studies for inclusion in the framework.

Step 4. Guidance on the adjustments required. High level adjustments are recommended for each value. Generic adjustments, applying to all benefit values, are outlined in Section 5.3.

Each of these steps is discussed in more detail in Section 2. The first three steps form part of the literature review and evaluation task, as reported in Section 4 and Appendix C. The outcomes of Steps 1 and 2 are also documented in the framework for the studies brought forward into the framework.

Step 4 is captured within the framework and in the guidance detailed below. Only simple / key adjustments are recommended.

5.3 Generic Adjustments

For total WTP and CS values only (therefore excluding expenditure values), an adjustment is outlined below to reflect the expected increase in these values as a result of increases in income over time.

Generic adjustments, applicable to all benefit values in the framework, are:

- adjustment to current prices, to be applied in all cases;
- distributional impact adjustments, to be applied if considerations of equity are important.

5.3.1 Adjustments to total WTP and CS values reflect change in income levels

The Environment Agency (2003b) suggests that values are increased by between 0.6 - 0.8% per year to account for the **income elasticity of willingness to pay**. WTP is positively correlated with income and given that incomes have risen in real terms over time people may be willing to pay more now than in the past.

It is recommended that the WTP and CS values are increased by 0.7% (middle of range) for each year that has past since the study was conducted. For example, for a study completed in 1990, values should be increased by 0.7% per year for 18 years for assessment in 2009.

This adjustment does not account for the **increasing scarcity of environmental amenities, or for a change in tastes** (i.e., possible increased preferences for environmental quality or a greater value placed on natural hazard protection benefits provided by the environment now compared to in the past), and is therefore **considered a conservative allowance**. It is reasonable to assume that this increase will not apply in a recession when average incomes are falling.

5.3.2 Adjustments to current prices

In all cases it is recommended that values presented in the framework are uplifted to reflect the current prices. The studies in the framework were undertaken in different years, therefore their values are not directly comparable.

This adjustment is carried out using the HM Treasury gross domestic product (GDP) deflator. The GDP deflator can be viewed as a measure of general inflation in the domestic economy. Inflation can be described as a measure of price changes over time²³. The latest GDP deflator table (updated on the 30th of June 2009) is presented in Table 5²⁴. In future, the latest version of the deflator table should be used. This is available from the HM Treasury website.

Values are updated in the following way using this table:

- Assuming the unit transfer value in 1991-1992 is £10.00;
- The index value of 2008-2009 (100.000) is divided by the index value for 1991-1992 (65.525);
- This gives a ratio of 1.526;
- The equivalent value in 2007-2008 prices is then £10.00 multiplied by the ratio of 1.526 or £15.26.

Table 5 GDP Deflator Table

Financial Year	GDP deflator at market prices		Financial Year	GDP deflator at market prices	
	2007-08 =100	percentage change on previous year		2007-08 =100	percentage change on previous year
1965-66	6.955	4.90	1987-88	50.127	5.73
1966-67	7.251	4.26	1988-89	53.529	6.79
1967-68	7.459	2.87	1989-90	57.342	7.12
1968-69	7.817	4.80	1990-91	61.861	7.88
1969-70	8.242	5.44	1991-92	65.525	5.92
1970-71	8.926	8.30	1992-93	67.546	3.08
1971-72	9.722	8.92	1993-94	69.396	2.74
1972-73	10.551	8.52	1994-95	70.478	1.56
1973-74	11.313	7.22	1995-96	72.502	2.87
1974-75	13.533	19.63	1996-97	75.207	3.73
1975-76	16.972	25.41	1997-98	77.173	2.61
1976-77	19.277	13.58	1998-99	78.799	2.11
1977-78	21.917	13.70	1999-00	80.350	1.97
1978-79	24.327	11.00	2000-01	81.406	1.31
1979-80	28.443	16.92	2001-02	83.224	2.23
1980-81	33.651	18.31	2002-03	85.909	3.23
1981-82	36.886	9.61	2003-04	88.330	2.82
1982-83	39.450	6.95	2004-05	90.786	2.78
1983-84	41.283	4.65	2005-06	92.480	1.87
1984-85	43.492	5.35	2006-07	95.216	2.96
1985-86	45.937	5.62	2007-08	97.858	2.77
1986-87	47.412	3.21	2008-09	100.000	2.19

²³ The GDP deflator reflects movements of hundreds of separate deflators for the individual expenditure components of GDP. The deflator is usually expressed in terms of an index, i.e. a time series of index numbers.

²⁴ Further information on the GDP deflator is available from http://www.hm-treasury.gov.uk/data_gdp_index.htm

5.3.3 Adjustments to account for Distributional Impacts

For certain policies or projects, such as major regeneration schemes, mechanisms to ensure disadvantaged communities are not made worse off as a result are desirable (IWAC, 2007).

The costs or benefits of a project or policy can fall to different income groups and social classes. It is therefore necessary to **understand who the winners and losers are in order to gain an insight into possible equity concerns.**

The principle behind distributional impacts (DI) assessment is that of diminishing marginal utility, whereby the value of an incremental unit of income reduces as income rises. In other words, £1 provides more benefit to a person of low income than the same £1 provides to a person of higher income. The same applies for a loss of income.

Annex 5 of the Treasury Green Book (2003) states that DI assessment should be assessed where it is '*necessary and practical*' to do so. Consideration should be given to the need therefore to do this assessment and to the appropriate selection of adjustments to be used depending on the nature of the benefits and the beneficiaries being considered.

Based on the Treasury Green Book (2003) recommended adjustment factors, those in the lowest and highest income bands value £1 as equivalent to £2.45 and £0.45, respectively.

For example a specific example is provided in the Flood and Coastal Defence Appraisal Guidance (Defra, 2004) which explains DI assessment as it applies to flood and coastal defence strategies and schemes. In order to determine whether DI assessment is 'necessary and practical' the following criteria should be considered:

- Whether the DI calculation is likely to be robust – i.e. can reliable data be sourced?
- Whether the assessment will contribute to an appraisal that demonstrates equity and fairness to people?
- Whether the DI assessment is appropriate given the scale of the overall appraisal – i.e. are time and effort requirements justified?

The approach recommends that the level of data available on the mix of social class groups and income levels within an appraisal area must be understood. If, a DI assessment is then proven 'necessary and practical', weighted factors by social class may be applied as given in Table 6 below. This will result in benefits to lower social classes being more valuable (or carrying more weight) than those to higher social classes. The Total Weighted Factor adjustment for social class groups C1 and C2 will have a negligible effect on the DI assessment; hence, the use of Total Weighted Factors is only recommended where AB or DE social class groups form the majority of the concerned population.

Table 6 Total weighted factors by social class group

AB	C1	C2	DE
0.74	1.12	1.22	1.64

Source: Defra (2004)

While these adjustment factors were developed specifically for flood defence appraisal, application of DI assessment may also be used for schemes relating to navigation and inland waterways; for instance where the costs of maintenance work

might disproportionately benefit higher social classes who can afford to own and run the boats which use the waterway.

The Defra guidance recommends that both weighted and non-weighted results are presented to highlight whether the results are sensitive to the weighting assumptions. For further details on non-weighted factors see Defra, 2004.

5.4 The Benefits Transfer Framework

This framework is of use to parties involved in the management and promotion of inland waterways and in the development of related policies. The information contained within it can be used in cost benefit analyses of projects, plans or policies.

The framework can be used to:

- **identify the benefits** provided and which add to the welfare of the location, regional or national population;
- provide high level **estimates for value** of some of the benefits thereby indicating where significant benefits can or are being realised; and
- **identify beneficiaries** or groups in society likely to receive the benefits.

The framework captures welfare values only. Welfare²⁵ is equal to the MV of a benefit plus its CS, as discussed in section 5.1.

The values derived from EcIAs are limited to the presentation of multipliers which can be used in estimating the number of jobs created by construction spend or visitor spend, or the extent to which jobs might be expected to be provided locally or regionally. These are addressed separately in Section 6.2.

5.4.1 Framework structure

The framework categorises benefits following to an ESA that is according to the **provisioning, regulating and cultural services** provided by inland waterways (see Section 3). Reference details (authors and title) are provided for each primary valuation study, followed by information on the quality of the primary study (Step 1 in BT methodology) and how equivalent the benefit valued in the primary study is to an inland waterways benefit (Step 2 in BT methodology).

The framework **captures both MV and CS value components** where possible. This provides the user with an understanding of how the total value of a benefit is built up ($\text{Total WTP} = \text{MV} + \text{CS}$). Where MV and CS are not identified separately in the primary study, the framework captures the combined value for the benefit (shown as the Total WTP).

The framework then provides details of the **recommended adjustments** to the unit values (Step 4 in BT methodology). This step is supported by the guidance text provided here.

The benefits provided by inland waterways will be realised by different people or groups of people. Some will be private benefits, for instance to land owners or

²⁵ Welfare economics is based on the premise that the purpose of economic activity is to increase the well-being of individuals, and that individuals are the best judges of their own welfare. Since these preferences are regularly revealed in the market place, there is a logical link from preferences to willingness-to-pay.

companies, others will be public benefits realised by recreational users or society more widely.

Identification of the specific beneficiary will often be location dependent. For that reason, the framework only identifies whether the **beneficiaries** are likely to be public or private in nature. In an economic analysis, private benefits might be treated differently to public benefits, for instance by using different discount rates²⁶. Government policy is to apply a descending discount rate, starting at 3.5% up to year 30; 3% for years 31-75; 2.5% for years 76-125; 2% for years 126-200; 1.5% for years 201-300; and 1% every year after that. Private discount rates might vary.

The unit values in the framework need to be multiplied by the quantity of units provided or used to derive an estimate of the benefit. This quantitative information is referred to here as '**physical data**'. For example, to estimate the benefits of angling trips on a given river the unit value per angling trip (from the framework) is multiplied by the number of angling trips that will be generated (or not lost) by a given project or scheme. The correct estimation of this physical data for **aggregation** purposes is as important as the identification of correct unit values. The use of incorrect aggregation data can result in the significant over or underestimation of benefits.

It is generally accepted that WTP values are related to the distance the beneficiary is from a site or good being valued, with WTP declining with distance from a resource. This can be represented by a distance decay function.

Distance decay can be accounted for by:

- adjusting the WTP unit value for beneficiaries within distance bands (e.g. 1-5km; 6-15km; 16-30km); or
- applying an average WTP unit values to all beneficiaries within the largest distance band (e.g. 30km).

However as the rate of change in WTP values by distance has been shown to vary by study (see Georgiou *et al.* (2000), Jacobs Gibb (2001) and Msharafieh *et al.* (unpublished), it is considered inappropriate to apply standard percentage changes by distance to the framework unit values. Therefore the average WTP (as presented in the framework) is applied to all beneficiaries within an appropriate distance band²⁷. This is further discussed in Section 6 on aggregation of non-use values.

It is important to not only consider the aggregation of values for a single benefit category but also how (or indeed whether) the sub-totals formed for each benefit can be added to one another. Take for example amenity value. This value is arguably captured by the property price premium associated with proximity to a waterway and by recreational benefits (people choosing to participate in outdoor activity beside a waterway as opposed to elsewhere). While there may be methods / valuation studies available to derive the amenity value explicitly, it may be inappropriate to add this sub-category to the other benefit categories (property premiums and recreation) as doing so will incur a level of double counting. This

²⁶ Discounting is the technique of applying a discount rate to convert future monetary amounts to their equivalent value in today's terms - based on the premise that people prefer to receive benefits in the present rather than in the future.

²⁷ It is noted however that in theory 'average' consumer surplus per individual should decline as the distance from the site increases, since substitutes increase with distance.

issue is discussed in relation to each sub-benefit, with guidance provided as to where benefits may overlap with other categories.

The full framework is presented in Appendix D. The values included in the framework are discussed below, by ecosystem service category and by benefit.

This section and Section 6 refer to studies and their associated values found to be suitable for inclusion in this benefits transfer valuation framework for inland waterways. Gaps in the available values are however noted in the tables at the start of each section and are also presented in Table 35 in Section 8.

6 Transfer Values and Guidance for Application

6.1 Welfare Values

This section presents the transfer values that can be applied to estimate the benefits provided by inland waterways in England and Wales.

The guidance provides information on the following:

- **Context of the original study** - what was being valued and where, what approach was employed, what was the sample size etc. This information should be considered by the user to guide appropriate application of the study and range of values. This is highlighted in blue to draw the users attention to it;
- **Unit values** in prices from the year they were estimated – these values will need to be adjusted to current prices prior to use;
- **Appropriate application** of those values; can they be applied in marginal assessments or to estimate the value of current benefits; do they apply just to navigable inland waterways or can then be applied more widely etc;
- **Adjustments** to be applied; this refers the user to the adjustments to be made as outlined in Section 5.3; and
- **Aggregation requirements**; this outlines the aggregation approach, provides information on the data required and presents possible sources for that information. Accurately identifying the aggregation requirements is as important to identifying the monetary unit value itself. The same care is therefore required in completing this step in the estimation of benefits values as is in selecting the appropriate value from the framework.

6.1.1 Provisioning benefits

Table 7 presents an overview of the benefits in this category and some information on the availability of transfer values.

Table 7 Summary of provisioning benefits

Benefit	Value provided	Comments
Creation of business opportunities	No	Guidance on estimating job numbers is provided in Section 6.2. Expenditure estimates are presented within the cultural services category.
Property price premiums	Yes	-
Renewable energy generation	No	See Section 6.1.2 for carbon benefits
Transport -Freight -Green transport	No No	Financial benefits are discussed here. Associated carbon savings are discussed in Section 6.1.2.
Water provision	Yes	-
Volunteering	Yes	Available information relates to financial savings for organisation, not to the personal / welfare benefits of volunteers. See Section 6.1.3 for a discussion on these.
Regeneration	No	See guidance on the calculation on employment creation in Section 6.2.

(a) Creation of business opportunities

Inland waterways provide a range of business opportunities. These are often enhanced through restoration and regeneration projects. Such business opportunities can result in significant future benefits for the entrepreneur, for those employed in the jobs created and for the wider community. However, these mainly indirect benefits are difficult to value in many cases as they are largely reliant on estimates of future outcomes associated with increased use of the waterways and the knock-on expenditure this generates.

The primary indicators of this benefit are the expenditure associated with various activities and the estimated jobs created (represented as full time equivalents (FTE)) resulting from the expenditure. The FTE figures are *not* considered here to be economic values in themselves, but rather an indicator of the benefits inland waterways provide in terms of creating business opportunities. These benefits can potentially be very large and have in the past formed a significantly element of the underlying business case for new canal infrastructure, for example the Liverpool Link.

For this reason, the expenditure values underlying the creation of these job opportunities are presented under the discussion on recreation activities, as it is these activities that generate the expenditure which supports the jobs. See Section 6.2 for guidance on how to estimate the number of jobs supported by this expenditure.

(b) Property price premiums

Research suggests that people are willing to pay a 'waterside premium' to live or work near a canal. GHK (2007) note that residential schemes benefit the most from this premium. In addition canal side locations usually achieve a relatively high density of build that makes them attractive to developers, and can also be sold or let quicker than many comparable properties.

Powe *et al.* (2000) present estimates of residential waterside premiums. A premium of between 3%-5% is estimated for canal side locations using the hedonic pricing method, and 9%-20% using stated preference methods.

British Waterway (2008) use an estimate of 18%, based on Oxera, 2003 and Willis and Garrod, 1994.

Other literature on price premiums attributable to property on or adjacent to inland waterways is presented in Appendix C.

Here we present a range of percentage premiums which can be applied under certain circumstances, based on a number of studies as indicated in Table 5 and 6 below.

Premiums are presented to estimate both marginal changes in the nature of the waterways and the current situation of properties on or adjacent to inland waterways.

It is important to note that the premiums vary significantly, due in part to methodologies applied and because in reality it is hard to generalise property premiums due to the complex variables involved in determining property prices. This may also be explained by the difference in premiums associated with new

developments versus existing housing stock. New developments are often built in conjunction with a good quality environment or the development of one whereas the condition of the waterways in proximity to existing residential developments may be much more variable.

For regeneration and restoration projects, property premiums can form a key part of the decision making process, **care is therefore required in reporting the confidence around the estimates presented and sensitivity analysis should be undertaken.**

In reality property prices vary for a wide range of reasons, of which proximity to an inland waterway will be just one. The significance of the effect of the waterway on property prices will vary by location and is highly likely to depend on the quality of the waterway in question. The ranges presented below are therefore best used to provide a view of the potential benefits only. If accurate estimates are required site specific analysis should be carried out.

Unit values

Table 8 applies to **new and existing properties** near to waterways and presents percentage premium ranges for three specific scenarios - new property value, existing property value and rental premiums on offices. The estimates presented in Table 8 come from a number of sources. Due to the variability in the literature and the site specific nature of these benefits it is recommended that these premiums are only used to provide ball park estimates and sensitivity analysis is applied in cases where this value is crucial to any decision process.

Table 8 Percentage price premium on new and existing properties due to proximity to canals

Type of property / Context	Premium	Source
Value added to new properties by the canal side	18% (3%-20%)	British Waterways (2008) ²⁸ Powe <i>et al.</i> (2000)
Property premium on existing properties within 25 m of the canal side	1.5 -8%	Powe <i>et al.</i> (2000) Willis and Garrod (1994) and in DTZ (2001)
Rental premium on waterfront office properties	0-10% (mean is closer to 0%)	GHK (2007) ²⁹

Table 9 based on Jacobs Gibb, 2001, presents property premiums, according to distance from a canal, as a result of **waterway improvements**. For example, properties directly on or adjacent to a canal that changes from a dry to a fully navigational waterway, can be expected to experience an uplift of 25%.

²⁸ Estimates come from Oxera (2003) Appraisal of the Non-market Benefits of British Waterways' Strategy: Final Report, who quote from Lambert Smith Hampton (2002)

²⁹ Original estimate comes from Wood and Handley (1999).

Table 9 Percentage premium on properties prices due to marginal change in local waterway

Type of property	Premium	Source
Properties on or directly adjacent to the canal		Jacobs Gibb (2001)
-no water to fully navigational canal	25%	
-non-navigation water to fully navigational canal.	15%	
Properties within 100 meters of the canal		
-no water to fully navigational canal.	15%	
-non-navigation water to fully navigational canal.	10%	
Properties within 500 meters		
-no water to fully navigational canal.	10%	
-non-navigation water to fully navigational canal.	5%	

Appropriate application of unit values

The premiums presented in Table 8 are intended to reflect the increment in property prices attributable to inland waterways.

A value of 18% has been provided for new properties by canals. This is taken from Garrod and Willis (1993) as presented in Powe *et al.* (2000) which presents a review of a number of studies. Care is required in applying this premium. It is built up based on properties within 20 meters of a canal having an 8% premium and properties with canal frontage having a further 8% premium. It is assumed that this relates to good quality locations. In lower quality locations, it must be assumed that the premium is reduced significantly. The range (3-20%) is taken from the lower bound premium estimated through the use of hedonic pricing and the upper bound premium estimated through the use of a stated preference survey, also presented in Powe *et al.* (2000).

It is considered likely that stated preference studies over estimate the actually premium paid by property buyers. When asked explicitly, respondents might suggest that they are willing to pay more than when the value is implicit in the price paid in a real the market which is considered to result in range of benefits provided by the location, and not just the proximity of the waterway³⁰. Therefore care is required in applying these estimates.

Where it is clear that the new property is in a high quality environment the 18% premium can be applied. However in cases of uncertainty, it is recommended that the lower bound range of the stated preference studies is applied (9%) and the ranges are used for sensitivity testing purposes.

Again, unless specific information is available to allow a mid range value to be applied to existing or rental properties, it is recommended that the ranges presented in Table 8 are applied. The upper bound estimate for existing properties is taken from the estimate presented in Powe *et al.* (2000) that properties within 20 meters of a canal have an 8% premium.

Table 9 applies to properties in places where an improvement scheme will result in visible improvements in a navigation function or water levels in the adjacent waterway. **These estimates all relate to inland waterways.** Their applicability to non navigable inland waters is therefore unclear.

Adjustments

No adjustments required.

³⁰ This could be due to a number of biases commonly reported in stated preference surveys such as 'yea saying'. This is where the respondents feels expected to have a value for a good and therefore confirm to the interviewer what they believe the interviewer wants to hear.

Aggregation

To estimate property premium benefits for a waterway the number of affected properties is needed, along with the average value of each type of property; new, existing, adjacent to or set back from the canal etc.

House price information can be found from the Land Registry House Price Index (HPI) which captures changes in the value of residential properties. The HPI is based on sales data collected on all residential housing transactions (cash and mortgage sales) in England and Wales since January 1995. The indices can be interrogated at a national level and for various regions, counties and boroughs.

(c) Renewable energy development

Waterways offer opportunities for the development of renewable energy, which can result in financial gains and social gains in terms of carbon savings. This section focuses on the potential financial gains only as carbon related gains are outlined in Section 6.1.2.

The extent to which these benefits are realised and the value of them depends on a number of variables such as the technology used, location and land ownership issues. It is therefore not possible to provide guidance on how to value these benefits.

An example of renewable energy generation from heating and cooling (see Appendix C) suggests that for each KWhr of energy produced, GlaxoSmithKlein (GSK) will save around £100K annually. This saving can not however be assumed to be uniform across technologies or operators.

See Section 6.1.2 for guidance on how to value the carbon emissions reduction benefits provided by the development of renewable energy in or along inland waterways.

(d) Transport

As with renewable energy, there are two main components to transport benefits:

- the financial savings to the operator (freight transport company and their customers, walkers and cyclists) of using the waterways network for transport instead of the road or rail networks;
- potentially avoided externalities of road traffic which may include accidents, noise, air pollution, road infrastructure costs, health and specifically the carbon savings where transport via inland waterways displaces more energy intensive transport, such as road transport. Inland waterways therefore provide opportunities for green transport.

The financial savings will vary depending on a range of factors including location, the product being transported and the available alternatives. It is not possible therefore to provide estimates of the financial savings or profit this activity might generate due to the large number of variables to be considered.

It is however possible to estimate the benefits of displacing road traffic for both commuters and freight transport.

Taking commuters first, canal towpaths have the potential to become an important part of the safe off road transport network being developed by local authorities and

Sustrans, the sustainable transport charity. Towpaths can offer safer travel alternatives, displacing pedestrian and cyclist traffic from the road network, and in some case valuable time savings, for instance where towpaths can be used as a short-cut.

The Department for Transport (DfT) has recently published a document entitled “NATA Refresh: Appraisal for a Sustainable Transport System” (DfT, 2009a) which includes estimates for the comparative costs and benefits of switching from a car to a bicycle for commuting. The monetised impacts include time travel costs, physical fitness benefits (including consideration of accidents inherent in both modes of transport), congestion reduction benefits, greenhouse gas emissions, tax revenue loss and ‘other’ costs and benefits.

The costs and benefits realised as a result of commuters moving from cars to bicycles will vary depending on the level of congestion at the time of their travel as well as the opportunity cost of their time. The opportunity cost of time is assumed to be higher for journeys made during working hours (for work purposes) than out of work hours. As such, positive net benefits only occur for cycling commuter journeys where an average or high level of congestion is assumed.

While passenger transport services are not common place on inland waterways, they can provide significant opportunities in certain locations. The Thames Tideway in London provides a passenger transport function, however beyond this little has materialised outside very local, mainly tourist orientated services. Examples include waterbus services in Birmingham, water taxis in Bristol, trip and restaurant boats in York and on the London canals, and short boat trips associated with waterways based tourist attraction or waterways under restoration (IWAC, 2007). The value of these services is not captured here but where they are commuter related might be considered to approximate those provided by displacing commuters from road to bicycles and walking.

The methodology and values provided by DfT NATA Refresh are provided below under ‘commuter transport’.

The value of the environmental benefits of moving freight from roads and onto rail are provided by DfT in their recent publication on the ‘Freight Mode Shift Benefits (MSB) Values’ report (DfT, 2009b). This approach compares the environmental costs of road freight movement with rail freight movement to estimate the benefit of rail freight. DfT assume that the impacts of water freight are the same as those of rail. Should this assumption be incorrect, it is likely that this approach will result in an underestimate of the benefits water freight.

This approach includes estimates for the following impacts: congestion, accidents, noise, climate change (carbon emissions), air pollution, infrastructure and other costs. It is therefore not necessary to estimate the carbon costs separately using the guidance presented in Section 6.1.2 below. However should the user wish to estimate only the carbon costs, Section 6.1.2 provides guidance on valuing the carbon offsetting benefits associated with displacement of freight transport from road to water.

The methodology and values provided by DfT MSB are provided below under ‘freight transport’.

(i) Commuter transport

Unit values

Table 10 shows the net benefits of displacing commuter journeys from a car to cycling and walking. These figures include net travel time costs, physical fitness benefits, congestion reduction benefits (incurred by other drivers as a result of one less car journey), greenhouse gas emissions savings, tax adjustments and 'other' costs and benefits. It is not clear what is included in this last category.

No values are provided for walking during periods of low or average congestion and cycling during periods of low congestion because in such cases the time delay costs experienced by cars are not significant enough to outweigh the physical fitness and other benefits gained by walking and cycling.

Table 10 Net benefit of switching from car to an alternative mode of travel (pence / km) (2009 prices)

Level of congestion	Low	Average	High
Cycle: commuter	-	0 to 14	187 to 201
Walk: commuter	-	-	130 to 144

Source: DfT (2009a)

Appropriate application of unit values

These estimates can be used to value the existing provision of green transport routes and any marginal change expected as a result of a project.

The physical data required are the miles displaced from car journeys to walking / cycling for commuting purposes and the level of congestion on the route. The baseline level of congestion should be determined on a case-by-case basis. Information can be found on the DfT website. Where information on the level of congestion is not available, it is recommended that a central value of £0.07 per mile (for average congestion levels presented in table 10 above) be used for cycling journeys and a zero value for walking. Table 10 above indicates that this would result in a significant underestimate of the benefits were the route actually highly congested, therefore some certainty over the level of congestion is desired and sensitivity analysis should be undertaken in cases of uncertainty

It is important to note that these values apply to journeys made for commuting purposes only and do not apply to travel during work hours for work purposes³¹. Neither do they apply to recreational walking and cycling visits which are discussed in Section 6.1.3.

Adjustments

No adjustments are required at present. However in the future values should be adjusted to current prices as outlined in Section 5.3.2.

These figures are likely to be updated according to further research and, for example, as a result for changes in how the shadow price of carbon is estimated (for the greenhouse gas component). Therefore it is recommended that in future years the values are checked against updated guidance from the DfT.

³¹ Such journeys do not incur a net benefit, due to the higher opportunity cost of time during work hours.

Aggregation

The total or marginal value of these benefits should be estimated by the number of commuter miles that are displaced from the road to the towpath or access route used by the walkers or cyclists.

Clearly it is necessary to determine the proportion of the total journeys made currently (if estimating the total value) or likely to be made as a result of a project (if estimating the marginal value) that would otherwise be undertaken by car. If journeys are in fact displaced from other (public) modes of transport the avoided externality costs will be much lower, perhaps zero.

(ii) Freight transport

Unit values

Table 11 shows the model shift benefits (MSB) of moving freight transport off roads and on to rail or water. These values include impacts associated with congestion, accidents, noise, pollution, carbon emissions, infrastructure and 'other' roads costs and net out the impacts associated with rail and water freight transport and the loss of taxation revenues.

Table 11 Modal Shift Benefits (2010 prices, pence per lorry mile)

Impact	Motorway		A roads	Other roads	Weighted average*
	High ⁺	Low			
Congestion	100.2	24.1	75.9	85.2	52.4
Accidents	0.5	0.5	5.7	5.6	2.8
Noise	8.6	6.0	7.2	9.1	7.0
Pollution	1.9	1.8	3.3	3.8	2.5
Climate Change (carbon)	3.6	3.6	4.2	4.2	3.8
Infrastructure	4.7	4.7	10.8	68.7	9.0
Other (road)	6.4	6.4	6.4	6.4	6.4
Taxation	-34.4	-34.5	-33.6	-34.8	-34.1
Rail or water costs**	-5.7	-5.7	-5.7	-5.7	-5.7
Total	86	7	74	143	44

⁺ this value is for sections of motorways where congestion is substantially higher. See the guidance for a list of motorways where this value can be applied.

* weighted by articulated goods vehicle kilometres and their use on the road network

**note that only noise, pollution, climate change, other and taxation are included in these values.

Source: DfT 2009b

Appropriate application of unit values

These values can be applied where the provision of transport opportunities are provided by navigable waterways. These might be new opportunities (in the case of a marginal assessment) or existing opportunities (in the case of a total value assessment).

As these opportunities are only available on navigable waterways, these values do not apply to other types of waterways.

Adjustments

These values are presented by DfT as 2015 values in 2010 prices. DfT note that these values will be used to value freight removed from the road network in the period 2010 to 2015 regardless of when the change over is made. Therefore no adjustments are required at present.

In the future, the guidance should be consulted directly to ensure appropriate adjustments are made³².

Aggregation

In order to apply these values it is necessary to have information on the amount of lorry miles which are displaced from the road network to the water network. Care is required to ensure that the appropriate values are applied with 'high motorway' values only being applied in cases where the section on the motorway in question is listed in Annex A of the User Guide (DfT 2009b).

Where no information is available on road type, the weighted average value can be applied.

As noted above, these values are based on the assumption that rail and water freight result in the same environmental impacts, valued at 5.7 pence per lorry mile.

(e) Provision of water

Water is a valuable resource. The ability to abstract it and sell it can provide financial benefits for those parties involved. British Waterways currently sell water, primarily for commercial rather than residential purposes³³. As this water is often offered on a 'take and return' basis, it can provide a public and environmental benefit not applicable to main water supply. British Waterways operate both the retention and recirculation of water in line with Defra's PSA on sustainable water use (PSA 28) (British Waterways, 2008).

British Waterways supply water at a significantly lower cost (typically £250 / MI for raw water) than potable supplies (£650 / MI) due largely to the reduced treatment costs associated with these abstractions. There are therefore financial savings and lower carbon emissions as a result of reduced need for treatment and pumping around the network and lower infrastructure costs as much of the water is supplied in open channels.

British Waterways (2008) estimate that the CS value associated with this provision of water is equal to approximately one-third (33%) of the charge (or the MV).

It is important to note that in some instances there could be *trade-offs* between water abstraction and other uses of the waterways, for instance navigation or recreation. However as British Waterways operate their abstraction in line with PSA 28, it is assumed that there are no significant dis-benefits associated with this abstraction. Dis-benefits could include reduced flows, resulting in reduced ability for navigation, reduced recreational enjoyment and wider environmental and biodiversity impacts.

³² This is available to download from:
<http://www.dft.gov.uk/pgr/freight/waterfreight/envirobenefits/>

³³ This is due to the infrastructure requirements of providing residential supplies from inland waterways.

Unit values

Table 12 below presents the MV and the CS value for British Waterways managed waters.

Table 12 Market Value, Consumer Surplus and Total WTP per MI of water abstracted (2008 prices)

Benefit	MV	CS	Total WTP
Water for abstraction	£250 / MI	£82.50 / MI	£332.50 / MI

Source: British Waterways, 2008

It is not possible to provide guidance on how to estimate the financial benefits for the operator from waterways supplies, over and above those provided by mains supplied sources, as they are dependent on a number of factors including the distance of the user from source, and thus the requirements of pumping, and the need to treat the water prior to use. These need to be calculated on a case by case basis.

Appropriate application of the unit values

These estimates can be used to value the existing provision of water from the inland waterway network and any marginal change in this provision as a result of a scheme.

As there is no evidence presented in the report to support the CS estimate, the confidence in this estimate is low.

Adjustments

No adjustments are required at present however in the future values should be adjusted to current prices as outlined in Section 5.3.2. In addition the CS value should be adjusted to reflect income elasticity based on the approach outline in 5.3.1.

Aggregation

The total or marginal value of these benefits is estimated by multiplying the total WTP value by the number of MI supplied. The number of MI supplied needs to be calculated on a case by case basis.

Carbon savings, where quantified, can be valued using the approach set out under Section 6.1.2, (a)(ii) below.

(f) Provision of volunteers

Volunteers contribute their time for free to a range of activities including towpath tidying, secretarial contributions to Canal Societies and Trusts, and contributions of professional skills to project developments.

Volunteers provide financial cost savings to the organisations they volunteer for. It is likely that the final benefits from this are felt in the redistribution of this money to generate other benefits (for instance additional towpaths, improved access, habitat improvements etc).

Volunteers also gain benefits in terms of having a sense of achievement, physical and mental health benefits and possibly a 'warm glow' feeling from helping others out. There is an opportunity cost associated with volunteer time; they could be doing something else instead and / or be earning money and it may be possible to use wages forgone to reflect the willingness to pay of volunteers to receive these personal benefits. However standard wage rates are also used to estimate the

financial saving to the organisation. Therefore it is not considered appropriate to use them to estimate both benefits. Further discussion on these private benefits is presented in Section 6.1.3, however no values are provided.

In addition volunteering promotes community awareness of waterways which over time can encourage the integration of the waterways into community planning processes. Such benefits might be realised in terms of enhanced environmental protection or through the use of the waterway for education and events.

The values presented here however are focused on the financial savings to organisation as a result of not having to employ someone to carry out the work undertaken by the volunteers and does not capture either the private benefit realised by the volunteer or the associated community benefits.

British Waterways (2008) presents a methodology for valuing these benefits based on the cost saving they provide. They provide estimates for unskilled labour, skilled labour (where a minimum of 6 hours training is required) and professional labour. This method provides the *gross* benefits realised by the beneficiary organisation. In order to calculate the net benefit it is necessary to deduct the costs to the organisation, for example the cost of training volunteers.

The Institute for Volunteering Research (2003) outlines a more detailed methodology to estimate the net value of volunteers which is based on a concept called "Volunteer Investment and Value Audit "VIVA".

VIVA is a measurement tool that assesses the 'outputs' of volunteer programmes (the value of volunteers' time) in relation to the 'inputs' (the resources used to support the volunteers). It therefore provides informative and readily grasped indicators of the scale and significance of voluntary work and the payback on an organisation's investment in volunteering.

This method allows the estimation of a VIVA ratio. This is produced by dividing the total volunteer value by the total volunteer investment. For example, a total value of £50,000 and expenditure of £10,000 yields a ratio of 5. The Ratio has a simple meaning: 'for every £1 we spend on volunteers, we get back £5 in the value of the work they do', a five-fold return on the organisation's investment in volunteering. See The Institute for Volunteering Research (2003) for details of how to calculate this ratio.

Unit values

Table 13 shows the gross value estimates for volunteer labour, as provided in British Waterways (2008). These values could be feed into the VIVA assessment.

Table 13 The gross financial cost savings provided by volunteers

Labour type	£ / day
Unskilled	50
Skilled	150
Professional	350

Source: British Waterways (2008)

Appropriate application of unit values

The values in Table 13 were estimated by British Waterways and therefore are specific to inland waterways. However they could be used to represent cost savings provided by volunteers to any type of organisation.

They can be used to estimate both existing benefits provided by volunteers and the marginal change in benefits where the number of volunteers changes as a result of a project or scheme.

The VIVA analysis could also be completed where the net benefit of the work undertaken by volunteers is required. It is recommended that the Institute for Volunteering Research (2003) is consulted which provides a methodology to complete this analysis.

Adjustments

These values should be adjusted to current prices using the approach outlined in Section 5.3.2.

Aggregation

The value per volunteer day needs to be multiplied by the number of volunteer days undertaken. Where the split between types of labour is unknown, it is recommended that the value for unskilled labour is applied.

As the number of volunteer days will vary by site this needs to be calculated on a case by case basis. British Waterways have some estimates of the number of volunteers used on their network. Other navigation authorities may also collate information on this, however it is understood that this is unlikely to be complete or consistently gathered to provide generic estimates that could be applied across sites.

6.1.2 Regulating Benefits

Table 14 presents an overview of the benefits in this category and the transfer values available.

Table 14 Summary of regulating benefits

Benefit	Values provided	Comments
Climate regulation – carbon savings; Renewable energy; and Transport.	Yes Yes	These values can be used to value the avoided damage costs associated with carbon emissions where these result from renewable energy development or transport modal shifts.
Drainage, water conveyance, flood protection and alleviation.	Partially	The final benefits associated with these regulatory functions are often inter-related. Transfer values are presented for flood protection benefits provided by wetlands and for a reduction in eutrophication in waterways. The applicability of these values currently may however be low.
Water regulation and pollution dilution		
Water Quality	Yes	Values of benefits associated with improvements in water quality are provided. These do not relate to existing benefits associated with a given water quality but rather marginal benefits resulting from a change in water quality.
Habitat provisions	No	See non-use values Section 6.1.3

(a) Climate regulation

(i) Renewable energy related carbon savings

There are two main benefits associated with the development of renewable energy schemes on inland waterways:

- Carbon (or other green house gas) savings relative to non-renewable schemes.
- Potential financial gains to the operator or financial cost savings (as discussed in Section 6.1.1)

The valuation estimates presented here relates to the carbon savings associated with renewable energy development on inland waterways.

As discussed in Section 4, government guidance (DECC, 2008) states that carbon savings associated with displaced energy arising from sectors involved in the EU ETS should be valued at the **market price of carbon**³⁴. The rationale for this is that such a reduction in emissions will not result in a net emissions decrease in the UK or wider EU, which is fixed by the quantity of permits or allowances. Instead, it represents an economic benefit whereby the UK is require to import less or able to export more allowances.

The Shadow Price of Carbon (SPC) is used to value carbon emission reductions where they are emitted from non EU ETS sectors. Currently the SPC is significantly higher than the MV, at £26.50per tCO₂ (in 2007 prices). For new schemes, the carbon reduction benefits should be valued using the updated DECC guidance (DECC, 2008). However note that estimates using the new approach (market price of carbon) will not be directly comparable to benefits estimated in the past using the SPC.

Unit values

The average price of an allowance in 2008 was £16.26 / tCO₂e³⁵ (tonnes of CO₂ equivalent)³⁶ (2008 prices) (see Table 15). This value is determined by market conditions and therefore needs to be based on live data. To download the guidance click [here](#).

Table 15 Projected Allowance Prices per tCO₂e (2008 prices)

Year	2009	2010	2011	2012
Allowance Price	£16.72	£17.21	£17.73	£18.38

Source: DECC, 2008.

Appropriate application of unit values

Carbon saving benefits from renewable energy could be provided by any waterway used for energy generation (or in fact any ecosystem) and so are not specific to navigable waterways. That said, navigable waterways may provide particular opportunities for the generation of renewable energy, for instance hydropower developments in association with existing weirs.

³⁴ Activities covered under the ETS are; changes in electricity use, changes in primary fuel use by EU ETS installations; aviation emissions from 2010; nitrous oxide from nitric acid and adipic acid production from 2012. Non ETS activities are - primary fuel use where not an EU ETS installation; road transport fuel; changed in GHG from land use, waste and agriculture.

³⁵ CO₂e means carbon dioxide equivalent. The conversion rates for other green house gases into CO₂e can be found at: http://www.carbontrust.co.uk/resource/conversion_factors/default.htm

³⁶ DECC (2008). Greenhouse Gas Policy in Evaluation and Appraisal in Government Departments available from <http://www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/greengas-policyevaluation.pdf>

The unit values are applicable to all carbon emitted or saved by EU ETS participating sectors, irrespective of the type of environment considered.

The unit values can be used to estimate total current benefits and marginal benefit that results from a particular activity.

Adjustments

Where live data are used no adjustments are required. However should the values presented in the DECC guidance be applied, then values should be adjusted to reflect current prices. See Section 5.3.2 for guidance.

Aggregation

To estimate the total value of the carbon reduction benefits provided by renewable energy schemes on inland waterway, the value per **tCO₂e** needs to be applied to physical data on the number of **tCO₂e** that will be off-set by the scheme.

The design and location of a scheme will influence its energy generation capacity, and thus the carbon savings that can be offset and the amount of carbon embedded in the infrastructure. The former is the benefit; however the latter is a cost and should be netted out to reflect the net carbon benefit associated with the scheme. The estimation of embedded carbon is not always straightforward. Should the user wish to learn more about this, they are directed to the Environment Agency's Carbon Calculator³⁷ designed to estimate the embedded carbon of flood defence construction schemes.

As noted in Section 4, it might be assumed from the little evidence available that 1MWh of renewable energy from **heating and cooling systems** saves between **900 and 1,000 tonnes of CO₂ annually**. Given this is an assumption based on very little data, it is not recommended for use except as a very high level 'ball-park' estimate of the potential carbon savings associated with such schemes.

British Waterways have suggested that their recently announced partnership with the Small Hydro Company to develop small hydropower along their network will deliver 110,000 tonnes of CO₂ savings from the generation of 210,000 megawatt hours of electricity. This suggests that **on average every megawatt hour of electricity generated through these hydro schemes** will provide around **0.5 tonnes of CO₂ savings**. Again, given the significant variability in actual savings from scheme to scheme and the lack of additional data to support this assessment, it is recommended that this estimate is only used for very high level 'ball-park' estimate of the potential carbon savings from hydropower schemes.

(ii) Transport related carbon savings

As noted in Section 6.1.1(d) transport benefits provided by inland waterways can be divided into 3 key categories. The first two, financial saving and green transport benefits are discussed in Section 6.1.1(d) while the third, carbon savings is presented here. While the method of valuation presented in Section 6.1.1(d) for green transport benefits includes a value for carbon savings from displacing commuter traffic from roads, it is not explicitly identified.

Here, the carbon benefits associated with the displacement of road freight to water freight are discussed and valued explicitly. In order to estimate the full range of

³⁷ Available from <http://www.environment-agency.gov.uk/business/sectors/37543.aspx>

environmental benefits realised by moving freight from roads to water, refer to guidance in Section 6.1.1(d)

A recent report by IWAC (2008) outlines the current status of freight transport by inland waterways network in England and Wales, and provides recommendations on how waterborne freight could be increased in the future to significantly decrease carbon emissions. The report presents average estimates of the carbon savings of transporting freight by water rather than by road which are used here.

Unit values

Transport related carbon saving can be valued using current government guidance³⁸ on valuing carbon, which recommends the use of the SPC for carbon emissions resulting from *non* EU ETS regulated activities, such as transport. The SPC in 2009 is £26.50 tCO₂ (in 2007 prices). This value should be inflated by 2% per year to account for the additional damage costs of carbon over time.

If the carbon savings being valued are not expected to be realised in 2009, then apply the value presented in Table 16 below and inflate it annually by 2% every year the carbon savings are realised.

Table 16 The projected SPC per tonne of CO₂

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
£ / tCO ₂	26.5	27	27.6	28.1	28.7	29.2	29.8	30.4	31.0	31.6	32.3

Source: <http://www.defra.gov.uk/environment/climatechange/research/carboncost/pdf/background.pdf>

Appropriate application of unit values

These values can be used to estimate the existing carbon benefits provided by moving freight by water instead of by road. They can also be used to estimate the value of a marginal change in the extent of freight taken off the roads and moved to the waterway.

Adjustment

The SPC values are presented in 2007 prices. The value selected should be adjusted to current prices using the approach outlined in Section 5.3.2. As noted above, it is also necessary to inflate this value, by 2% for each year when analysing the benefits over a number of years.

Aggregation

In order to aggregate this value it is necessary to know the number of thousand freight tonne kilometres that will provide a carbon savings. This data will be site / case specific³⁹.

Table 17 presents the carbon emissions generated from freight transported by both road and water. It can be seen that for every thousand freight tonne kilometres transported by water rather than road, there is a saving on 0.06 tonnes of carbon (0.08-0.02). A tonne kilometre is the movement of freight achieved when one tonne of cargo is transported one kilometre. For example, a journey of 10kms by a barge

³⁸ Available from either <http://www.defra.gov.uk/environment/climatechange/research/carboncost/step1.htm> or <http://www.defra.gov.uk/environment/climatechange/research/carboncost/pdf/background.pdf>

³⁹ Tonne-km figures may be available from navigation authorities and from the DfT annual Waterborne Freight Statistics reports.

carrying 500 tonnes represents a movement of 5000 tonne-kms. This would imply a saving of 0.3 tonnes of carbon.

Table 17 Tonnes of carbon emitted per thousand freight tonne kilometres

Type of freight	Tonnes of carbon emitted
Road	0.08
Water	0.02

Source: IWAC, 2008

The carbon saving value (0.06 tonnes of carbon per thousand freight tonne kms) has to be converted to tonnes of carbon dioxide, to match the unit of monetary value being used. Each tonne of carbon is equivalent to 3.67⁴⁰ tonnes of carbon dioxide. So the 0.06 tonnes of carbon saved is equivalent to 0.22 tonnes of carbon dioxide.

The value of carbon savings from freight transportation is derived by:

- multiplying the 'thousand freight tonne kilometres' by 0.22 (tonnes of carbon dioxide), to give the total tonnes of carbon dioxide saved.
- multiplying the total tonnes of carbon dioxide saved by the SPC value selected from Table 12; in 2009 this is £26.50, to give the value of the carbon savings in one year.
- To estimate the value of benefits over a number of years it is necessary to inflate the SPC value each year by 2%.

(b) Drainage and water conveyance, flood protection and alleviation.

Inland waterways managed for navigation purposes provide drainage and water conveyance functions which may indirectly provide flood protection and alleviation benefits to communities and businesses along the banks and in the flood plain. The protection element is provided by the hard structures and reinforced banks, while the alleviation benefits are provided by the drainage and conveyance of water away from valuable assets.

British Waterways estimate that the canals under their management drain 30% of the catchment area of England and Wales. The value of this drainage benefit in terms of any potential flood protection or alleviation it might provide will depend on the assets (houses, commercial properties, agricultural land) afforded protection.

Work was completed in the late 1970s to estimate the value of the **drainage benefits** of British Waterways' network (Fraenkel *et al.* 1975). This used a replacement cost approach, whereby the costs of installing infrastructure to provide the same drainage functions were taken as a proxy for the benefits of this function. These estimates are considered out of date and are therefore not presented in the Framework.

While there is no clear picture on the range of benefits provided by the drainage and conveyance functions of navigable waterways, it is thought likely that there could be significant and should be further investigated. See Section 8.1.3 for a recommendation for further research in this area.

With respect to potential **flood alleviation and protection** benefits, in order to estimate the benefits currently provided it is necessary to understand the types and number of properties and land protected by the waterways. This information is also required to assess the marginal benefits of a scheme.

⁴⁰ $44/12=3.667$, where the molecular weight of CO₂ is 44g/mole and for carbon is 12g/mole.

These benefits should be valued using the Multi Coloured Manual (2003), the standard approach to flood risk management appraisal across England and Wales. The methodology is too detailed to re-produce here, and it is recommended that the Manual itself is consulted to estimate the value of these benefits.

In addition to protecting property and land, *new* schemes may also provide environmental benefits where they create new wetland habitats. For example on canals this could involve renewing canal bank protection by replacing steel trench sheets with softer edge protection which provides habitat for water voles or re-alignment of canals such that the original abandoned section is used to create new wetland.

The value of the benefits provided by such a scheme can be valued using the Eftc (2007). Flood and Coastal Erosion Risk Management: Economic Valuation of Environmental Effects Handbook. This handbook presents a detailed methodology and provides transfer values to estimate the environmental benefits which may be realised by a scheme. The values provided take account of the range of ecosystem service that might be provided by habitats, including angling and bird watching and regulating services, such as carbon sequestration. Where this approach is applied, it would result in double counting of benefits as outlined in the framework.

Wetland habitats, as well as hard structures, can provide flood protection benefits. However these benefits might be most commonly realised by non-canalised waterways, where the bankside habitats can provide some form of protection to the adjacent properties and land. That said, a value for this benefit is provided here for completeness. These benefits are not currently commonly realised by navigable waterways, however they may be provided as part of new restoration or regeneration schemes and therefore are considered worthy of note.

Woodward and Wui (2001) provide average consumer surplus values per hectare of habitat for the provision of flood protection benefits provided by wetlands. This paper presented the results of a meta-analysis of 39 WTP studies for wetland services. The original studies estimated WTP values using a range of techniques including contingent valuation method (CVM), travel cost method (TCM) and hedonic pricing (HP); and methods using market price proxies (net factor income, energy analysis, opportunity cost, cost savings and avoided damage costs, substitute costs) MV and net profits.

While there are more recent wetland studies, other sources do not provide disaggregated values for the flood protection benefits provided by wetland habitats alone, thus the values in Woodward and Wui are applied here.

Unit values

Table 18 below presents the value of wetland flood defence benefits per hectare, based on Woodward and Wui (2001). This does not include a value for the channel itself, but rather the habitat linked to it. The values presented in this study have been converted from 1990 US dollars to 1990 pounds sterling and from acres to hectares for ease of use.

Eftc (2007) presents an average value of £700 / ha (from Woodward and Wui, 2001) for the provision of a combination of services from wetlands. As this value is lower in current prices than the mean value presented in Table 18 (which is equivalent to £912 in 2008 prices), this suggests that in addition to the flood protection benefits provided by the wetland habitat, the value in Table 18 also

includes some elements of other functions of wetlands, possibly wider water regulation or erosion control benefits.

Table 18 CS for flood protection benefits per hectare per year (1990 prices)

Value	Mean	Range
Flood protection	£577	£131 -2,564

Source: Woodward and Wui (2001)

Appropriate application of unit values

These values can be applied to value flood protection benefits currently provided by wetlands and the additional benefits that could be provided by new wetland habitat provided as part of a scheme or project. As noted above, these benefits might not currently be provided by inland waterways to any great extent, but may form part of new schemes.

The values assume a uniform provision of benefits, and do not reflect habitats of certain quality or in certain locations⁴¹. This is a weakness in these values as clearly the extent to which flood protection can be provided will depend on the make up of the habitat and more importantly its extent and location. The range should therefore be applied to reflect cases where the values are likely to be significantly larger or smaller than the average.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

These values should be aggregated over the number of hectares of habitat providing the benefit.

As they represent different components of the value of the flood protection benefits, these values can be added to any benefits in terms of avoided cost calculated using the Multi Coloured Manual.

(c) Water regulation and pollution dilution

In addition to the provision of water for drinking, water interacts with habitats and species in number of other roles within ecosystems. Inland waterways facilitate the transport of water and have a role to play in the water cycle. It is difficult however to separate out the role that inland waterways play in this process from that of other elements of the natural environment. As noted above, water conveyance can also provide flood protection related benefits.

This regulation and transport of water can also provide water **purification and waste treatment services**, which results in the provision of clean or clearer water. This in turn provides a series of important benefits, including health related benefits, visual and aesthetic benefits and non-use benefits.

The ability of habitat types to provide these services however will vary depending on its exact make up and the species present within it⁴², and also on the processes and

⁴¹ It is noted that the Eftc guidance provides values for wetlands that provide a range of services, including angling and other recreation.

⁴² For instance, filter feeding organisms can act to filter organic matter and pollutants from the water column.

activities in surrounding areas which have resulted in 'pollution'⁴³ ending up in the waterway in the first instance.

The extent of the benefits provided will be dependant on the current water quality (e.g. how clean it is, what is the capacity for it to assimilate further pollution), the location and the presence of human populations using the water or habitats, and the species (e.g. fish) dependant on it.

The link between the waterway and how it provides pollution dilution benefits needs to be understood and quantified, before it can be valued. Given the dependant variables noted above, this is not a straightforward task.

While Pretty *et al.* (2002) provide values of the cost of eutrophication in freshwaters in England and Wales, these values *cannot* be used to assess the benefits provided by waterways in treating pollution which ends up in them as the impact of that pollution will not be uniform. This applies to both marginal changes in a waterways ability to provide these benefits and to the estimation of the current total benefits provided.

The values presented in Pretty *et al.* could however be applied to a scheme resulting in a reduction in the eutrophication. These marginal changes may arise as a result of a restoration project where run-off is reduced or treated prior to release in to the waterways.

Unit values

Table 19 provides estimates of the loss in value from the eutrophication of waterways. In cases where there is a reduction in eutrophication as a result of a scheme, the loss-values can be applied to estimate the value of the benefits provided.

Along with a range of other impacts, Pretty *et al.* note that eutrophication can result in a 10% loss in property prices and a decline in visitor expenditure due to closure of waterways.

Table 19 Value lost as a result of eutrophication on waterways

Benefit	Loss value	Comment
Property prices	10%	For properties adjacent to eutrophic waters. It does not represent the income derived from higher property prices associated with adjacency to waterways as outlined in Section 6.1.1
Recreation	£16.90	Expenditure per visitor day to estimate the recreational value loss due to water body closure (2002 prices)

Appropriate application of unit values

These values should only be applied in cases where there is a significant and visible eutrophication problem.

They can be applied where the value-lost from eutrophication, or the reduction in value-lost (e.g. the benefits resulting from a reduction in eutrophication) can be shown to result from a scheme or project.

These values **can be applied to both navigable and non navigable waterways.**

⁴³ This might refer to pesticides, colouration or other potentially detrimental substances.

Adjustments

The recreation expenditure value should be adjusted to reflect current prices as per the guidance set out in Section 5.3.2. See 'aggregation' below for guidance on how to apply these values.

Aggregation

Property prices:

The loss in property values as a result of eutrophication is equal to

$$= \text{No of properties} * \text{frequency of loss of value due to eutrophication} * \text{average loss}$$

Recreation:

The loss in recreational expenditure is equal to:

$$= \text{Total number of day visits to the waterbody each year} * \text{frequency of closure (\% of days)} * \text{total expenditure per day visit}$$

(d) Water quality improvements

Georgiou *et al.* (2000) assessed WTP for a range of water quality improvements in the River Tame. The River Tame is the main river of the West Midlands, and the most important tributary of the River Trent. Much of the course of the river has been modified over the centuries and the urban sections now run mainly through culverts or canalised channels. The catchment of the Tame covers an area of nearly 1500 km² and contains a population of about 1.7 million people. Approximately 42% of the Tame basin is urbanised, making it the most heavily-urbanised river basin in the United Kingdom. At the time of the assessment, the river quality was very poor. Fish stocks were virtually non-existent, plant growth, insects, birds and animal life were limited and the river was unsuitable for boating or swimming.

The main objective of the study was to contrast applications of the contingent valuation and contingent ranking (CR) methods. The study produced WTP estimates for 3 different levels of improvement.

- The large improvement involved; trout and salmon returning and good game fishing possibilities; an increase in plant and wildlife and the possibility for otters to survive; and the river being suitable for boating and swimming.
- The medium improvement involved; some game fish species returning and the river good enough for fishing; an increase in the number of types of insects and greater numbers of birds and wildlife; and the river being suitable for boating but not swimming.
- The small improvement involved; a few fish species returning; more plants growing, and waterfowl using the river; and the river being suitable for boating but not swimming.

The improvements in water quality are expected to provide a range of final benefits. It is not immediately clear what the respondent values most for each scenario - fishing, biodiversity or boating and swimming? However the authors conclude that protecting the environment is the main reason given for stating a positive WTP. It is therefore assumed here that the WTP value can be broadly attribute to the protection of the water environment and associated range of regulating services.

This study was reviewed as part of the Jacobs (2007) report for Natural England and was found to meet most of the basic and preferred requirements under best practice

guidance for stated preference studies. The quality is therefore considered to be high.

Unit values

Table 20 shows the WTP values estimated using the contingent valuation (CV) and contingent ranking (CR) approach. The authors note that the CR method generates higher mean WTP values for water quality improvements, and it is recommended that they are used to provide a range for sensitivity testing.

Table 20 Mean WTP per household per year for water quality improvements (2000 prices)

Improvement	WTP (CV)	WTP (CR)
Large	£18.12	£31.50
Medium	£12.07	£21.34
Small	£7.60	£8.64

Source: Georgiou et al, 2000.

Appropriate application of unit values

It is important to note that these values are for improvements in water quality from a very poor status.

The improvements in Table 20 might be matched to the following Water Framework Directive water body status:

- Large = from very poor to good / high status
- Medium = from very poor to moderate / good status
- Small = from very poor to poor / moderate status

The values in Table 20 should only be used where changes in the water quality being assessed are broadly equivalent to those valued.

These values are not suitable for estimating the value of the existing water quality to beneficiaries. They do however **apply to both navigable and non-navigable waterways**, as boating might reflect canoeing / kayaking that can be carried out on non-navigable water bodies.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

An analysis of distance decay effects as part of this study revealed that, on average, only the population living within a 36 mile radius of the river were of relevance when aggregating benefit estimates for large improvements, and 17 miles for small improvements.

This could vary by site however and is likely to depend on the nature of the river being assessed. Where the rivers are similar in nature then it is recommended that the above distances are applied in aggregating the values. For a medium improvement the middle value of 27 miles should be applied. See Section 6.1.3 (k) for guidance on how to calculate the number of households within each distance band.

6.1.3 Cultural Benefits

Table 21 presents an overview of inland waterways cultural benefits and the availability of transfer values. The list of benefits in Table 21 is not a precise match

of the benefits presented in Section 3 (see Table 2). While every attempt has been made to rationalise these lists, the benefits presented have been adapted to facilitate better use of available valuation literature from which the transfer values are sourced.

Table 21 Summary of cultural benefits

Benefit	Values provided	Comments
Canal recreation	Yes	Both CS and expenditure values provided for waterways recreation activities. These cover both water and land based recreation.
General recreation	Yes	
Informal recreational use	Yes	Marginal WTP values provided for informal land based recreation.
Angling	Yes	-
Bird watching	Yes	The values provided apply to the watching of high profile bird species. This will be rare for inland waterways.
Heritage values	Partially	Values for heritage visits only are provided. These values are taken from a very small sample and so confidence in them is low.
Visual Amenity	Yes	These values relate to the presence of utility service structures along waterways, such as pipelines or pylons.
Education	No	A description of these benefits from the literature is provided to assist the user.
Volunteering	No	
Community Benefits	No	
Non use values	Yes	A range of non-use valuations are presented. They should not be summed. The most appropriate value should be selected for use.

(a) Canal recreation

Willis and Garrod conducted two studies at the start of the 1990's to assess the value of a range of canal related recreational activities in the UK. The values for some of these activities are detailed below.

Willis and Garrod (1990) estimate visitor WTP for the recreational benefits of the Montgomery and Lancaster canals using a travel cost approach, which takes the money people spend on travelling to a recreation site as a proxy for their WTP. For both canals CS values are reported for the following users – walker and dog walkers, shortcut takers, fishermen, boaters and visitors to attractions. Casual users of the canals, such as dog walkers, are found to have a lower CS than users for whom the canal forms an essential part of their activity, such as fishermen or boaters.

The Travel Cost Method (TCM) takes account of the travel expenses (e.g. petrol) as well as the cost of the time spent travelling to and from the site. The authors note that the exclusion of the value of people's time in travelling to the location from the 1990 study means the CS values are likely to be underestimated.

While this study is old, the quality is considered to be moderate to high. The authors used a truncated regression model to take account of people who choose not to visit the canal or visit less than once per year in order to avoid the problem of biasing results toward positive responses which are inherent in the TCM.

Willis and Garrod (1991) again used the travel-cost method to determine visitor's WTP for the recreational benefits of various inland waterway sites throughout England. These comprised:

- Anderton – a semi rural location
- Gloucester and Sharpness Canals - runs through a number of locations thought to be primarily rural in nature.
- Newark – a market town situated along the River Trent
- Weaver Navigation – a semi rural location
- West Midlands canals – various narrow canals covering a range of locations, thought to be primarily urban.

The study considers the number of trips completed by each individual visitor for a particular activity during any one time period. Unlike Willis and Garrod (1990), this study incorporates the opportunity cost of time valued at 43% of earnings⁴⁴ with appropriate reductions for children and non-working individuals. The approach applied is useful for determining how user sub-groups value specific waterway activities.

The overall quality of the study is considered to be moderate to high and while this study is now very old, it is still heavily quoted in the literature. The fact that the availability of substitute sites was not discussed with respondents may have resulted in the values being over-estimated. However the modelling approach selected produced values that were considered to be lower-bound estimates.

Unit values

Values in Willis and Garrod 1990 and 1991 are presented by location and by recreation type. The studies provide values in different years so these have been adjusted here to 1989 prices for ease of reference and comparison. Ranges are provided here to account for site variations. Where possible the context for the ranges is provided below to guide the user towards the upper or lower bound estimates (see Table 22).

Table 22 Consumer surplus per visitor per trip (1989 prices)

Benefit	CS	Methodology
General visitors - Locals (<10 miles)	£0.02 -0.09	TCM
General visitors - Non –Locals (>10 miles)	£0.22 - £10.94	TCM
Walking	£0.08- 0.40 -0.63	TCM
Dog walking	£0.03 – 0.33	TCM
Short cut takers	£0.07 -0.360	CVM
Cycling	£0.31	CVM
Boating	£0.165 -0.45	TCM

Source: range is sources from Willis and Garrod 1990 and 1991

General local visitors (<10miles) – these values vary by location. People in urban areas seem to have a higher CS value relative to other types of locations. However there does not seem to be any relationship between CS and the extent to which the location is urbanised. It is therefore recommended to use the range in the analysis.

Non local visitors (>10miles) – these values show wide variability by sites, with the value for Gloucester and Sharpness Canals (£10.94) being significantly greater than that for Anderton (£3.66), Newark (£0.85) and the West Midlands (0.82). The Weaver navigation had the lowest value at just £0.22 per visitor per visit. The

⁴⁴ As recommended by the Department of Transport, 1987.

variability in these estimates is likely to be related to their profile amongst visitors and possibly their quality. Unless the policy site is similar to one of the above sites, it is recommended that the values presented are used as a range for sensitivity purposes.

Walking – three values are provided in Table 22. The lower value relates to semi-rural areas (£0.08); the mid value to mainly rural areas (£0.40) and the high value to mainly urban area (£0.68). These estimates are around twenty years old and relate to only a small number of sites, and so may not still hold. It is therefore recommended to use the range in the analysis.

Dog walking – the upper bound estimate (£0.33) is taken from the sample at the Gloucester and Sharpness Canals. The canal goes through a number of locations however these are thought to have been primarily rural in nature at the time of the study. The lower bound estimate (£0.03) is the average CS from the WTP estimates for dog walking at the other sites in Garrod and Willis (1991). These ranged from £0.04-0.014, and are thought to relate to semi rural and small towns, which are possibly more accessible to dog walkers. It is recommended that the range is used in the estimation of CS.

Short cut takers – these values are taken from Willis and Garrod (1991), estimated using a CVM survey rather than a TCM approach. The TCM results for ‘short cut takers’ from Willis and Garrod (1990) are based on very small sample sizes and are therefore not considered appropriate for use here.

Cyclists – these values have been estimated using a CV survey. This survey is not fully reported in the original study and the sample size is unknown. The authors note that the CVM was used as a means of testing the results from the two approaches, with the study focussed on the TCM approach. A value for cycling was estimated at only one canal site – the West Midlands, so it is not possible to derive a range. This value should only be used to give a ‘ball park’ estimate of the potential cycling value.

Boating – these values were estimated at just three of the five survey sites, Anderton, Newark and Gloucester and Sharpness Canals (Willis and Garrod, 1991). It must be assumed that the surveyors did not encounter visitors participating in boating in the other locations where sampling was undertaken. It is recommended that the range is used here.

Appropriate application of unit values

The values are suitable for estimating both total current values and the value of a marginal change in the quality of the recreational experience resulting in an increase in the number of visitors.

As they were elicited specifically for canals, the suitability of these values for use on other type of navigable or non-navigable waterways may be questioned. Arguably canals generate higher values than other waterways and therefore use of these values in other types of navigable or non-navigable waterways *may* over estimate the visitor CS. Another way of looking at this is that the values are likely to be largely dependant on the characteristics of the site (visual amenity, environmental quality, facilities, etc.) rather than the type of water body. However, it could be argued that different types of waterways will also differ in terms of characteristics. The point here is that in transferring these values, consideration should be given to comparability between the nature (type and characteristics) of the study site and of the transfer site.

Care is required not to double count these recreation benefits. The values are not suitable for estimating, for instance, both boating and cycling CS values. This is because, as noted by the author some respondents were carrying out multiple activities at the site when questioned. Their travel costs will therefore be captured under all activities they noted. It is not clear which activities this is of greatest concern with. Where an overall value is sought, the general **local or non-local estimates** should be used. These capture the benefits from a range of activities.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

British Waterways (2008) suggest that visitors to the waterways enjoy themselves more when boating activity is taking place. The original source⁴⁵ of this information, quoted in British Waterways 2008, estimated a 40% increase in visitor enjoyment, however British Waterways (2008) suggest that a 25% increment may be more realistic. For sensitivity testing purposes where it is expected that the presence of boating activity is likely to significantly impact on the visitor's enjoyment, CS values could be inflated by 25% to reflect this. This is best applied only to informal recreation estimates, for instance local visitors or walkers; not to specialist visitors such as anglers.

Aggregation

The unit values need to be multiplied by the number of visitors undertaking each activity at the site being assessed to derive the total benefit.

In order to estimate the number of visitors, users of this guidance could consult the UK Tourism Survey, as this may provide indicative estimates; however, it is not possible to disaggregate waterway visits specifically using this source.

British Waterways carry out a survey of Inland Waterway visits (Inland Waterways Day Visitors Survey (IWDVS)). These data are collated by telephone every two weeks and can be related to a specific waterway. Where visitor monitoring programmes have been undertaken (using pedestrian, bicycle, or vehicle counters for example), these data may form a useful comparison for an equivalent site. In addition, local recreation clubs / groups may also be able to provide estimates of user numbers

Should no real data be available, the Benefit Assessment Guidance (Environment Agency, 2003a, see Part Two – Rivers and Groundwaters) presents default data in some cases and methods to estimate the number of visitors and their split between different type of activities.

(b) Recreation expenditure values

Expenditure values for different recreation activities have been taken from a number of literature sources.

The first is a cost-benefit analysis (CBA) completed by GHK (2005) for British Waterways on the Bedford Milton Keynes Waterway. This was a project to create a 25km navigable waterway between the Grand Union Canal at Milton Keynes and the River Great Ouse at Bedford, connecting the national canal network (British

⁴⁵ Referenced only as K and A Caen Hill study.

Waterways managed) with the Fenland Waterways (Environment Agency managed). The authors note large uncertainties in relation to the estimation and valuation of health, water supply, land drainage and recreation benefits. For this reason a second study is presented and a lower bound estimate for boating expenditure relating to hire boats is used here. This is taken from Jacobs Gibb (2001) report on the Chesterfield Canal restoration.

The Jacobs Gibb report assessed four options for restoring different sections of the Chesterfield Canal and the creation of a navigation link along the River Rother to Rotherham. Extensive consultation was undertaken as part of this work which included a questionnaire sent to 120 organisations, an open-day to which 24 key organisations were invited, site visits and review of relevant local authority plans.

Ecotec completed a number of reports between 1997 and 2001 on the role of six canal enhancement schemes in stimulating or supporting local area regeneration. These reports determined the type and scale of developments that had taken place, assessed the economic impact in terms of standard economic outputs and 'other impacts' such as increased property values, and established critical factors related to the success of the scheme.

Ecotec (2006) also provide estimates of expenditure on the Kennet and Avon Canal. The objectives of the work were to assess the economic benefits of the canal restoration:

- arising from increased tourism and leisure activity within the local economy;
- on the supply-side of the tourism and leisure economy, in particular updating the database of tourism and leisure businesses within the canal corridor, and assessing the importance of the canal restoration on the health and performance of these businesses; and on property developments, considering the role of the restoration in bringing forward sites for development and enhancing the image of specific areas as suitable locations for inward investment.

In addition to the above sources expenditure data is collated within the Inland Waterways Day Visitor Survey (IWDVS) carried out by British Waterways. These are presented alongside the expenditure data provided in the above literature sources for completeness. They could be used to inform the range of these values where necessary.

It is important to note that only a proportion of this expenditure is directly related to the presence of the waterway and this will vary by site. For improvement schemes all or some of the additional visitor spend may be as a result of the improvements provided.

Unit values

Available expenditure values for the literature review are shown in Table 23 below.

All values have been converted to 2004 prices for ease of presentation here. As noted, GHK (2004) highlights significant uncertainties around the recreation estimates. To err on the conservative side, it is recommended that the lower bound estimate is applied where provided, with the higher bound estimate used only for sensitivity purposes. Ranges were however not always available.

In relation to boating expenditure, where the split for both hire and private boats is not known, the lower estimate of £11 should be applied to be conservative.

Table 23 Expenditure values per activity per person per trip (2004 prices)

Activity	Expenditure	Source
Boating - Hire	£14.49 -38	Jacobs Gibb / GHK
Boating - Privately owned	£11	GHK
Walking	£5	GHK
Cycling	£5-7	GHK / Ecotec('06)
Canoeing / kayaking	£3.14 -5	Ecotec('06) / GHK
Day visitors	£3.84-4.50	Ecotec / Graves
Overnight visitors	£55	Ecotec ('06) from UK Tourism Survey

Expenditure data from the IWDVS is presented in Table 24. This is a three year average of the values from 2007, 2007 and 2008 surveys. The values were uplifted to 2008 prices to estimate the average. These values can be used instead of those presented in Table 24 above or alongside to provide a range.

Table 24 Expenditure values per activity per person per trip from the IWDVS (2008 prices)

Visit category	Mean value 2006-2008
Powered boats ("boats with engine")	£9.50
Unpowered boats ("boats without engine")	£3.46
Fishing	£4.05
Cycling	£4.40
Dog walking	£6.05
Leisure / heritage / museum visits	£9.79
Walking / rambling	£3.37
Pub visits	£8.25
Running / jogging	£2.91
Visits - to get somewhere	£10.52
sat or stood	£3.15
Other	£4.07
All visits	£5.57

Appropriate application of unit values

These expenditure values can be combined with the CS values presented in Section 6.1.3 (a) to estimate the total WTP for each activity. The estimates can be used to value both marginal changes in recreational benefits or the total value of current benefits.

The values provided here are for use in a CBA where WTP estimates are sought. If they are used in an EcIA, they should be adjusted for **displacement effects** (i.e. where spending is not additional but displacing spending elsewhere), **leakage effects** (the fact that not all of the expenditure is retained in the local area) and possible **multiplier effects** (where visitor spending results in knock on spending)⁴⁶.

Adjustments

These values should be adjusted to current prices using the approach outlined in Section 5.3.2.

As noted above they could be combined with the CS values presented for similar activities in Section 6.1.3 (a) to estimate total WTP.

⁴⁶ Please see AINA (2003) Demonstrating the value of waterways: A good practice guide to the appraisal of restoration and regeneration projects, for guidance on these adjustments. Also see the '3Rs' guidance' at: <http://www.communities.gov.uk/publications/corporate/assessingimpacts>.

Aggregation

User or visitor numbers are required to aggregate these values.

Water sports participation rates for 21 activities can be found in British Marine Federation (BMF) (2007) Watersports and Leisure Participation Survey 2007. Local clubs and interest groups may also be able to provide this information.

British Waterway or other waterway management organisation may be able to provide estimates of visitors or those undertaking **other activities**, and as noted above the British Waterways day visitor survey may be of use. Alternatively local interest groups should be contacted. Data from equivalent sites elsewhere may also provide a useful information source where this is available.

British Waterways (2008) use a value of 160 visitors per km of towpath per day to aggregate benefits. So if 1 km of tow path was reconstructed, this would equate to 58,000 visits (160 visits / day * 365 days). There is no indication however of what types of visitors these are. Where more specific information is not available, these estimates could be used to aggregate informal day visit values.

However there is likely to be a significant variation in use levels depending on the nature and location of the site – for example, 1km of towpath in a central urban area may generate 2-3 million visits annually, whereas lightly used rural towpaths will likely see many less than the 58,000 average figure quoted. It is necessary therefore to appropriately identify aggregation data as errors could result in significant over or underestimates of benefits.

(c) Informal visitors WTP for improvements to the access and environment along side the waterway

In 2008 British Waterways completed an evaluation of the total benefits delivered by the waterways they manage. This assessment presented values for a range of benefits, one of which was informal visitor values for improvements to access and the local environment alongside the waterway. Using estimates from Coker *et al.* (1989)⁴⁷ and quoted by Oxera (2003), British Waterways provide a WTP value for improvements which included a paved pathway along the bank, seats, more extensive planting in the water with the banks extensively landscaped with trees and shrubs.

The primary study was based around the Brecon Canal Basin, where the construction of a new canal basin and a theatre have provided a visitor attraction and are contributing to the physical regeneration of what was formerly an unattractive locality.

This study however was not available for review, so the values presented below are taken from British Waterways (2008). It is therefore assumed that these values have been appropriately interpreted by Oxera (2003) from the original study.

Unit values

Table 25 below presents the WTP value per person per visit for improvements to the canal relating to access and general environmental quality. While this is a user value, it may also contain non-use elements.

⁴⁷ Coker, Tunstall and Penning-Roswell (1989). "Evaluation of the Recreational and Amenity Benefits of Flood Alleviation Scheme for Maidenhead" as quoted by Oxera (2003).

Table 25 WTP for access and environmental improvements per person per trip (2003 prices)

Activity	WTP
Informal visits	£1.98

Source: British Waterways, 2008

Appropriate application of unit values

This value should only be used where the improvements being assessed are similar in nature. The value is suitable for valuing marginal change in benefits as a result of the improvements, but not for valuing current benefits.

This value may well contain an element of non-use value, so it inappropriate for use in combination with non-use value estimates for the same group of beneficiaries for such improvements.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

Visitor numbers are required to derive the total benefit of access and environmental improvements. These are site specific. British Waterway or other waterway management organisation may be able to provide estimates. Alternatively local interest groups should be contacted.

(d) Anglers WTP

The values for angling related benefits are derived from Spurgeon *et al.* (2001).

Spurgeon *et al.* (2001) carried out a CV survey to estimate the WTP of anglers to **maintain the current state of the fishing** at their regular site, in terms of number, diversity and size. A telephone survey was conducted with 806 anglers from six regions in England and Wales.

The survey asked anglers what they currently pay to fish at their regular site (their expenditure) and what they would be willing to pay on top of that to maintain the current status of this site (their CS).

The study is considered to be of moderate to high quality. When reviewed against best practice guidelines for CVM studies it is found to meet all of the basic and most of preferred requirements. A pilot survey was undertaken which suggested the information provided was clear and unambiguous and that visual aids were being used effectively.

In terms of benefit consistency the match is considered to be high. The study area matches the area for this project – i.e. England and Wales.

The values can be split into expenditure and CS values. The authors consider the CS to be *conservative*, given the potential for strategic behaviour as “anglers are likely to be wary of expressing their full willingness to pay because they feel that the [costs of] licences are likely to go up”.

Unit values

The unit values estimated are presented by type of waterway in Table 26, showing expenditure, CS and the total WTP values.

If the user prefers to apply an average **CS value only across all types of waterways** per angling trip, Spurgeon *et al.* estimate this to be £2.10 for coarse fishing and £2.70 for game fishing (in 2001 prices).

Table 26 Anglers total WTP by type of angling and type of waterway (£ / trip) (2001 prices)

	Coarse Angling			Game Angling		
	Expenditure	CS	Total WTP	Expenditure	CS	Total WTP
River	18.00	3.10	21.10	26.00	4.30	30.30
Canal	13.00	2.70	15.70	-	-	-
Lake	17.00	2.40	19.40	27.00	3.10	30.10

Source: Spurgeon *et al.* (2001)

Appropriate application of unit values

The user needs to consider which of the above values are most suitable for valuing the angling resource (or loss of resource) under assessment.

If there is no information regarding what type of angling is more prevalent or how many anglers fall into each category, it is recommended that the values for coarse fishing are applied, as these represent a conservative lower bound estimate. Where the water body type is not known, it is recommended that the values are used as range for sensitivity purposes.

The values are not specific to waterways, and can be used to value both total current benefits and marginal benefits (or costs) arising from a new activity or scheme.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

The WTP values should be multiplied by the relevant number of angling trips. Site specific information may be available from local fishing clubs or from British Waterways day visitor survey.

If the user does not have information on the number of anglers, a range of methodologies for estimating angler numbers and angling trips are presented in the Benefit Assessment Guidance (Environment Agency, 2003a, see Part Two – Rivers and Groundwaters).

(e) Bird watching

A number of studies estimate bird watching benefits in the UK, however only one study is considered appropriate for use in the framework.

Dickie *et al.* (2006) reviewed the economic impacts on tourism, expenditure, jobs, etc. of bird watching, associated with 10 spectacular bird species.

Wildlife attracts visitors, and they spend money. Spending by visitors can benefit a wide range of enterprises in a local area, through direct, indirect and induced impacts helping to provide income and employment for local people. This expenditure can be taken to reflect visitors' WTP for the benefits of bird watching, however it excludes any element of CS that visitors may hold.

This value is only applicable to high profile species and should not be used to estimate expenditure related to watching more commonly spotted birds.

Unit values

Dickie *et al.* estimate the expenditure value for bird watchers to be £7.17 (2006 prices) (Table 27). This is not a total WTP as it does not contain any CS value, and should therefore be considered a lower bound estimate of bird watching value for spectacular species.

Table 27 Expenditure values for osprey watching per person per day (2006 prices)

Value	Expenditure
Osprey watching -UK	£7.17

Appropriate application of unit values

This value is *not* applicable to the vast majority of inland waterways as it relates to **high profile bird species**, such as the osprey, the eagle, red kite and the peregrine. The unit value can be used to estimate both the value of a marginal change and the current benefits received. The value is applicable to all ecosystems where spectacular bird species are found - it is not restricted to inland waterways.

Expenditure values are taken here to reflect welfare gains to beneficiaries for use in welfare assessments. Where these values are used in an EcIA care is required to appropriately adjust them for leakage, displacement and deadweight and possible local and regional multiplier factors.

Adjustments

This value should be adjusted to current prices using the methodology outlined in Section 5.3.2.

Aggregation

The unit value per person is multiplied by the number of bird watchers to estimate the total value of bird watching at a site. If estimating current benefits this would be the current number of bird watchers. If estimating the marginal benefits resulting from some intervention, such as a restoration project, then an estimate of the potential number of additional bird watchers expected is required.

The RSPB or local interest groups may be able to provide estimates of bird watchers for specific sites.

(f) Visual Amenity

Inland waterway can be very picturesque providing landscape benefits, while visual blights along the waterways can reduce the recreational amenity for visitors. In 1998, Garrod and Willis published the results of a Contingent Ranking (CR) study (a form of stated preference study) to estimate the loss of amenity value on inland waterways due to the presence of public utility service structures along them.

The five English canals sites assessed were chosen to represent different canal types and user populations. The 1,000 respondent were asked to rank a set of four alternatives, each specifying a particular mix of reductions in the level of pipe bridges, pylons and other overhead cables and stating an annual increase in utility bills that households would have to pay for the improvements. A high number of respondents, 932, gave usable responses to the CR exercise.

Unit values

Table 28 below presents the WTP value per household per year for a 1% reduction in the number of types of service structures in England's inland waterways. The study notes that respondents appear to have had difficulty in distinguishing the benefits of reduced pylons from other cable crossings as their WTP were almost identical.

Table 28 WTP per household per year for a 1% reduction in the number of services structure (1995 prices)

Service structure	WTP / hh / yr
Pipe bridges	£0.04
Pylons	£0.09
Other cable crossings	£0.10

Appropriate use of unit values

The authors note that the model used to estimate the values presented in Table 28 is not useful for estimating the current impacts of these structures on the visual amenity provided by inland waterways and that therefore, using the aggregate value of WTP to remove all services as a proxy for visual amenity may not be methodologically robust.

These values are **specific to inland waterways**.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

These values should be multiplied by the percentage reduction or increase in structures to be provided along the waterways, so where a 5% change is expected the adjusted value from Table 28 is multiplied by 5.

This is then aggregated by the annual number of adult visitors to the waterways whose amenity values may be affected by the presence of the service structures divided by the number of adults per household. The study used a mean of 2.23 adults per household.

Visitor data may be available from British Waterways or other local groups, or by using the methods outlined in the Benefits Assessment Guidance (BAG) (2003).

(g) Visiting heritage sites – canals

Adamowicz *et al.* (1995) presents WTP values for a number of benefits including visiting heritage sites.

This CV study⁴⁸ estimates an average (or mean) WTP for the additional maintenance of canals to ensure boating, heritage aspects and tow paths.

The survey was undertaken throughout the UK and respondents were asked how far they lived from their nearest canal site and the water-based recreation site which they visited most frequently. As the study used respondents from around the UK, the values can be taken to have general application, rather than being specific sites

⁴⁸ This study also completed a choice experiment and a travel cost method survey. However only the CV results are reported here as these are conservative and were the values used by the authors for aggregation.

Respondents were presented with a scenario to fund additional maintenance of the canals for boating along with their heritage aspects and tow paths. The alternative scenario offered a lower level of maintenance at no cost, but did not ensure the canals were maintained.

The overall study has a sample size of 331 valid responses. This sample was further broken down depending on how the respondent viewed the canals. The sample size of respondents valuing the canals as heritage resources was only 40.

The overall quality of this study is considered to be moderate to high as it was found to meet both the basic and the preferred criteria under the best practice guidance for CV surveys. However, the small sample size of this sub-group calls into question the robustness of the heritage values. Given that they are the only ones available, they are presented here for completeness.

Effectively respondents to this survey provided a use value for the heritage benefits of the canals they live nearest to and / or waterways they visit. This use value may contain some elements of the users non-use value also. The average (or mean) and median values are shown in Table 29 below.

Unit values

The median value shows that half of the respondents were willing to pay less than £1.50 per household per year. For the average value to be £7.47 per household per year (see Table 29), some respondents must be willing to pay an amount much higher than the median. With highly skewed distributions such as this, a conservative approach is to use the median WTP value, and this is recommended for the framework. Mean values can be applied for sensitivity testing purposes.

Table 29 WTP of those who 'view canals as heritage resource' per household per year (1995 prices)

Value	WTP
Mean	£7.47
Median	£1.50

Appropriate application of unit values

Due to concerns over the robustness of these estimates given the small sample, these values should *only* be used to provide a high level ball-park estimate of the heritage benefits of inland waterways.

The values are **specific to canals**. They can be used to assess current heritage benefits, but *not* the value of a marginal change in the heritage values of the canals.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

In order to estimate total heritage benefits an estimate of the number of visitors who perceive the canals as a heritage resource is required. No standard assumptions are available for application here so the user will need to make an estimate of these beneficiaries in order to complete the aggregation step. This should be based on an understanding of the heritage importance of the site being assessed, and any known data on visitors. The methods presented in the BAG (2003) may assist the user to estimate the number of beneficiaries.

(h) Education

Inland waterways can provide opportunities for education and training in history and nature etc. The literature recognises that inland waterways provide educational (and behavioural) benefits through activities such as angling for disadvantaged or problem young people, however further research is required in order to quantify and value such benefits.

There is also evidence that outdoor education contributes to children's creative development and ability to cope in real-life situations. Outdoor education improves exposure to a range of cultures, talents and interests as well as improving social skills through participation and interaction. This is particularly important for children from low-income or disadvantaged backgrounds. British Waterways (2008) note that 68% of the top 10% of the most deprived communities in England live within 5km of a waterway, increasing the potential to maximise these benefits.

There are a range of publically funded programmes which support community involvement and children's education through involvement in waterways projects, these include: The Living Water, Active Water programme, which supports community involvement in a range of education, environmental, training and other activities; and, Wild Over Water (WOW) targeting children via learning resources and child centred events. WOW aims to support delivery of activities, encourage children, school groups and families to visit waterway destinations and to facilitate relationships between primary schools and the organisations which manage Britain's inland waterways. This is funded by British Waterways, the Environment Agency, Inland Waterways Association and the waterways trust. British Waterways (2008) estimated that 27,740 students through key stage 2 level will benefit from the WOW curriculum.

Education is central to the promotion and realisation of the full range of benefits provided by inland waterways. General evidence on WTP values has shown that the better informed or more knowledgeable the public is, the higher is their willingness to participate, protect and pay for inland waterways. It is also an investment in the future sustainable use of the waterways.

The data to enable quantification of the value of education benefits is not currently available. Nevertheless, the literature presents evidence of the possible significance of these benefits. For instance, outdoor fieldwork is found to positively reinforce the link between affective and cognitive learning. Outdoor adventure activities are also proven to improve student's personal efficiency and social skills. Overall, strong evidence of the benefits of outdoor education has demonstrated both short term and long-term positive effects⁴⁹.

(i) Volunteering

Section 6.1.1 provides an approach to value the financial savings associated with using volunteers to carry out necessary tasks. However in addition to the economic contribution provided by volunteer activities, volunteers gain benefits themselves through having a sense of achievement, physical and mental health benefits and possibly a 'warm glow' affect from helping others out.

In order to quantify the extent of these welfare benefits, it would be necessary to conduct primary research which asks people about the value of the benefits they receive from volunteering. Alternatively, the use of standard wage rates (depending

⁴⁹ For more information on this and further references, see Rickinson *et al.* (2004).

on the level of volunteer work being undertaken) could stand as a proxy for the consumer surplus or well-being aspect of volunteering. This relies on the assumption that if the individual was not volunteering, he / she could be employed and earning a salary of £X.

The waterway association is the other beneficiary, and arguable gains the same benefit – i.e. if the individual was not volunteering, they would have to employ someone and pay them £X. Clearly, including £X as a proxy for both aspects of this benefit would result in an unacceptable risk of double counting and thereby an over estimation of benefits.

Therefore, the framework presents a valuation approach only for the organisational benefits realised from volunteering (see Section 6.1.1) and does not include any private benefits realised by the volunteer themselves or the associated community benefits.

Further, these benefits are not restricted to inland waterways. They can be provided by voluntary activities carried out in any natural environment, for instance woodlands or peatlands.

While, at present, it is not possible to estimate the welfare benefits provided through voluntary action, it is clear that there are benefits and it is recommended that where these have or could be realised they should be described in a qualitative manner.

(j) Community Benefits

Community involvement through volunteering and attendance at events can also help build or reinforce social capital within neighbourhoods by increasing levels of empowerment and strengthening the sense of attachment residents feel to local areas.

Restoration and regeneration along inland waterways can also provide good quality public domains which can play an important role in enhancing civic pride and the image / perception of town and city centres. This increased sense of civic pride is evident in many locations around the country. For instance in Liverpool residence and political figures noted their additional pride resulting from regeneration projects undertaken in the city (Clarke, *pers. comm.*). In Swindon the main driver for the regeneration of the canals was the improved community feeling and civic pride that results rather than any increase in local spending through the provision of more and better shopping facilities for instance (Edmonds, *pers. comm.*).

British Waterways (2008) presents a list of community related benefits provided by inland waterway. These are presented here to ensure that, while no quantitative values are available, users can identify benefits in a quantitative or descriptive way:

- Providing local character and identity - diversifies towns / regions giving them a competitive edge;
- Transforms use of town centre away from current dominance of pub / club culture to a more family-friendly setting;
- Connectivity - linear nature of canals provides pedestrian corridor, a relaxed and safe atmosphere shared by workers and visitors;
- Quality of town gateways is a key indicator of quality of the place itself and improves the first impressions of visitors;

- Productivity, health and satisfaction of workforce are improved through good urban design, which may be related to inland waterways developments. There may be less absenteeism and lower staff turnover; and
- Inland waterways can attract further inward investment which in turn can enhance the public realm in addition to providing improved local economic opportunities.

The New Economics Foundation (NEF) produced a handbook entitled 'Prove it! Measuring the effect of neighbourhood renewal on local people' in 2000 (NEF, 2000). This handbook describes a method for measuring the effect of community projects on local people, on the relationships between them and on their quality of life. While this approach does not provide any monetary values it is worth considering where the community aspects of a project are likely to be significant in terms of justification.

(k) Non-use values

Non-use values reflect an individual's WTP for improvements in or protection of the ecological quality or quantity of a resource they have no intention of using or consuming. Non-use values may relate to individuals wanting to ensure that resources are protected for future generations, or because they simply derive a benefit from knowing that the resource will continue to exist in a good quality.

(i) Non-use values for the continued maintenance of the canal system for boating, heritage and tow paths

The values presented here are based on Adamowicz *et al.* (1995) – see Section 6.1.3 (g) for background to this study.

Non visitors to canal sites were interviewed and found to have a significant WTP value, as reported in Table 30 below. There were 331 valid responses in the sample, 204 were non-visitors whose WTP values represent non-use values. This is considered to be a good enough sample size to derive robust estimates.

Unit values

Non-visitors were found to be WTP on average £5.55 per household per year for the non-use benefits they receive from the continued maintenance of the canals. However, the median value is less than £0.75 per household per year, indicating some respondents were willing to pay a lot more than the average.

With highly skewed distributions such as this the conservative approach is to apply the median value. It is recommended here that the median value is applied and the average value used for sensitivity purposes.

Table 30 WTP of non-visitors per household per year (1995 prices)

Value	WTP
Mean	£5.55
Median	£0.75

Source: Adamowicz *et al.* (1995)

Appropriate application of unit values

These values are best applied to the assessment of a navigable waterways maintenance programme. They could be applied where an assessment of the current benefits provided by the programme are sought, as they show what beneficiaries are WTP for the benefits of this maintenance. They are **inland waterway specific**.

Care is required in applying these values to a maintenance programme at a site that currently does not provide these benefits. It is often the case that WTP values are higher to maintain current benefits, than they are to receive new benefits (see Garrod, G.D and Willis, K.G., 1996). Therefore applying these values to the provision of new benefits is likely to over estimate the value.

Where user only benefits are sought for such improvements, it is recommended that the WTP values for informal visitors for improvements to access and the environment along side the waterways is applied (see Section (c) above).

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

Care to avoid double counting is particularly important when adding use values and non-use values, as use value may contain an element of the users' non-use value. The unit value is multiplied by the appropriate population to estimate the total non-use benefit. Determining the non-use population is not as straightforward as determining the user populations. There are no clear cut rules to predict the existence or absence of non-use values.

It is necessary to consider how important the resource is; if it is nationally important then the relevant population is likely to be the whole nation, or conversely if it is locally important the relevant population might be the local population. It is also necessary to consider whether or not non-use values are likely to decline with distance from the site. If a site is of international / national importance, it is conceivable that distance from the site is irrelevant in terms of any distance decay⁵⁰ effect.

It has often been assumed that where a non-use value exists, it exists for all non-users. However it is more correct to sample the non-user population by geographical location to ascertain where non-users hold values (Bateman *et al.*, 2005). Care is also required to ensure that the users' non use value is not already captured within the use values estimated for other benefits (such as recreation).

Adamowicz *et al.* (1995) asks respondents about the canal they lived nearest to, so it might be assumed that these beneficiaries are spread evenly across the country and that if non-users inside X radius had a non-use value, this would apply across the entire country. However given the canal network is not evenly distributed in England and Wales (see Appendix A) this assumption is unlikely to hold.

If it is not possible to estimate the non user population using real sample data for instance, it is recommended that the default values provided in the Benefits Assessment Guidelines (Environment Agency, 2003a) are used. See Table 31 below for the default values it presents.

⁵⁰ Distance decay relates to how WTP varies as the respondent's distance from the object or site in question increases.

Table 31 Distances over which non-use values are relevant

Distance Decay Assumptions for Determining Non-Use Population		
Conservation Importance	Degree of Environmental Quality Change	Distance (radius) Assumed Relevant for Aggregation
Local only	Small	30 km
	Moderate	40 km
	Large to Very Large	60 km
Regional	Small to Moderate	60 km
	Large to Very Large	120 km
International / National	Small to Very Large	60 km to 150 km

Source: EA (2003) Corrigendum –rivers- non-use (August 2003). Environment Agency.

Applying the BAG approach, it is recommended that the relevant non-use population be calculated as follows from Table 30:

- Select the level of conservation importance of your site (group of sites);
- Identify the degree of environmental change likely; and then
- Select the relevant distance over which the relevant population occurs.

The population and households of the area at different distances from the inland waterway can then be calculated using available census information.

Alternatively the population density (available from the Office for National Statistics) can be multiplied by the distance in kilometres (taken from Table 31 above) and then multiplied by π (3.14) to get the total population within a given areas. This value should then be divided by 2.3 to provide an estimate of the number of households.

The Environment Agency note that their aim has been to err on the conservative side in terms of defining the population that are likely to hold non-use values. They also note that these distances assume that all of the population up to the edge of the distance band holds a positive WTP towards the waterway, and nobody beyond the distance band does. This is a simplification of reality where a high proportion of the population is likely to hold a positive WTP closer to the river; the proportion decreasing as you move further away.

It should be noted that these distances represent the fact that the mean WTP for non-use benefits starts to decrease before this distance, and will continue at some positive rate below the mean beyond this distance; however, multiplying the mean by the population within this distance band provides the appropriate approximation of total WTP across the entire population.

Please see the Benefits Assessment Guidelines (Environment Agency, 2003a) for a detailed description of this method and the source literature behind it.

(ii) Non use values associated with biodiversity improvements

Biodiversity in effect provides two distinct functions. Firstly it acts as a stock and interacts with other stocks in the ecosystems to produce the supporting services (e.g. microclimate regulation, soil formation, water cycling and photosynthesis) which flow from it. For example, the existence of biodiversity ensures that underlying system (such as the water cycle) can continue to operate. Biodiversity therefore provides a level of resilience to the system.

Secondly, biodiversity provides non-use values. For some people these values might relate to cultural or spiritual benefits, for others to concerns over long term survival of the planet. It is these non-use values that are considered to be captured within WTP studies that value biodiversity as presented below. While biodiversity itself is not a final benefit realised from inland waterways, non use values are considered to be final benefits.

Spash *et al.* (2004) carried out a study to develop our understanding of value of biodiversity in water ecosystems, considering economic, ethical and social psychology aspects. The objective of this study was to examine the applicability of using CBA to quantify environmental change in river basin projects, in the context of the Water Framework Directive. This involved an extension of the standard CV survey to include social and psychological drivers and to test their power in explaining a respondent's WTP.

The Tummel catchment in the Grampian region of Scotland was chosen as the study site. The Tummel catchment drains into the River Tay. The area includes eight reservoirs and pre-existing lakes which are used for hydro power generation, along with the rivers and streams draining into and connecting them.

Many of the surface water bodies in this catchment have been provisionally designated as Heavily Modified in the River Basin Management Plan for Scotland, produced by the Scottish Environment Protection Agency (SEPA) in December 2008. This classification means that it is no longer possible for these water bodies, under their current use (water abstraction and / or the presences of weirs or dams for recreation or energy generation) to achieve good ecological status.

The study asked 1,012 respondents what their **maximum WTP** each quarter over the next year would be **to restore biodiversity in the River Tummel and its surrounding area from 14% to 70%**.

As with many of the studies included in the framework, this study meets most of basic and preferred best practice criteria of stated preference studies as assessed by Jacobs (2007) for Natural England. Pre-Testing was carried out by an accredited survey company as was the pilot testing. These pre-tests serve to improve the scenario design and the likelihood of respondents understanding the scenarios presented to them. The sample size was large, however 437 of the respondents gave zero bids and there were 293 protest bids – i.e. respondents who refused to bid or said they didn't know what they would bid on the scenario presented. Zero bids were included in the analysis, refusals or don't knows were excluded, giving a sample size of 719 respondents.

It is worth noting that biodiversity could increase *or* decrease with canal restoration projects. It is the net change in biodiversity which should be valued, and not the gross biodiversity value of a restored canal.

Unit values

The WTP estimate presented in Table 32 below is equal to four quarterly payments of £5.62 for one-year (i.e., a one off payment of £22.48). This is the lower bound estimate as it includes zero bids. If zero bids are excluded from the analysis, the mean WTP increases to a one-off payment of £57.32 (£14.33 *4).

It is recommended that the lower bound estimated mean WTP value is applied. However care is required to account for the fact that the median estimate is £0.00. See 'Aggregation' below for more on this.

Table 32 WTP per household as a one-off payment (2003 prices)

Value	WTP
Mean	£22.48
Median	£0.00

Appropriate application of unit values

The WTP values presented relate to a significant improvement in biodiversity (a 14-70% restoration in biodiversity). Therefore, this value should only be applied to cases where significant improvements, or losses, in biodiversity are expected.

In the case of inland waterways, significant losses may occur as a result of some other activity such as hydropower development, or significant biodiversity improvement could result from some form of intervention or restoration.

The likely reason the scenario presented to respondents involved such significant biodiversity improvements is the fact that the Tummel catchment is largely heavily modified and therefore has room for significant biodiversity related improvements.

In order to apply this value to an inland waterway, it is necessary to understand the level of change (increase or decrease) in biodiversity expected as a result of the project / policy being considered. This change may be along the waterway itself or in other habitats where there is a direct or indirect link to the waterway. Direct links in the hydrology to two sites might mean that actions taken along the waterway impact associated habitats and their biodiversity. Indirect links might result where the waterway provides a food source for a species which resides in a near by (but not linked) habitat. The biodiversity improvements therefore may be realised outside of the waterway itself.

This value cannot be used to estimate the total current value of existing biodiversity at a site and are **not specific to navigable inland waterways**.

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

As the median WTP is zero the authors raise concerns around aggregating the study's estimates across populations. The median indicates that over 50% of the sample was unwilling to increase their electricity bills to pay for the biodiversity improvements.

Aggregation to the general population is problematic. However, as payment vehicle problems⁵¹ accounted for around 38% of the non-payment responses, zero WTP may not be an accurate reflection of some respondent's true WTP.

To account for these uncertainties, it is recommended that a conservative 'distance band' is adopted (see 'aggregation' under Section 6.1.3 (k)(i) above).

⁵¹ The payment vehicle is the method presented to respondents by which they would make their payment; in this case via quarterly electricity bills. Other studies have used national or local taxes or entrance fees.

(iii) Non use values associated with water quality improvements

Msharafieh *et al.* (unpublished) have recently completed a choice experiment (CE) estimating the WTP for environmental benefits received from improved water quality in the Manchester Ship Canal (MSC). The MSC is a 36 mile long seaway from the River Mersey to the heart of Greater Manchester and the North West of England, moving some 8 million tonnes of cargo a year. The canal is privately owned.

The paper on this study is not yet available. The assessment presented here has been reviewed by the study authors and is based on a detailed presentation..

The CE provided a range of attribute levels and an associated price to respondents. The CE assessed the following attributes of the MSC:

- a. number of affected reaches;
- b. days per year with bad smells;
- c. ecological condition; and
- d. increase in water bills per year as the payment method.

Respondents in 602 households were interviewed from 13 districts in Greater Manchester, forming the catchment of River Irwell and the MSC.

The quality of this study is considered to be high. It is recent, directly related to improvements in an inland waterway and produced by the University of Stirling who have many years experience in designing and carrying out CE.

Improvements in water quality are expected to provide a range of benefits. However as respondents were driven by improvements in the ecological condition, not by the length of the river improved or by the smell, and the fact that 59% of respondents never visited the MSC, non-use values and ecological improvements values appear to dominate. It is therefore assumed that the value for improvements in ecological condition can broadly be attributed to a WTP for biodiversity protection and non-use values.

The study team tested how respondent's characteristics affected their WTP for the scenario presented to them. Choosing two extreme examples where one respondent is older, doesn't consider environmental policy to be very important, doesn't know the canal and looks after the home full time, and the other respondent is young, single in full time employment and believes that environmental policy is very important, it is clear that respondent's characteristics significantly influence their WTP.

The large differences between individuals WTP suggest that to increase the social willingness to contribute to the proposed project requires policy strategies (for instance information campaigns) tailored to the people who are not keen on paying for the MSC restoration.

Unit values

The mean household WTP for improvements in the ecological condition of the canal were estimated along with mean household values by distance from the site. The overall mean is presented in Table 33 below.

Table 33 WTP per household per year for improvements in ecological condition of the canal (2008 prices)

Value	WTP
Mean	£6.00
Median	-

Appropriate application of unit values

As this value relates to an ecological improvement, it is **suitable for use in relation to both navigable and non-navigable waterways**, but only to estimate the marginal value of improvements, *not* the value of the current ecological benefits provided by good water quality.

The MSC provides an access route for cargo to the city of Manchester. It is therefore very large and does not provide the same types of benefits as say a rural canal used mainly for recreational boating. Care is therefore required in applying this value. It is recommended that this value is only applied to value ecological improvement in similar types of waterways.

Adjustments

Given these value are in 2008 prices, no adjustment is require at present⁵². However in the future these values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Varying WTP values are provided for a range of distance bands. However it is considered that the application of varying WTP values by distance is not necessary here and that average values are appropriate.

Aggregation

WTP was found to increase with distance from the MSC but fall to zero at a 30 mile radius. This may have to do with the large non-use set of respondents and / or perceptions regarding the current status of the water quality in the MSC.

The presentation reviewed presents WTP values by distance band, however given the high profile nature of this site, the fact that households located within 2 miles of the MSC expressed their opposition to improvement measures (in the form of a negative WTP) and the fact that the varying WTP values by distance account for all attributes, not just improvements in the ecological condition of the canal, it is recommended that when applying this value, the approach outlined under 'aggregation' in Section 6.1.3 (k)(i) above be applied to identify appropriate distance band.

(I) Combined value estimates

As noted above in some cases the values presented may contain elements of other benefits, in addition to the primary benefit they are considered to reflect. It was therefore considered useful to present values for benefits that are combined where these are likely to be provided through inland waterways projects. Therefore presented below is a valuation of the benefits received from canal maintenance which would ensure the continued availability of boating and tow paths and the preservation of heritage aspects of canals.

⁵² As the GDP deflator table only provides one value per year, currently it is only possible to update values to 2008 prices.

(i) Boating, heritage aspects and tow paths

The values presented are based on Adamowicz *et al.* (1995) – see Section 6.1.3 (g) for background to this study.

The values are for all respondents to this survey which contained users and non-users and thus represent use and non-use values. There were 331 valid responses in the survey. This is considered to be a good enough sample size to derive robust estimates

Unit values

The values presented in Table 34 below represent household use and non-use values for the retention of boating, heritage aspects and towpaths at their nearest canal or most visited waterway. As the sample is skewed, shown here by the median value of just £0.75 and a significantly larger mean value of £6.66, it is recommended that the median value is used to estimate these benefits. The mean value can be used for sensitivity testing purposes.

Table 34 WTP per household per year to retain boating, heritage and towpaths (1995 prices)

Value	WTP
Mean	£6.66
Median	£0.75

Source: Adamowicz *et al.* (1995)

Appropriate application of unit values

These values are best applied when considering the benefits of a service related maintenance programme⁵³; They could be applied to an assessment of the current benefits provided by a programme, as they show WTP for the benefits of the maintenance regime which allows for the continuous provision of the current level of services.

Care is required when applying these values to a site that currently does not provide these benefits. It is often the case that WTP values are higher to maintain current benefits, than they are to receive new benefits (see Garrod, G.D and Willis, K.G., 1996). Therefore applying these values to the provision of new benefits is likely to over estimate benefits.

These **estimates are inland waterway specific.**

Where user only benefits are sought for such improvements, it is recommended that the WTP values for informal visitors for improvements to access and the environment along side the waterways is applied (see Section 6.1.3 (c)).

Adjustments

These values should be adjusted based on the guidance presented in Section 5.3.1 and 5.3.2.

Aggregation

As this value contains both use and non-use elements and is a value per household, it is recommended that aggregation is carried out based on the approach outlined in Section 6.1.3 (k) for the aggregation of non-use values.

⁵³ This refers to maintenance required to maintain a service (such as navigation) and does not include safety related maintenance which is a statutory requirement for navigation authorities.

This value should not be added to other informal use or non use estimates as this is highly likely to result in double counting. It is unlikely to account however for the WTP for specialist recreation activities such as boating and angling. Where direct benefits from these activities can be identified, they should be added as separate values.

6.1.4 Cross cutting benefits

As noted in Section 3, the typology of benefits attempts to identify and value final benefits from the services provided by inland waterways, in order to avoid double counting. As health and tourism benefits are considered to be provided by a range of other benefits valuing them separately could result in double counting. They are therefore discussed below in qualitative terms based on a review of the available data and literature. This information can be used to help the user consider these benefits within any assessment.

(a) Health

Definition

A growing body of evidence suggests that green spaces such as those associated with inland waterways provide many benefits to human health and wellbeing. These benefits are considered here to be ‘cross cutting’ in that they are provided by a suite of services provided by inland waterways, either individually or in combination. They are not therefore final benefits as defined here, but are captured through the realisation of other final benefits.

The health related benefits particularly relevant to inland waterways are largely indirect and arise from, for instance, the opportunities for physical activity which promotes both mental and physical health and well-being including recreation and volunteering, the assimilation of atmospheric pollutants by the natural habitats along the waterways and the provision of water for abstraction.

Physical activity within a natural environment (“green exercise”) may bring additional benefits. These benefits are by no means restricted to natural or semi-natural settings; the advantages of green spaces in the urban environment are also well documented in the literature, though these benefits are rarely quantified.

Data source and values

Pretty *et al.* (2005) documents the effect green exercise has in combating Type II Diabetes, Osteoporosis, stress and mental illness and other health concerns arising from physical inactivity. Estimates of the costs of these illnesses to the National Health Service (NHS) are provided; for example 9% of the NHS annual budget (£5.2billion) is spent on all forms of diabetes per annum. The risk of Type II diabetes is 33%-50% higher for inactive people. Treatment of mental illness also takes up £3.8billion of the annual NHS budget. In total it is estimated that 6% of the total NHS budget (of £70billion in 2005) is spent as a result of inactivity. While these are UK wide estimates and not explicitly linked to inland waterways, it is clear that there are significant potential costs saving to be made by increasing activity levels, and inland waterways can play a role in this.

British Waterways (2007) quotes an earlier report by Bird (2004) estimating the health benefits of recreation in terms of avoided costs to NHS, work absence and early mortality at £310 per annum per inactive person (2006 prices). GHK (2005) also undertook a literature review and, referring to Bird (2004), found a potential cost saving of £0-£0.64million per annum from additional people becoming physically active. This is based on up to 226,000 people (25% of expected visitor numbers)

becoming active due to proximity to a waterway who would otherwise be inactive. The GHK (2005) study relates specifically to the construction of a new waterway – the Bedford to Milton Keynes link; therefore the estimated 226,000 visitors may be entirely attributed to the addition of this new waterway.

Further attempts to relate health benefits to physical scales can be found in Peacock *et al.* (2005) which found that the addition of 3km of footpath generates £0.1million-£1.0million of avoided costs of physical inactivity to the economy, based on 16% usage by local residents.

So while costs savings to the NHS are known to be realised as a result of increased physical activity, it is not possible from the available information to extract data which can be used to estimate the value of these at any marginal level. It is also very difficult to disaggregate these benefits to identify the role navigable waterways play in any increased physical activity.

British Waterways (2008) report the results of towpath visitor surveys conducted in 2003 which found an average 62% of respondents indicated that the presence of a canal increased the amount of physical activity they regularly undertake. Bird (2004) also concludes that contact with nature generally can improve behaviour and self-discipline, enhance emotional development, reduce crime and aggression and improve community integration.

The benefits provided by the natural environment in tackling and preventing crime is also evidenced by the Forestry Commission's 'Offenders and Nature' schemes (Forestry Commission, 2007). More than 1,000 offenders have been involved in forest conservation as part of their custodial sentence. The report notes that this programme reduces the risk of re-offending "by equipping offenders with life and work skills and improving health and wellbeing". There is no such programme known to take place in or around inland waterways; however the relevance and capacity certainly exists.

Other benefits include the potential decrease of pedestrian and cyclist traffic on roads, potentially reducing the number of traffic accidents. Further, those that walk or cycle on canal towpaths are likely to be less at risk from the health impacts of traffic-related air pollution (British Waterways, 2008).

It is difficult to apportion these benefits, as the full benefit may be only partially derived by inland waterways. Outdoor exercise, for example, is beneficial for health and many people exercise in 'green spaces'. No studies were identified that have attempted to disaggregate the proportion of health benefits of exercise that can be attributed to green spaces. Some benefits are likely to be more closely tied to specific locations than others, such as the mental health benefits gained from being surrounded by or looking at nature. These benefits are likely to be more tied to the quality or status of natural systems in their entirety rather than to any specific element of it. Any valuation task would therefore be complex to design and analysis.

In addition to the positive health related benefits provided by inland waterways, it is worth noting that inland waterways may also result in negative health outcomes. These could take the form of increased risks of accidental drowning due to the regular use of the waterways for recreation purposes; or the exposure of people to pests or insects which can have negative health implications including hay fever or allergies. The significance of these negative aspects is thought to be low overall and any WTP to avoid them likely to be very subjective.

(b) Tourism and regeneration

In a similar way to health, inland waterways provide **tourism benefits** through a range of final benefits. In this case they are considered to include the provision of business opportunities and associated job creation and also the provision of recreation facilities and associated expenditure.

These associated expenditures may give rise to further recreational benefits and expenditure, beyond the local population. Some of these values are likely to be a displacement of recreational activity from other locations and therefore largely relate to a redistribution effect rather than additional benefits. An exception is expenditures from overseas tourists which represents a net benefit to the UK.

Tourism benefits are also provided as a result of **regeneration projects** which allow newly regenerated inland waterway communities to be branded, thereby creating economic value for businesses by generating and securing consumer demand. Branding can also provide a price premium for business and residential properties and community benefits in the form of civic pride. It is likely to be the case that each of these benefits in isolation is less valuable than their total sum.

There are various ways to measure **brand value**⁵⁴. For standard products or brands, value can be assessed at the firm, product or consumer level. All of these calculations are, at best, approximations. In terms of valuing the branding of inland waterways it may be possible to use a range of measures to provide a more complete understanding of the value of any brand created however this would need to be completed at a local level due to the number of variables involved.

6.2 Economic Impact Values – employment creation

The primary indicators of the potential business opportunities attributable to inland waterways are the expenditure associated with various activities and the estimated employment resulting from this expenditure. It should be emphasised that employment creation figures are not economic values themselves, but serve as an indicator of the benefits inland waterways provide in terms of creating business opportunities.

The review of the EclA literature (see Appendix C) shows that there are a range of multipliers used in order to forecast the employment benefits likely to be created through additional expenditure, be that from construction activities or recreation visitors.

Generally in the literature these figures are estimated using slightly different methods. There are two commonly used indicators of employment creation – jobs and FTE jobs. The method for estimating these is slightly different as a job may be short or long term however an FTE assumes a permanent position.

These multipliers assumed that every £X of construction expenditure equals 1 person-year of employment (with 10 person-years equivalent to 1 FTE) or every £Y of recreation expenditure equal 1 FTE.

⁵⁴ <http://www.brandeconomics.com/Principles%20of%20B%20C9ndEconomics.pdf>
<http://www.morarconsulting.com/BrandValuationFramework.aspx>

6.2.1 Data sources

While the exact value varies by project, the range is not too dissimilar. The following are examples taken from the literature relating to construction expenditure:

- The Leeds Waterfront project (quoted in Ecotec, 2007) use £55-80K to estimate construction jobs. The lower estimate was used for restoration and regeneration projects, while the higher was used for new builds.
- The Union Canal study (quoted in Ecotec, 2007) use £55-65K to estimate construction jobs.
- Ecotec (2007) use expenditure of £55k - £80k to estimate one construction man year. The lower figure is used for refurbishment / renovation projects, while the higher figure is used for new builds due to high capital costs. Ecotec go on to state that 10 construction man years equates to 1 FTE.
- Association of Inland Navigation Authorities (AINA) (2003) recommends £50-60K of construction expenditure as equal to 1 person year of employment. This is a best practice guide for the appraisal of regeneration and restoration projects.

In order to estimate the FTE generated as a result of recreation / tourism expenditure, there are a number of multipliers used throughout the various EcIAs:

- Ecotec (2007) applied factors of 1 FTE per £40,000 general visitor spend (including, direct, indirect and induced expenditure) and 1 FTE per £80,000 boating expenditure, while boating visitors was similarly used to calculate jobs created / supported using a multiplier of £29k per 1 FTE.
- British Waterways (2007) apply a factor of 1 FTE per £35,000 visitor spend as a result of a restoration project (assuming that the benefits will be generated 5 years after restoration is complete);
- Ecotec (1996) applied a factor of 1 FTE per £25,000 visitor spend, as did Jacobs-Gibb (2001); however it is not clear whether these figures include indirect and induced expenditure; and
- Dickie *et al.* (2006) applied a multiplier of 1FTE per £38,650 tourist spend.
- AINA (2003) suggest that £25,000 of tourist expenditure will generate 1 FTE.

The studies quoted above generally use values that have been derived from a small number of original sources, particularly the Scottish Tourism Multiplier study in the early 1990s and therefore often incorporate various assumptions in adjusting the figures to the appropriate present values.

6.2.2 Recommended multipliers

Based on the available evidence, it is recommend that to estimate employment creation from **construction expenditure** a range of **£55 - 80K be applied to estimate the number of construction man years of employment created**. The lower value should be taken where the project is a restoration and regeneration project. This is in line with the AINA guidance which relates specifically to restoration and regeneration projects. The higher value can be used for new developments. In general, a more labour-intensive project would merit the use of the lower bound estimate, while a more capital-intensive project would qualify for the upper bound estimate.

To turn construction man years into FTE it is necessary to divide by 10, whereby 10 construction man years then equate to 1 FTE.

As FTE is the most recognised indicator in relation to employment creation and provides a better reflection of the likely impact of the employment on the economy, it is recommended that estimates are presented as FTE. This can however be presented along side an estimate of jobs also.

With regard to **recreation expenditure**, it is recommended that a range of **£25,000 – £40,000 of general visitor expenditure be taken to support 1 FTE**. This range is derived the range presented in the literature above. The wide range is likely to result from the fact that these estimates span a decade. British Waterways recommend the use of the upper bound estimate.

It is important to note that in an EcIA, employment impacts should be presented by gross and net FTE, accounting for displacement and leakage within the socio-economic context the region. However the figures above represent direct employment only, and therefore a multiplier should then be applied to take account of indirect and induced jobs created or supported by the project. Guidance on this can be found in the Additionality Guide produced by English Partnerships (2004).

7 Key Issues

7.1 Introduction

This section presents a discussion of the key issues encountered by project. The key issues are organised into **methodological issues** (some of which have been overcome, others remain outstanding) and **data gaps and limitations**.

The issues discussed in this section have informed the development of the recommendations presented in Section 8.

7.2 Methodological Issues

7.2.1 Benefits categorisation

The final benefits realised through the presence and continued maintenance of inland waterways were identified at the start of the project. An ecosystem services categorisation was adopted in order to provide links between this work and Defra's ecosystem services strategy, which is seeking to embed the ecosystem services approach (ESA) across government appraisal.

However, the types of benefits discussed in the literature and valued though stated and revealed preference studies are **not always a good match** for the list developed for the project. As a result a flexible approach has been adopted.

Section 3 presents the list of benefits defined for the project, while the guidance (Sections 5 and 6) presents the benefits for which reliable transfer values are available. In some cases this has resulted in the presentation of values for intermediate benefits rather than final benefits as was the objective. For instance, the final benefit associated with flood alleviation is the reduction in damage to properties and land, however the values provided in the framework are for the service as it is provided by wetlands; this is independent of the value of the properties or land protected. The same applies to water quality improvements, where the final benefits are likely to be reduction in the need for treatment, possibly health benefits and environment and biodiversity benefits valued through non-use values, but the framework reports a value for improved fishing, biodiversity and boating and swimming.

This is further complicated by the fact that for a number of studies it is **not clear what exactly is being valued**. For example, Lawrence and Spurgeon (2007) completed a CE study to elicit WTP for improved fish populations. This may in fact be eliciting the respondent's WTP to go angling (a use value) or their WTP to have what they consider a healthy environment which can support improved fish populations (which may be motivated by non-use values), or both. This demonstrates the difficulty of drawing boundaries around how people think about, view and value these benefits. Many studies are not included in the framework due to this concern.

Conceptual issues arise when the typology of benefits does not align with people's expectations. For example, it may be difficult for users to grasp why significant benefits such as *tourism* and *health* are not listed alongside other benefits which may be viewed as less significant. From an economic perspective the **final benefits or outcomes** of services need to be identified and valued, however the resulting typology of (final) benefits is not necessarily compatible with the way

people see benefits, which can be more holistic in nature. It is therefore necessary to outline how benefits such as health and tourism fit alongside the final benefits provided by the waterways. In appraisal terms they are not additional to the final benefits; however they can be presented alongside other values in order to provide additional weight and context to the discussion.

Similar conceptual issues arise around quantifying the benefits provided by **community cohesion** and improvements or **branding**. While these benefits are often recognised in the literature, there are rarely tangible outputs to measure. This limits any possibility for valuation. Even where stated preference techniques are employed, the difficulty in defining a clear and credible scenario could create limitations.

7.2.2 Marginal versus total values

This project has focussed on providing transfers values to assess the *marginal changes* in the benefits provided by inland waterways. However, an aspiration of the Defra / IWAC research programme is to value the existing benefits provided by the inland waterways of England and Wales. Where possible appropriate studies have been identified to facilitate this, however it is likely that in many cases the physical data are not available or readily understood to allow such valuations to be undertaken. An example of this is the regulatory services providing water purification and pollution dilution services; it is very difficult to identify the total extent of these benefits to facilitate their valuation as it will depend on the natural carrying capacity of the system and the polluting inputs to it. **Considering such benefits at the margin is conceptually more straightforward** and backed up by a greater degree of scientific understanding. It is also a **sound approach in terms of economic theory**.

7.2.3 Benefits transfer literature

The literature highlights a number of criteria for a successful benefits valuation transfer (see Section 2). These include a minimum requirement that the policy site and study site⁵⁵ are similar in nature and that the good or service being valued between these sites is equivalent. However, the existing body of **valuation literature was not designed with benefits transfer in mind**, so using these studies for transfer purposes is less straightforward than it otherwise might be.

In addition, the **level of reporting** on the key factors and information needed to inform the benefit transfer exercise is **variable** across studies. This may simply be due to publication restrictions on word counts, or it may be because certain issues were not considered within the study; it is often difficult to know which the case is.

The transferability of the values is often therefore based on available information and judgement. Obviously the greater the requirement for accuracy then the more important the need for concrete information on the study characteristics and approach becomes. As noted in Section 5, the **values presented in the framework should only be used as ‘ball-park’ estimates** to guide the identification of significant benefits of schemes or scenarios.

Many benefit values commonly quoted in the literature are from relatively **old studies**, for instance recreation values from Willis and Garrod (1991) and the

⁵⁵ The original study site is often referred to as the ‘*study site*’ and the site to which the existing values are applied to the ‘*policy site*’.

drainage benefits provided by the inland waterway network from Button and Pearce (1988) and Fraenkel *et al.* (1975).

Public preferences change over time. The now widely held public concern over climate change serves to illustrate that real preference for environmental good and services has changed dramatically in the last 20 years. This is due largely to a greater awareness of environmental issues and the increasing pressures on and scarcity of the natural resource base. While we can account for the impact of income changes on WTP since the original assessment, there is **no known data on how our preferences have change**. It therefore cannot be assumed that the results from older valuation studies reflect our preferences today.

Methodological advances further weaken the reliability of older value estimates. Econometric models and experimental design underlying more recent studies, especially in CE, are a lot more sophisticated. Therefore many of the earlier studies are likely to be less applicable to BT than later studies.

No adjustments are recommended to reflect potential variations in values between different types of inland waterway, for instance canals with historic structure, canals through agricultural lands, and naturally navigable rivers. This remains an issue that can only be addressed through careful selection of transfer values and consideration on the characteristics of the study and policy sites to ensure that values are appropriately transferred.

Given that more detailed adjustments do not necessarily reduced error margins (see Appendix C), and in an attempt to maximise the use of the framework, only simple adjustments are presented in Sections 5 and 6. This increases the need for consistency between the study and policy sites, however this is on occasion compromised by the limited literature (see section 7.2.1).

7.3 Data Gaps and Limitations

7.3.1 Gaps

Section 4 presents a discussion of the literature and the extent to which it provides values for each of the benefits. There are gaps in valuation data for all ecosystem service categories.

Within the **provisioning services** category the benefits are largely financial. Gaps arise because the financial benefits information is not readily available or transferable. The benefit values mainly originate from EclAs⁵⁶ and the figures tend to be very project / site specific and not suitable for transfer as they are directly tied to the scale of the project or the characteristics of the site and its surroundings.

Regulating benefits are best valued at the margin. It is often difficult to conceptualise how these benefits are provided and the role waterways plays in this provision. For instance water regulation and pollution dilution – is this really about maintaining flows or about removing pollution downstream to where it can be assimilated better? It has not been possible to identify values for all aspects of the final benefits which might arise from these services. For instance, the final benefits provided by the drainage function of inland waterways are not clearly defined and will vary by location. The gap here is therefore due to the difficulty in identifying the

⁵⁶ EclAs typically include expenditure figures for visitors and users and the estimated full time employment (FTE), sustained or created as a result of the expenditure.

benefits, and there is also thought to be a lack of suitable valuation data for application here.

There may be air quality related benefits provided where navigation requirements result in habitat changes. No literature on this has been identified and it therefore remains a gap.

As expected the values available for **cultural services** relate to recreation and non-use values. Gaps remain in the estimation of heritage benefits provided by inland waterway and the structures along them and also for the benefits which are difficult to measure such as education, volunteering and community benefits.

7.3.2 Limitations

The main limitation is the **confidence** that can be placed in the values presented. While the best primary studies are included in the framework, issues around sample size and a clear definition of the valued good raises concerns over the confidence that can be placed on many values and their transferability. Ranges are provided where possible and can be used to assess the sensitivity of the outcomes to the inclusion of specific benefits.

The framework and guidance developed for this project provides **gross benefit estimates**. It *does not* facilitate consideration of costs, potential dis-benefits or trade-offs (where the provision of one benefit, such as navigation, reduces the provision of another benefit such as water abstraction). In order to understand whether a particular project or policy is *economically viable* information on costs, dis-benefits and trade-offs is necessary.

Another consideration is the need to isolate the benefits which are dependant on the presence of the inland waterways from those that might be realised anyway. **Benefits are not always 100% dependant or attributable to the waterway.** For example, the objective of a regeneration project may be to improve the area, and the presence of the water contributes to the regeneration but the regeneration (and therefore all its benefits) are not 100% dependent on the waterway. It can be difficult to determine the additional benefit provided by the waterways, for instance the Broads Authority use the waterways to promote activities with local communities and schools, but these activities could equally be undertaken in a wood. It is not clear that the waterways provide anything additional to a wood in this case and in estimating the net benefits (rather than the gross benefits) some account should be taken of the other non-waterway substitutes that may be available. This is particularly of note if attempting to estimate the current benefits (rather than the marginal ones) provided by the waterway. This issue may not be of significance in some case, for example in ECIAs or redistributional assessments where the final project outcomes are being appraised regardless of the apportionment of their dependence of the waterway.

A similar issue, not addressed within this project, relates to concerns over how to isolate the benefits from inland navigable waterways from a wider wetland, heritage or landscape system, as in the case of the Broads National Park.

In addition to the scope limitations noted above, it has not been possible to consider in any detail the implication of the provision of these benefits on **climate change** adaptation. For instance, what role inland waterways could play as flood risk increases or how the range of benefits provided by inland waterways might be

affected by a need to abstract more water from a waterway? See Box 4 for a short discussion on this.

Box 4 Climate Change and inland waterways

IWAC (2007) notes that climate change will have a significant effect on inland waterways. In England and Wales summers are expected to get noticeably drier, river flows lower, flash flooding to become more common and some traditional water sources are likely to become less reliable.

The Environment Agency has advised navigation authorities that they will be required to apply for abstraction licences in future. While this may not lead to immediate curtailment of water supplies for navigation, there is little doubt that some waterways will find it more difficult to achieve adequate supplies of water throughout the year in the future. Under these circumstances, some consideration of the trade-offs between the need for water to maintain navigation and recreation and the abstraction needs will be required.

Can waterways be part of the solution? In areas of water stress, the waterways may be used for storage. Water transfer is also possible, although the costs in upgrading waterway assets (bank protection, by-weirs at locks) can make water transfer upgrades prohibitively expensive.

Climate change can contribute to an increase in flood risk in many areas and waterways can be used as part of the flood defence system in terms of receiving flood waters. Waterways can also provide valuable access for emergency services, for example during the floods of summer 2007 (British Waterways, 2008).

Concerns over climate change also opens up new possibilities for the use of waterways for transport, because of the potential carbon savings associated with green transport. Around a third of the system will only take smaller vessels with shallow draught but the Olympic development demonstrates the potential for transporting aggregates, construction materials and waste from estuaries to and from construction sites. However, construction contractors have little experience with using transport by water and this presents a potential barrier.

Finally, climate change will see the movement of species from south to north due to alterations to their habitat and the wider environment. Waterways can serve as part of a system of green corridors through which some of these slow migrations can take place. These changes may also result in additional costs associated with the management and control of invasive species as temperatures change and areas become more favourable for invasive species.

Source: IWAC (2007)

It is not possible to transfer the values derived from **EclAs**, for a range of reasons:

- The EclA results are dependent on the economic conditions at the project site (availability of labour, industries presents etc), and relate to a specific point in time when the context of the project is set;
- The impacts are forecasts, not estimated from known data⁵⁷; and
- The focus of the assessment tends to be tailored to the needs of the individual funders.

However, some expenditure-related estimates for recreation activities have been applied within the framework as these are thought to be based on actual estimates rather than forecasts.

⁵⁷ This makes their use less appropriate for appraisals; however evaluations may be able to draw from forecasts/projections in order to inform future projects.

8 Recommendations for Further Work

8.1 Introduction

This project is the first step in a process aimed at the identification, realisation and maximisation of the benefits provided by inland waterways.

While the ecosystem services approach ties in well with central government research and plans for developing economic appraisal across government, from a development agencies and local authorities point of view stronger links to economic development are important. The framework developed here can facilitate this, by highlighting the range of welfare benefits which can be added to the standard economic impact indicators as considered important for a site.

Table 35 below presents the summary finding of this study; noting the benefits and whether transfer values are presented in the framework; the level of confidence in the available values for the use specified, the context in which they can be used and the remaining gaps in the quantitative data where possible. This summary facilitated the identification of the recommendations listed below.

Table 35 Overview table

Ecosystem Service Category	Benefit	Values in Framework	Confidence (H,M,L)	Context for use and Gaps
Provisioning Services	Creation of business opportunities	GAP	N / A	The indicator 'job creation arising from expenditure' is used to value this benefit. Useful multipliers are identified, but not captured in the framework explicitly as it is focused on welfare values only. These multipliers are not specific to expenditures on inland waterways.
	Property premium	Yes	M / H	The premiums presented have been developed for properties in or adjacent to waterside locations. A range of premiums have been provided depending on the type and exact location of the property.
	Renewable energy (financial gains)	GAP	N / A	Only anecdotal evidence of these benefits is available. The associated carbon savings from the generation of renewable energy is addressed separately. See below.
	Transport	Yes	H	Values are provided for the combined benefits (environmental, financial cost savings etc) of commuters changing transport modes from road to bicycles or walking, and for freight movement from road to rail or water. These value are applied to cycling or walking along waterways, or the movement of freight along waterways, however they can also be applied to commuter movements in other locations (e.g. through parks) or freight movements via rail. The values are therefore not restricted in application to inland waterways. Physical data is required on the miles displaced from car journeys to walking and cycling for commuter purposes or freight transport and the level of congestion on the route. Depending on the scale of the assessment it may be difficult to estimate the volume of displaced road journeys, especially in the case of commuters, as there may be a large number of variables to consider.
	Provision of water	Yes	H	These values are based on the value of the water abstracted directly from British Waterways managed waters. It is assumed that the value of this water to other navigation authorities is likely to be similar and therefore that these value are applicable across all navigable waterways. Confidence in the market value data is high; but low in relation to the CS values presented due to a lack of information into how this value was estimated.
	Volunteering	Yes	H	These values were developed specifically for inland waterways by British Waterways, but are also applicable to non-navigation authority organisations. They represent the cost savings to the organisation benefiting from volunteer work. The number of labour hours worked by volunteers is required in order to estimate the full value of these benefits. These data are not necessarily collated by all navigation authorities so gaps may exist in the physical data.

Table 35 Overview table continued

Ecosystem Service Category	Benefit	Values in Framework	Confidence (H,M,L)	Context for use and Gaps
Regulating Services	Carbon savings (renewable energy and transport)	Yes	H	The valuation data come from Government Guidance and confidence in these estimates is high. The values can be applied to carbon savings associated with navigable and non-navigable waterways. Aggregation is dependant on the savings in energy or tonne kilometres and the value of those savings in terms of carbon reductions. Some evidence of the associated carbon reductions savings in energy or tonne kilometres is provided however this is largely site specific so gaps still exist.
	Drainage, water conveyance, flood protection and alleviation	Partial	L / M	The values presented are associated with the flood protection benefits provided by wetland habitats. These benefits may in reality be only partially provided by inland waterways and so they are only applicable where a habitat along the waterway is providing a flood protection benefit to adjacent properties and environments or where a scheme will provide such a habitat. The significance of these benefits for England and Wales' inland waterways is likely to be low. The most significant gap relates to the lack of any clear understanding of the benefits provided by drainage and water conveyance service and the extent to which these are currently provided.
	Water regulation and pollution dilution	Yes	M	Value loss due to eutrophication of the water course is used as proxy for the benefit of reversing this process. The values presented can only be applied where the value-lost from eutrophication, or the reduction in value-lost (e.g. the benefits resulting from a reduction in eutrophication) can be shown to result from a scheme or project. A significant gap therefore remains in estimating the value of water quality services provided by inland waterways. The values presented can be applied to both navigable and non navigable waterways where eutrophication is a significant problem.
	Water quality	Yes	M	The values presented are thought to be broadly attributable to the protection of the water environment and associated range of regulating services. While the quality of this study is considered to be high, the overall confidence in using these values in the framework is medium (or possible medium to high) due to the uncertainty around what exactly the respondent is providing a willingness to pay for. The values can be applied to value benefits from both navigable and non-navigable waterways. The physical data is required on the number of beneficiaries. The study found that the population living within a 17-36 miles radius were the relevant population to consider.

Table 35 Overview table continued

Ecosystem Service Category	Benefit	Values in Framework	Confidence (H,M,L)	Context for use and Gaps
Cultural Services	Recreation (all forms)	Yes	M	Estimates are provided for the CS and expenditure value for a range of recreational activities undertaken in or along waterways. There is a mix in the primary studies between those specifically considering inland waterways and those applicable to all types of waterways. The data is old and public preferences are likely to have changed significantly since the early nineties when some of these studies were published. Physical data required to aggregate these benefits is available from a number of sources however there appears to be no centralised point to access these data and collation of data is likely to be inconsistent across navigation authorities.
	Visual amenity	Yes	M	Values reflect the marginal change (improvement or loss) in visual amenity as a result of increasing / decreasing the number of service structures around waterways. These values are specific to inland waterways as the original research was carried at five English canal sites. The values are not useful for estimating the current impacts of structures on the visual amenity provided by inland waterways and therefore, using the aggregate value of WTP to remove all services as a proxy for visual amenity may not be methodologically robust.
	Heritage aspects	Yes	L	Values reflect the preservation value of canals for those who "view canals as heritage resource" and represent respondents' use value for the heritage benefits of the canals they live nearest to or visit. This use value may also contain some element of the user's non-use. The primary study is considered to be of good quality, however the sample size of the group responding to the question on heritage resources was very low and therefore the results are unlikely to be robust. Estimating the physical data requirements for aggregation requires an understanding of the heritage importance of the sites being assessed and any known data on visitors.
	Education	GAP	N / A	Information is currently restricted to anecdotal evidence, no valuation data available. The key difficulty is on how to define and quantify the final benefits of education provided by inland waterways.
	Volunteering	GAP	N / A	No valuation data available for the 'well being' benefit of volunteering. The cost saving benefits provided by volunteers is discussed above.
	Community benefits	GAP	N / A	Information is currently restricted to anecdotal evidence, no valuation data available. It is clear however from the evidence presented that community improvement and cohesion benefits realised through the regeneration and restoration of inland waterways can be significant and often provides sufficient justification for investment in the waterways.
	Non-use values	Yes	M / H	Non-use values are provided for the continued maintenance of the canal system for boating, heritage and tow paths; biodiversity improvements and water quality improvements. These values are all specific to inland waterways however they can be applied in relation to both navigable and non-navigable waterways. Care is required in applying these values to ensure that they are appropriate to the policy site being assessed.

8.2 Recommendations

This section presents recommended studies aimed at developing our understanding of the economic value of inland waterways and at enhancing the confidence placed on the outputs of the benefit transfer framework developed for this project. The recommendations are presented in the style of draft project specifications, at the request of the Project Steering Group, which could be developed by potential funders and researchers. They are presented in an order which is felt to reflect their priority in terms of building the evidence base and developing the framework.

8.2.1 Testing the benefits transfer framework

Objective

To test and develop the benefits transfer framework as a tool for assessing the benefits of inland waterways.

Background

The framework presents high level estimates often from studies undertaken in high profile, specific locations, which may not match a given site requiring assessment. Applying the framework to specific sites or issues would test:

- whether the list of benefits identified fits with those realised through real projects;
- the availability and applicability of the values presented within the framework; and
- how user -friendly the guidance is.

Outline approach

There are a variety of ways the framework could be tested including:

Current restoration / regeneration projects

Inland navigation authorities, e.g. British Waterway or Environment Agency, could be requested to utilise the framework on a current or forthcoming project, e.g. the Boston-Spalding Link that the Environment Agency recently tendered. It is thought at this point that the only additional work that would be required would be to write a short report on the outcome of the test and provide recommendations to further development of the framework and guidance as appropriate.

Recently completed projects

The framework could be tested on a site that has been recently developed, or had a change in management, to provide a retrospective analysis for funders, e.g. Liverpool Canal Link.

Local Authority indicators

The framework could be tested against the indicators used by Local Authorities to evaluate their activities. It would be useful to map the ecosystem services / benefits onto these indicators so it is apparent to Local Authorities how the benefits relate to the indicators of interest to them. British Waterways have carried out some initial work to identify which of these indicators are relevant to inland waterways. Further work could be undertaken to map the benefits identified in the framework onto those Local Authority Indicators identified by British Waterways. A selection of these indicators is provided below:

- % of people who feel that they belong to their neighbourhood;
- Civic participation in the local area;
- % of people who feel they can influence decisions in their locality;

- Overall / general satisfaction with local area;
- Participation in regular volunteering;
- Environment for a thriving third sector;
- Adult participation in sport and active recreation;
- Use of public libraries;
- Visits to museums and galleries; and
- Engagement in the arts.

The outcomes of the testing could be used to inform the future development of the framework. The framework can be developed over time to include additional valuation data as it becomes available. It could also be developed to include additional contextual information on the benefits with examples of cases where these benefits have been realised. A more automated software tool could be developed which provides the user with drop down menus to help them select benefits and values and with information at key points to steer them in the selection of appropriate studies.

8.2.2 Primary valuation work

Objective

To provide up-to-date welfare values for a selection of benefits provided by inland waterway and applicable across the UK.

Background

The valuation literature that can be applied to inland waterway benefits is both dated and limited. There is clearly a need to develop new up-to-date information on public preferences and willingness-to-pay for the benefits provided by inland waterways. This will require primary research. This research should be designed to provide values which can be transferred across different types of waterways with different attributes and to consider both use and non-use values.

Outline approach

Prior to undertaking the valuation study, a qualitative survey of public preferences with regard to inland waterways is recommended. This would allow the valuation work to be focused on the key benefits of value to the general public. The testing of the framework discussed in 8.2.1 would also help identified priorities for the primary valuation work in terms of the significance of the benefits, gaps and uncertainties in available estimates.

The primary valuation survey should be designed to answer the most important questions with regard to how the public perceive and value these benefits. Clearly these will vary by location, however they are likely to include recreation and the associated direct and indirect benefits (the support for local businesses and health benefits), community benefits provided by regeneration projects and non-use values

A stated preference valuation study is recommended which could take two forms – a **Choice Experiment** (CE) or a **Contingent Valuation** (CV) study. The former allows the value of individual attributes of a non-market good, in this case the inland waterway site, to be estimated; whereas a CV study would look at the value of the whole good.

The problem with commissioning stated preference research on specific sections of canals or sites is the possibility of encountering part-whole bias, and omitting to consider scope effects. **Part-whole bias** arises where a respondent ascribes some of his / her value for the good as a whole to the specific site (because this is all s /

he is being asked to value, rather than the good as a whole). **Scope effect** should be present in theory due to the **diminishing marginal utility** of successive increments of a good. Thus a second waterways site should command less value than the first site. This is problematic for benefit transfer since it implies values derived for one site cannot be readily transferred to a second site, and aggregated to derive the value of both sites.

A study of the **value of waterways across the country** as a whole would avoid problems of part-whole bias; and would also allow for scope effects to be included. Addressing both of these problems would increase the transferability of the WTP values derived from such a study.

There are a number of advantage and disadvantages to stated preference techniques which would have to be considered prior to selection, however it is also **possible to combine the two techniques** within one survey which would allow the value of the site in question to be estimated (using CV questioning) and then allow for that value to be split down to its 'public good' individual attributes (using CE questioning).

Public good attributes of waterways might include boating, locks, other canals structures, towpaths, angling, water quality, etc. Levels of provision of each of these attributes can be specified in the CE, e.g. in relation to the maximum achievable.

CE can handle a large number of attributes within a single survey, if attributes are 'blocked' into different CE packages. CV or another CE can then be used to derive a value for the packages as a whole. Thus a CE could also deal with the public's WTP for regeneration features of canals in urban and rural areas, drainage services, wildlife, etc. in addition to the more traditional services usually associated with waterways.

A sample across the whole country would also permit people's preferences and WTP for different waterways and canals to be identified. **People may have different preferences and values for different canals.** They may value the attributes of a local canal or waterways higher than a canal or waterway at a greater distance from their residence; or value historic canals in some parts of the country higher than others. These effects can be elicited from a CE, and the values aggregated across the population as a whole.

The sample could include **both visitors and non-visitors** to canals and waterways. This would provide both estimates of use and non-use values for the 'public good' nature of canals and waterways.

A CE would also permit greater transferability of values between different sections of canals. For example, from the CE it would be possible to estimate the value of a given stretch of canal or waterway with specific attributes (*X, Y, Z, etc*) with each of these values specified at a particular level e.g. water quality, etc.

It is difficult to specify the exact sample size *a priori*, since this depends on the splits which would be required in the analysis (e.g. by different income groups; regions of the country; etc.), the experimental design, and the number of choice cards presented to each respondent. However, a **sample of 1,200 to 1,500 should permit a good national coverage** with the option to analyse the data by sub-sections of the population.

Such a **study would not cover all the benefits** provided by canals and waterways. The enhanced value of property adjacent to canals and waterways would still need to be appraised using hedonic price models or expert judgement by professional valuers. Similarly, actual expenditure to gain access to canals and waterways for recreational user would still need to be counted in addition to their open-access non-priced recreational utility of such users.

The important point of such primary valuation work would be to **produce an up-to-date WTP value for the ‘public good’ values of canals and waterways**, which could be readily used in a benefit transfer to provide estimates for the value of any stretch of canal or waterway, and for the value of any improvements to these sections of canal or waterway.

8.2.3 Assessment of drainage benefits

Objective

To derive up to date values for the **drainage benefits provided by inland waterways**.

Background

It is often purported that the drainage functions provided by inland waterways is of significant value. Estimates of the value of this function are currently being based on a 1978 study of the costs of replacing an inland waterways’ natural drainage function, should it be lost. Aside from the fact that this study is now very old, this replacement cost is not strictly speaking a measure of welfare benefits.

Outline methodology

It is recommended that the actual benefits provided by the drainage function of inland waterway are investigated based on the current land use in England and Wales, e.g. flood alleviation (possibly looking at damage costs avoided or WTP to avoid damages), land drainage to support crop production (possibly valued based on a change in productivity) or other benefits.

A clearer specification of the land drainage function of the waterways and the final benefits associated with this service **would allow the design of valuation approaches to estimate this benefit**. This assessment should be carried out from a welfare perspective where possible and not simply rely on replacement cost or cost avoided approaches.

8.2.4 Centralised collation of physical data

Objective

To provide a **centralised information point for the physical data** required to undertake the monetary valuation of benefits.

Background

There is currently **no central source providing the physical data** required to monetise the benefits (e.g., number and types of visitors, length of towpaths, number of people living within xkm of inland waterways). This means that this data are typically hard to collate and may not be provided in a consistent form across sites, or be in a form suitable for the valuation exercise. Given the need for appropriate aggregation of unit values in estimating benefits, the availability of a centralised quality assured data source could significantly reduce errors and increase both confidence in final benefit estimates and also the consistency of these estimates across region and organisations.

Outline methodology

The approach could be developed from the following broad steps:

- Further **scope out the physical data required** to estimate the benefits presented in the framework;
- **Identify all holders** of this data;
- Highlight the appropriate presentation of this data for valuation purposes; and
- **Explore options for collating** and holding this data centrally, through consultation with potential data holders and users.

8.2.5 Green transport

Objective

To provide evidence on the benefits of green transport routes as provided by tow paths.

Background

Green transport is politically attractive as a means of contributing to carbon reduction targets, as well as healthy life style agendas. However, the significance of these benefits is not well understood.

Outline methodology

An understanding of the existing and potential use of green transport routes is needed. This could be built up from data on a range of associated aspects including:

- People's actual usage of canals for commuting and how this might change if a site was developed or improved;
- Details of their transport alternatives; and
- An understanding of the actual availability of routes, population densities and traffic densities in these areas.

Once the change in travel patterns is better understood, the benefits provided through reductions in commuter traffic could be valued in terms of the carbon offset (assuming that people would otherwise travel by road or rail), the health benefits and also possible time saving benefits where people travelling to work spend less time commuting by using green transport routes. These benefits, along with avoidance of other road externalities could then be valued using NATA car miles (p / km) approach outlined in Section 6.1.1.

In addition to clearly identifying the final benefits realised by the provision of green transport routes and their significance, the research should seek to answer a number of other questions including;

- **How can the benefits of green transport be maximised?**
- **How do the carbon savings from green transport compare** to other possible initiatives that would reduce carbon emissions, such as promoting canal holidays in the UK as an alternative to holidays requiring air travel.

9 List of Acronyms

AINA – Association of Inland Navigation Authorities
 BAG – Benefits Assessment Guidance
 BCU – British Canoe Union
 BMF – British Marine Federation
 BT – Benefits Transfer
 BW – British Waterways
 CBA – Cost Benefit Analysis
 CE – Choice Experiment
 CLA – Country Land & Business Association
 CR – Contingent Ranking
 CS – Consumer Surplus
 CV – Contingent Valuation
 CVM – Contingent Valuation Method
 DECC – Department of Energy and Climate Change
 DfT – Department for Transport
 DI – Distributional Impact
 EAFR – Environmentally Acceptable Flow Regime
 EclA – Economic Impact Assessment
 ESA – Ecosystem Services Approach
 EU ETS – European Union Emissions Trading Scheme
 FCDPAG – Flood and Coastal Defence Project Appraisal Guidance
 FCERM – Flood and Coastal Erosion Risk Management
 FHRC – Flood Hazard Research Centre
 FRM – Flood Risk Management
 FTE – Full Time Equivalent
 GDP – Gross Domestic Product
 GHG – Greenhouse Gas
 GSK – GlaxoSmithKline
 HP – Hedonic Pricing
 HMWB – Heavily Modified Water Body
 HPI – House Price Index
 ITCM – Individual Travel Cost Method
 IWA – Inland Waterways Association
 IWAC – Inland Waterways Advisory Council
 IWDVS – Inland Waterways Day Visit Survey
 MA-BT – Meta-analysis Benefits Transfer
 MSB – Model Shift Benefits
 MSC – Manchester Ship Canal
 MV – Market Value
 NCBA – National Community Boats Association
 NEF – New Economics Foundation
 NFU – National Farmers Union
 NHS – National Health Service
 NUV – Non-use Value
 OLS – Ordinary Least Squares
 ONS – Office for National Statistics
 PSA – Public Service Agreement
 PSG – Project Steering Group
 R&D – Research and Development
 RO – Renewables Obligation
 RSPB – Royal Society for the Protection of Birds
 SAC – Special Area of Conservation

SEPA – Scottish Environmental Protection Agency
SIG – Special Interest Group
SLM – Sensitive Lorry Miles
SPA – Species Protection Area
SPC – Shadow Price of Carbon
SSSI – Site of Special Scientific Interest
TCM – Travel Cost Method
TEV – Total Economic Value
US EPA – United States Environmental Protection Agency
USD – United States Dollars
VIVA – Voluntary Investment and Value Audit
WFD – Water Framework Directive
WfT – Waterways for Tomorrow
WOW – Wild Over Water
WTA – Willingness to Accept
WTP – Willingness to Pay

10 Glossary

Benefits transfer (BT). The use of primary value estimates generated for one location / context (known as the study site) to a similar location / context (policy site). The transferred values are typically adjusted to account for differences in key variables between the policy and study site.

Choice experiment (CE). A stated preference valuation approach used to determine willingness to pay. Their strength is their ability to provide a rich set of results by assessing a variety of different ways in which a resource's quality might vary. They describe the resource in terms of its attributes (or characteristics) and the levels that these take (e.g. Good, Moderate or Poor). They can be used to assess the value associated with a change in any of these characteristics.

Cost-benefit analysis (CBA). A form of economic analysis in which costs and benefits are converted into money values for comparison over time.

Consumer surplus (CS). Savings to consumers arising from the difference between what they are willing to pay and what they are charged (price). For non-marketed goods and services, CS can reflect the total value. Consumer surplus can arise when expanded supply is associated with a fall in price. It can also arise when the output price is regulated by government and set below the demand price.

Contingent ranking (CR). Contingent ranking surveys are an alternative to contingent valuation (see below). The main characteristic is that respondents are asked to rank alternative options / programme outcomes according to their preferences. It is the preferred environmental valuation method in cases where the good is difficult to value or when the good is not familiar to respondents as it minimises strategic behaviour.

Contingent valuation (CV). A direct means of estimating willingness to pay based on the stated preferences of consumers, through the creation of a hypothetical market. Contingent valuation estimates can be used to provide an estimate of the economic value of non-traded outputs and inputs, especially those for which there is no direct market information, as is the case for many environmental effects.

Diminishing marginal utility. A general principle used in economics to express that for any good or service, the marginal utility of the consumption of one extra unit of that good or service decreases as the quantity increases, all else constant.

Displacement. Displacement occurs where spending is not additional but in fact just displacing spending elsewhere in the economy. It is often the case that jobs creation opportunities largely involve the displacement of jobs from another sector in the economy or location in the country. The level of displacement will often depend on the current employment rates in an economy; where there is high unemployment; displacement effects are likely to be lower than where unemployment rates are low.

Distribution effects. An analysis of the net income effects of project / policy costs and benefits on different participants. Distribution effects can refer to the net income effects between producers, users, and government, and also net income effects for the poor; and foreign and domestic participants.

Distributional impact (DI). A term used to describe the distribution of the costs or benefits of interventions across different groups in society. Proposals might have

differential impacts on individuals, amongst other aspects, according to their income; gender; ethnic group; age; geographical location; disability. (HM Treasury Green Book Glossary)

Economic impact assessment (EclA). An economic impact assessment traces spending through an economy as a result of a particular policy or project and measures the cumulative effects of that spending. Economic impacts are defined as the positive or negative effects on the level of economic activity in a defined area (local municipality, region). The two most appropriate indicators of economic impact are the change in employment levels and value added to the community from increased spending. Account is taken of displacement and leakage effects and possible multipliers.

Full time equivalent (FTE). A measurement equal to one staff person working a full-time work schedule for one year.

Greenhouse gas (GHG). Greenhouse gases are chemical compounds that contribute to the greenhouse effect. When in the atmosphere a greenhouse gas allow sunlight (solar radiation) to enter the atmosphere where it warms the Earth's surface and is reradiated back into the atmosphere as longer-wave energy (heat). Greenhouse gases absorb this heat and 'trap' it in the lower atmosphere.

The 2007 assessment report compiled by the IPCC observed that "changes in atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation alter the energy balance of the climate system", and concluded that "increases in anthropogenic greenhouse gas concentrations is very likely to have caused most of the increases in global average temperatures since the mid-20th century"⁵⁸.

Gross domestic product (GDP). The monetary value of all goods and services produced within a country's borders in a specific time period, usually one year. The GDP includes purchases by consumers and by the government, private domestic investments and net exports of goods and services (exports less imports).

Leakage. Leakage refers to the fact that not all of the expenditure from an activity (such as recreation, construction etc) is retained in the local area. Adjustments are required to reflect that fact that some of the benefits created by the expenditures will in fact be realised outside the local economy.

Market value. The price for which a good is bought and sold in a market.

Meta-analysis. Meta-analysis is a statistical technique which reviews, summarises and combines previous quantitative research. Such analyses attempt to define systematic relationships between reported valuation estimates and the attributes of the respective studies that generated these, in effect combining research on one topic in one large study.

Meta-analysis benefits transfer (MA-BT). The process of applying the results of meta-analysis for use in benefits transfer. One of the greatest strengths of using meta-analysis for benefits transfer is the ability to combine and summarize large amounts of information from previous studies. This strength can also lead to one of the greatest weaknesses of this method which is the loss of important valuation details across time and space in the aggregation process.

⁵⁸ http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Multiplier. The multiplier is the relationship between some change in an economy and the succeeding economic activity that occurs as a result of that change. The multiplier is an estimate of how much additional economic activity will result from some new investment in an economy. It is called the multiplier because the original investment is "multiplied" by the multiplier to obtain to total economic impact.

Non-use value. The concept of non-use value refers to the value that people derive from economic goods (including public goods or natural resources) independent of any use, present or future that people might make of those goods. Non-use value includes both existence value and *pure non-use value*, as well as bequest value, option value, and value arising from paternalistic altruism.

Opportunity cost. The benefit foregone from not using a good or resource in its best alternative use. Opportunity cost measured at economic prices is the appropriate value to use in project economic analysis.

Option value. The value that people place on having the option to enjoy something in the future, although they may not currently use it.

Ordinary least squares (OLS). A statistical technique used to define a line that best summarises the relationship between two variables. This is determined as the one where the sum of squares of the deviation between the sample line and each of the original data points has the least value.

Public goods. Goods for which consumption by any one individual does not detract from the ability of others to consume them. An example of a pure public good is street lighting or national security, where no one individual can be excluded from consumptions by another consumption of the good. .

Sensitivity analysis. The analysis of the possible effects of changes to a project or policy. Values of key variables are changed one at a time, or in combinations, to assess the extent to which the overall results, measured by the economic net present value, would be affected. Where the project or policy is shown to be sensitive to the value of a variable that is uncertain, that is, where relatively small and likely changes in a variable affect the overall project result, mitigating actions at the project, sector, or national level should be considered, or a pilot project implemented.

Shadow price of carbon (SPC). The SPC represents the cost to society of the environmental damage caused by a tonne of carbon (or the CO₂ equivalent) emitted into the atmosphere. It was initially set at £25.50 in 2007 and will rise to £59.60 by 2050.

Total Economic Value (TEV). The sum of all the relevant use and non-use values for a good or service.

Travel cost method (TCM). The travel cost method is used to estimate economic use values associated with recreation sites. It does so by examining the time and travel expenses incurred by visitors to the site. It is consequently assumed that these values represent the "price" of accessing the site for each user. The **Individual Travel Cost Method (ITCM)** uses survey data collected from visitors on site on the characteristics of their visits (e.g. number of visits, expenses related to travelling) as well as socio-economic characteristics. This data is then analyzed to produce a demand function for the "average" visitor to the site, the area below which gives the average consumer surplus. The average consumer surplus, multiplied by

the total relevant population, provides an estimate of the total consumer surplus for the site.

Use value. The value derived from the actual use of a good or service, such as hunting, fishing, bird watching, or hiking.

Willingness to accept (WTA). The minimum amount of compensation consumers would be willing to accept for foregoing units of consumption.

Willingness to pay (WTP). The maximum amount consumers are prepared to pay for a good or service. WTP can be estimated as the total area under a demand curve. Changes in WTP can occur when the demand curve itself shifts because of changes in income or in the prices of substitute goods.

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Appendix A – Map of Inland Waterways in England and Wales



Appendix B – Literature Review Table

Column ID	Title	Description
2	Title of Study	General reference information on study / report.
3	Full Reference	
4	Date of Publication	
5	Published (Y / N) specify whether (1) Journal, (2) official Government report, (3) grey literature	Specify how study was published.
6	Type of Assessment: Market – WTP; Market – EcIA; Non-market; Meta-analysis (specify whether market or non-market).	Type of assessment reported in study according to the figures presented.
7	High Level Summary - include objectives and conclusion of study. Note any problems with study raised by author (especially biases in the results)	Summary information on report. Information contains high level objectives and conclusions if possible.
8	Category of Benefit (as described in study)	Columns define what the category of benefit valued is according to the study's description and categorises the benefit according to the Framework of benefits.
9	Ecosystem Services Category of Benefit (as per BT Framework)	
10	Category of benefit as per Framework (best match) This should be ordered by Ecosystem service; Benefit category; Benefit	
11	BT carried out (Y / N)	Specify whether a BT was carried out in the study.
12	If BT Y - provide further information on Primary study, adjustments made etc.	If a BT was conducted, general information on the source study is provided, such as author(s), year published and values BT.
13	Location - Specific and Region / Country	General information on the study site location for either source or BT studies. Information on the proposed change and socio-economic characteristics of either source or BT study.
14	Physical characteristics of the study site	
15	Proposed change in the provision of the service (note baseline condition, over what spatial area change is proposed, time frame, range of change etc.)	
16	Socio-economic characteristics of the population (e.g. is it a representative sample of UK / region / area)	
17	Market conditions: Are substitutes available / considered in study? (Y / N - if Y, provide details).	Information on the market conditions and whether the study considers such factors as whether substitute sites are available?
18	Survey Method: SP or CE / CVM; TCM etc.	Survey method of source studies specified. As much detail captured here as possible, such as survey modelling.
19	Survey size (if known)	
20	Is the transfer function available in the study? (applies to WTP studies ONLY) (Y / N - If Y list variables included (income, quality, substitutes, hh characteristics)	Is the transfer function provided in the study? If yes, list the variables it considers to enable the figures to be adapted to a different location / situation.
21	Statistical robustness / validity of data. If possible include stats here.	Comment on the statistical robustness of the data, including any quantitative analysis where possible.
22	Year of Data	Year for values, e.g. 2006 £ etc.
23	Values (£)	Actual values reported
24	Unit of Value (£ / person etc)	Unit of values reported.
25	Category of Value: Expenditure; CS; Total WTP; Income; Visitors (# of, etc.); Jobs (FTE created etc.).	List the category of the value(s) presented. For example, if full-time equivalent information is presented, it would be categorised as 'Jobs'.

Appendix C – Literature Review

C.1 Introduction

A comprehensive review of the literature was undertaken for the project. The literature search was focussed on UK data sources, however as far as possible suitable overseas studies were also sourced⁵⁹.

Literature was initially gathered from Jacobs' in-house library of environment valuation studies and from publicly available sources and journals. In addition, key stakeholders and potential data users were contacted in order to identify relevant grey literature sources. An email request for data was also circulated on the RESECON list server, which is a global email list of resource economists.

The literature collated covers:

- The academic literature on BT in order to draw out best practice in BT, pitfalls and limitations and to help develop an approach for evaluating the valuation studies for the purpose of this project; and
- Valuation studies, covering both economic welfare studies and Economic Impact Assessments, in order to determine the best transfer values.

The BT literature is discussed in Section C.2. The valuation studies are recorded in a **literature matrix** which facilitates a consistent review of all available studies and is designed to capture, to the extent possible, study aspects that influence their transferability and have implications for the adjustment to be made to the values estimated. The information captured within the literature matrix is reviewed and analysed in Section C.4, by benefit type.

C.2 Benefits Transfer Literature

BT applies the results (values) from existing studies (typically peer reviewed) to a policy (or project) scenario under consideration (Desvousages *et al.* 1998 as quoted in Iovanna and Griffiths, 2006). The original study site is often referred to as the '*study site*' and the site to which the existing values are applied to the '*policy site*'.

BT avoids the need for expensive and time consuming primary studies and thereby offers a practical route to benefits estimation. However, even with appropriate adjustments, the transfer values will inevitably contain a margin of error. In order to maximise the uses of BT in decision making potential transfer errors and biases should be minimised, and any remaining errors made explicit so that users can place the appropriate emphasis in their decision making on the transfer values.

There are three broad approaches to BT:

- Transferring unadjusted unit values – this will be subject to bias caused by differences in socio-economic characteristics of the relevant population, physical characteristics, proposed change in the provision of the service and market conditions between the policy and study site;
- Transferring adjusted unit values; and

⁵⁹ There remain a small number of studies for which full copies have not been possible to obtain. These are outlined in the Literature Matrix.

- Transferring benefit functions.

Values estimates from a single study may be transferred, or a meta-analysis of a number of previous estimates may be undertaken to derive a benefit function or value based on a cross section of studies. See Appendix C.2.3 for a discussion on meta-analysis.

There is an on-going debate within the academic community as to the reliability of BT. It has been suggested that average transfer errors are around 40-50%; however the range can vary greatly (Ready and Navrud, 2006). Shrestha and Loomis (2001, in Hanley *et al.* 2006) find an average transfer error of 28% in a meta-analysis model of 131 US recreation studies while Brouwer (2000, in Hanley *et al.* 2006) surveyed seven BT studies and found that the average transfer error is around 20–40% for means and as high as 225% for benefit function transfers.

Barton, 2002 rejects the claim that BT functions out perform unadjusted or simple income adjusted WTP estimates based on his test of the convergence of two identical CV studies of coastal water quality at two urban locations in Costa Rica. Pearce *et al.* (2006) concluded that the level of sophistication of the transfer method does not alter conclusions as to the likely size of the transfer error and that in their case the average transfer using the three approaches to BT noted above all resulted in an over or under estimate of about 38%.

This dispels the reasonable assumption that transferring value functions is more robust than simple unit value transfer. Ready and Navrud (2005) note that the evidence of this is mixed at best, with some studies finding improvements and others not. It is therefore unlikely to be possible to estimate average error factors by the BT approach applied.

Given the practical appeal of a BT approach the question that needs to be asked is - what level of error is acceptable? The required accuracy of the transfer exercise can pragmatically be related to the application of the information. Filion *et al.* (1998) and Bergstrom and de Civita (1999) (both referenced in Bergstrom and Taylor, 2006) discuss a continuum of BT applications from those requiring relatively high accuracy (e.g. compensation / litigation, policy decisions) to those requiring relatively low accuracy (e.g. gains in knowledge, screening, advocacy). This is further discussed in O’Gorman and Bann (2008).

Even a simple BT, with a large error factor, may provide an indication of whether the benefits and costs are of the same order of magnitude. Quantification of benefits increases its comparability with cost and the transparency of the information and the decision. A counter view is that if confidence in the BT is low it would be better to use a qualitative description of the benefits, rather than present monetary estimates that may be misused. It is clearly important for the user to understand the confidence they can place in the numbers estimated through BT. This is further considered in Section 7 of the main report.

Ironically, the need to use BT is most acute where the challenges are most difficult. Ecological benefits by and large do not have market prices and therefore need to be estimated through primary studies. But the number of primary studies is limited and therefore BT is often adopted to reflect these benefits in CBA and other appraisal processes. As noted above, the accuracy of the transfers can be questionable especially given the site-specific nature and complexity of ecological benefits. This is particularly relevant to the valuation of benefits arising from regulating services. Such transfer exercises require an understanding of the linkages among

environmental stressors (e.g. excessive nutrients in the waterways), ecosystem impacts (e.g. eutrophication) and ecosystem services (e.g. recreational fisheries) at the study and policy site.

C.2.1 The application of Benefits Transfer in the UK

In the UK the application and interest in BT approaches is growing based on an increasing need to demonstrate the full range of costs and benefits in policy formulation and project appraisal. In the context of inland waterways, it is the objective of this study to produce a BT Valuation Framework which would allow the full range of benefits to be routinely considered in policy and project appraisal, and thereby facilitate better informed decisions.

BT has been used extensively in the evaluation of water company schemes under the periodic review process following the development of the BAG for PRO4 (Environment Agency, 2003a)⁶⁰. In PRO4 the BAG was used to consistently evaluate 450 water company schemes and was therefore able to reflect the relative benefits of schemes and facilitate comparisons.

More recently the Environment Agency (Eftec, 2007) has developed a handbook for incorporating environment effects into flood risk management appraisal. The approach is tailored to reflect the purpose of the assessment and hence the level of confidence needed of the benefit estimates. The practitioner is guided through three possible levels of analysis:

- A preliminary analysis based on the use of default data to provide a quick view of the likely magnitude and significance of the benefits;
- A bespoke BT where more detail is needed; or
- A primary benefit study where the value of the environmental effects are significant to the decision and the scheme likely to be contested.

In parallel with this project, Defra has commissioned a study to develop a benefits transfer framework for ecosystem services. This study is being carried out by Eftec and partners and is at present ongoing.

C.2.2 Key findings from the literature

A number of protocols or criteria for successful BT exist in the literature, a selection of these are discussed below:

- Only primary studies based on sound scientific methods should be considered for transfer (Freeman, 1984);
- Similarity between resource conditions, site characteristics, market characteristics is important;
- Values should be related to socio-economic characteristics of the sample through a regression function (Desvousages *et al.* 1992 as in Loomis and Rosenberger, 2006);
- Equivalency of basic commodities being valued is important, as are similarity of the baseline and extent of change, and similarity of the effected populations (US EPA, 2000);

⁶⁰ The BAG makes extensive use of default values for physical factors such as the importance of sites for conservation purposes, the relevant population bands for use in distance decay assessments or the relevant number of visitors to a site. The BAG provides a broad-brush assessment of benefits at specific sites; a more tailored site specific approach is needed for sensitive cases.

- Error margins can be significant and should be considered alongside the need for accuracy; and
- The approach to BT applied does not necessarily have an impact on the error margin in the transferred value.

Boyle and Bergstrom (1992) (referenced in Loomis and Rosenberger, 2006) proposed criteria for BT as far back as 1992. These are still considered to be valid requirements and are as follows:

- The non-market commodity valued at the study site must be identical to the non-market commodity to be valued at the policy site (commodity definition compatibility). However, given that this is in many cases impossible, this condition in practice is relaxed to the commodities closely corresponding on several key criteria;
- The populations affected by the non-market commodity at the study site and the policy site have identical characteristics (market area compatibility); and
- The assignment of property rights at both sites must lead to the same theoretical appropriate welfare measure (welfare measure compatibility).

C.2.3 Meta-analysis

Meta-analysis combines and summarise large amounts of information from previous studies. This make this it a potentially strong BT approach, however there is a risk that important valuation details across time and space can be lost in the aggregation process. Bergstrom and Taylor, 2006 conclude that before Meta-Analysis-Benefits Transfer (MA-BT model) models can be widely adopted, more convergent validity tests are needed to compare the estimates of the economic value of an environmental commodity from these model estimates with those from non-market techniques (such as Stated Preference approaches). Lindhjem *et al.* 2008 test the reliability of *international* meta-analytic BT based on a data set of forestry related SP surveys from Norway, Sweden and Finland. They find that despite homogeneity across valuation methods, cultural, economic and institutional conditions in the three countries and a meta-analyses with large explanatory powers, the transfer errors are still large (between 47-126% depending on the model). Further, they show that international meta-analytical transfers do not on average perform better than simple value transfer averaging over domestic values, bringing into question any justification for the increased effort they require.

Meta-analysis models with application for BT have been developed for:

- Outdoor recreation – Risenberger and Loomis, 2001, Walsh, Johnson and McKean, 1990;
- Water quality – Boyles *et al.* (1994), Smith *et al.* (2002);
- Air quality – Smith and Huanng, 1995 as in Bateman *et al.*, 2000; Smith and Pattanayak, 2002 as in Rosenberger and Stanley, 2006;
- Threatened and endangered species – Loomis and White, 1996; and
- Wetlands – Ghermandi *et al.* (2007), Brander *et al.* (2006), Brouwer *et al.* (1999), Woodward and Wui (2001).

A good meta-analysis needs to be carefully conducted following systematic protocols for model development, data collection, data analysis and interpretation. According to Bergstrom and Taylor (2006), a MA-BT model would have the following characteristics (many of which echo the requirements of a successful BT in general):

- Commodity consistency: the commodity being valued should be approximately the same within and across studies. This includes the spatial and temporal aspects of the service, the range of the change, and the reference condition. Commodity inconsistency could occur for example where wetlands studies valuing end products such as commercial or recreational fish harvest are combined with studies looking at the natural characteristics and capacity of wetlands to remain healthy ecosystems (as indicated by ecological processes and functioning). The lack of studies available may force the analyst to use generic groups – e.g. for recreational activities that provide a reasonably similar sets of services;
- Scale of the change: for example one study may measure WTP for a 1,000ha increase in wetlands protection while another estimates a 100,000ha increase. Theoretically we would expect scale to influence total WTP, with WTP being higher for the higher scale. However we know that the relationship would not necessarily be linear (Brookshire *et al.*, 1980, van Buetan and Bennet, 2004 both referenced in Bergstrom and Taylor, 2006). In addition, WTP for the change in services provided is likely to be sensitive to starting point bias (e.g. the reference level) specified within and across studies;
- Core economic variable consistency: a MA-BT model satisfies core economic variable consistency if it includes the basic or core economic variables – e.g., price, income, quality, substitutes, and household characteristics;
- Study design variables: study design variables such as WTP valuation method, WTP elicitation method, WTP calculation method need to be understood. Elicitation approaches include dichotomous choice, open ended questions, payment cards and iterative bidding (see Shrestha and Loomis (2003), Rosenberger and Loomis (2000), Walsh *et al.* (1992) as in Bateman *et al.* (2000)). An understanding of the biases in various elicitation methods is required; and
- Welfare change consistency: measures of WTP within and across a meta-analysis should represent the same Hicksian welfare change measure. Conceptually CVM measures Hicksian consumer surplus⁶¹, whereas travel costs methods measure Marshallian consumer surplus⁶².

These are summarised in Table C.1.

Table C.1 Features of a good meta-analysis – benefits transfer model

Commodity consistency	Commodity being valued is approximately the same within and across study
Economic variable Consistency	Price, income, quality, substitutes, and household characteristics included
Study Design variable consistency	WTP valuation method, WTP elicitation method, WTP calculation method.
Welfare change inconsistency	Measures of WTP within and across a meta-analysis should represent the same Hicksian welfare change measure.

Source: Based on Bergstrom and Taylor, 2006

C.3 The Literature Matrix

The literature matrix is presented as a separate Excel file. A list of the headings with a description can be found in Appendix B. This matrix captures information on

⁶¹ To evaluate welfare change, Hicks proposed to use either the compensating or the equivalent variation. The compensating variation is defined as the additional income that the consumer must receive to leave his utility unaffected by the price change.

⁶² Marshallian consumer surplus is defined as the difference between what a consumer is willing to pay for a good and what he/she has to pay. It is measured as the area under the demand curve and above the going price.

the nature of the benefits valued in the literature and maps them on to the benefits of inland waterways as outlined in Section 3, paying regard to the level of benefit consistency.

Information to help assess the robustness and transferability of the benefit estimates is also captured, such as the date of the study, the sample size and survey technique, whether adjustments have been made for income or other socio-economic factors, etc. For studies which include statistical analysis, the transfer function is noted where available, along with information about the variables included and which ones are statistically significant (for instance education, general environmental attitudes, etc). EcIAs often utilise adjustment factors such as multipliers, which determine indirect expenditure resulting from primary expenditure; and displacement, leakage and deadweight factors, which estimate net employment according to the gross number of jobs sustained or created within the wider regional or national economic context. Such adjustment factors are accounted for in the matrix as well. Finally, where primary studies have been referenced or used for BT in proceeding secondary studies, detail as to the use of the primary study outputs is noted.

The valuation literature is consistently evaluated against the criteria set out for each level of the assessment (as discussed in Section 2).

All known literature sources have been entered into the literature matrix according to the benefit categories presented in the framework. Benefit estimates are presented where possible; however, for those studies where the benefit consistency was deemed insufficient to proceed or the study considered not relevant to inland waterways, the review process was not completed.

In many cases both the primary data sources and secondary sources are listed. This allows insights into how these primary sources have been applied in BT to date. The matrix groups values by benefits, as opposed to ordering by study which would require the reader to go look across sources for an overview of each benefit. This facilitates an easy comparison of values for each benefit and type of 'indicator of value' (expenditure, income, jobs etc).

The values presented in the literature matrix have *not* been uplifted to 2009 prices. They are recorded directly from the reviewed literature and therefore reflect differing base years.

C.4 Valuation Literature (welfare and economic impact)

The key objectives of the literature review are to provide an overview of all the available literature related to the benefits provided by inland waterways and to capture the study characteristics and factors needed to judge the use of a study's outputs in BT.

The discussion presented below follows the ecosystem services categorisation; split into provisioning, regulating and cultural services. The benefits associated with each category are discussed as appropriate under each section below.

It has been difficult in some cases to assign benefits to a particular category. Benefits are therefore discussed where they are considered to best fit - this has resulted in some benefits appearing under two categories. For instance, the costs savings and carbon savings provided by renewable energy generation are discussed separately under provisioning services and regulating services respectively.

C.4.1 Provisioning benefits

Provisioning services are those that result in products being provided by the environment (ecosystems). In relation to inland waterways, provisioning benefits refer mainly to economic benefits such as the creation of business opportunities; the provision of property price premiums; the provision of renewable energy generation capabilities; transport opportunities and associated cost savings; the provision of water for abstraction and the provision of volunteers.

Job creation is also considered separately where these jobs arise directly from regeneration or restoration⁶³ expenditure. These data sources contain estimates for a range of 'indicators of value'. 'Indicators of value' refer to both financial and economic values and physical estimates such as increased visitor numbers or jobs created. These physical estimates can be used as indicators of future financial or economic benefits, especially with regard to regeneration and restoration projects.

The studies reviewed are all inland waterways specific, some relating to restoration or regeneration projects, others looking more widely at the benefits from inland waterways. There is also a mix of EclAs and economic welfare studies.

The data sources are discussed in more detail below by benefits category.

(a) Creation of business opportunities

The creation of business opportunities may have significant future benefits for the entrepreneur, for those employed in the jobs created and for the wider community. However, these may be difficult to value in many cases as they are largely reliant on estimates of future outcomes associated with expenditure.

The primary indicators of this benefit are the expenditure associated with various activities and the estimated full time employment (FTE) resulting from the expenditure. It should be emphasised that FTE figures are not economic values themselves, but serve as an indicator of the benefits inland waterways provide in terms of creating business opportunities.

Analysis should include both direct and induced impacts – for example expenditure within a specific region has a knock-on effect of inducing expenditure both within and outside the region. Employment impacts should also be presented by gross and net FTE, accounting for displacement and leakage within the socio-economic context the region.

Expenditure values and multipliers used to estimate FTE as a result of expenditure vary depending on the nature of activity. Tourism and recreation related expenditure / FTE are therefore discussed in the section on Cultural services; likewise expenditure / FTE related to regeneration are discussed below under the Regeneration heading.

Values for the 'creation or support for business opportunities' come mainly from EclA studies which cover a range of specific activities relating to both bank-side and water based businesses (e.g. boating hire companies, shops and restaurants). The largest number of values identified relate to this category of benefit.

⁶³ Restoration meaning the renewal and refurbishment of an existing building or structure; regeneration meaning investment in areas in order to reverse economic and socio-economic decline.

The expenditure data contains information on the average spend of visitors and the annual operating costs versus revenue for certain activities. These might include the annual income from boat hire versus the maintenance, mooring and licensing fees. It also contains information on the total value of some activities such as visitor expenditure in the local economy, which will serve as a benefit to supporting local businesses.

Where these values relate to recreation expenditures they have been considered under 'recreation'.

(b) Property premium

Inland waterways can generate an economic benefit in the form of property premiums beyond the average rent or sale of residential and commercial property. Estimating waterside property amenity is complex as the premium is likely to be inter-related with other location, neighbourhood and structural features and is also likely to vary for the specific type of amenity provided. The available studies attempt to isolate the effect 'proximity to waterside amenity' has on the price of a property, deriving ranges that can be adopted in the analysis of inland waterways.

Fifteen studies have been reviewed in reference to property price uplifts resulting from proximity to a waterway, 14 of which are UK based. Values originating in five of these studies have been taken forward for inclusion in the framework as follows.

Willis and Garrod (1994) used a hedonic price model to estimate the economic benefits gained by residents from a waterside location throughout a range of urban, suburban and semi-rural districts in Greater London and the Midlands. The results found an average premium of **3-5%** for domestic properties, with the upper value relating to the more affluent areas in the Midlands, and the lower to Greater London, which contains greater variation. These percentage estimates are much lower than those in other studies, including Willis and Garrod (1993) which resulted in a range of 8-19% depending on the distance of the property from the waterway. This may be explained in part by the fact that only existing properties were considered - some in older, run-down areas – as opposed to new properties within specialised pristine developments. It may also be explained by the techniques used to estimate the premiums values; the lower estimate is estimated through hedonic pricing, while the higher estimate is estimated through stated preference methods.

British Waterways (2008) carried out an analysis of the property uplift values attributable to a proximity to inland waterways based on a literature review. They conclude that it is appropriate to base their calculations on an **18%** price premium for residential properties (quoted in Oxera 2003, original study conducted by Lambert Smith Hampton in 1999). This is based on small sample size of only 64 properties in the Milton Keynes area adjacent to a "well maintained" canal. British Waterways (2008) assert this is a minimum value used to estimate the economic benefit of British Waterways activities to maintain the canal network in good working order.

The report notes, however, that evidence relating to commercial properties is more limited and the uplift is lower than for residential properties. Rental uplifts were shown (quoted from Wood and Handley, 1999) as varying from 0-15% for office accommodation and 0-25% for leisure development. The main driver for these increases may in fact be the overall location in a town or city rather than the proximity to the waterway specifically. This reinforces the need to consider the

influence that waterways have on the provision of these benefits and the difficulty in many cases to separate this out from other influencing factors.

In another literature review, Powe *et al.* (2000) refer to both the Willis and Garrod (1993 and 1994) studies, noting the difficulty of quantitatively estimating waterside premium. Summarising a number of hedonic price and stated preference studies, the report arrives at a 3%-20% residential premium for waterside locations which “provide[s] useful upper and lower bounds.” Powe *et al.* (2000) also point out that the speed of sale / rental can be equivalent to an implicit asking price and may be more appropriate for quantifying the waterside premium.

GHK (2007) examined the economic impact of waterway development schemes through six case studies. They reference Willis and Garrod (2000) which estimated a range of 9-20% value added to a new home in a canal-side location. A study conducted by Wood and Hanley (1999) is also referenced, quoting a 0-10% (mean closer to 0%) rental premium on waterfront office properties.

DTZ (2001) presents uplift ranges of 3%-10% for executive residential property within 25-225m of the canal, 1.5%-5% for basic residential units, 1.5%-5% for retail properties and 3%-10% for leisure properties. The actual economic benefit realised within this range is location specific, depending largely on the existing property prices and rental rates in the surrounding area. It is unclear how these uplift estimates have been derived; however they are likely to have originated from the Willis and Garrod (1993 and 1994) studies.

Jacobs-Gibb (2001) conducted an economic assessment of four restoration options regarding different sections of the Chesterfield Canal. Recognising that different restoration options will affect the level of environmental amenity and the associated property price differently, they applied a 25% premium for property immediately adjacent to the canal when restored from having no water to becoming fully navigable. A 15% premium was applied to adjacent properties when restored from a non-navigable to fully navigable canal. For properties within 100m, a 15% and 10% premium was applied, depending on the level of restoration (from no water to full navigation or non-navigable water to navigable water). Likewise, a 10% or 5% premium was applied to properties within 500m.

A discussion of reviewed studies which have *not* been included in the framework continues below.

Field (2008) in undertaking a literature review, quotes the Willis and Garrod (1994) estimates and notes that the original study methodology is robust; having taken into account other factors which determine house prices.

Pretty *et al.* (2002) discuss the disamenity of eutrophic water bodies, and apply a 10% loss value to properties adjacent to waterways experiencing eutrophication. It is not clear how the loss factor was derived; however, this value is presented in the framework to represent the possible benefits of a restoration or regeneration scheme which would remove the effects of eutrophication or similar.

Ecotec (2007) conducted analysis of the Welsh canal corridor, identifying the number of buildings within 50m of the canal (waterfront properties) and those within 50m – 200m (adjacent to canal). As the distinction between residential and commercial buildings could not be easily made, a property value uplift of 3-5% was applied. Again, this is likely to have been derived from Willis and Garrod (1994) although not explicitly stated. The basis for choosing this conservative range was to

account for the fact that uplift values will likely be lower for the existing property stock than for new developments which can maximise the amenity value at the design stage. The authors also surmise that the property price impact would be lower in built-up areas than more attractive, rural locations.

The Bedford Milton Keynes Waterway Cost-Benefit Appraisal (GHK, 2005) bases the capital uplift of residential properties in the proximity of the proposed restored route on Garrod and Willis (1994). A 20% uplift was applied to properties <50m from the water's edge and 5% for hinterland properties 50m – 200m from the water's edge.. This resulted in an overall economic benefit of £34.1m - £91.2m for waterfront properties and £25.6m - £68.4m for hinterland properties (2004 prices).

(c) Renewable energy development opportunities

Inland waterways do not necessary spring to mind when considering renewable energy generation, apart from perhaps with regard to hydroelectric energy generation. A recent example however serves to prove that inland waterways have the potential to provide significant carbon saving opportunities, along with economic gains for participating companies. While the financial savings of such schemes obviously fall under the category of provisioning benefits, the associated carbon savings from reduced CO₂ emissions are discussed in the section on regulating services below.

At this stage, the evidence of benefits from renewable energy generation associated with inland waterways is largely anecdotal. As the extent to which these benefits may be realised will rely largely on the specific nature of individual schemes, it is not possible to recommend values for use in BT.

The following examples are therefore provided for illustrative purposes only.

A scheme recently announced by GlaxoSmithKline (GSK) on London's Grand Union Canal uses 'heat exchange technology' where water from the canals is used to air condition its offices, reducing carbon dioxide emissions. GSK expects to save £100,000 in energy bills a year and cut carbon emissions by almost 1,000 tonnes. British Waterways estimates a further 1,000 businesses alongside its urban waterways could also harness the opportunity, primarily large offices that use considerable amounts of energy cooling their buildings as a result of the large amounts of heat generated by computers and lighting⁶⁴.

British Waterways (2008) notes that there is the potential to generate 5 MW of energy through heat exchange technologies. They estimate this could save around 4,600 tonnes of CO₂. This suggests that each mega watt of energy could save 920t CO₂ annually. Linking this back to the GSK example, it might be assumed that the scheme generates around 1MW of energy and that this provided savings of around £100,000 annually.

(d) Transport routes

Investment in canals in Great Britain in the eighteenth century was intended to facilitate freight transport between commercial centres (Adamowicz *et al.* 1995). While inland waterways continue to provide freight transport routes, the emphasis has broadened to include a range of alternative transport purposes, including

⁶⁴ Note that this technology can have environment costs as the water returned to the waterway can be slightly warmer than the water extracted. These costs should not be ignored. This activity can only be undertaken with consent from the Environment Agency.

walking / cycling on towpaths both for recreation and commuting, passenger transport such as ferries, and others.

The benefits associated with these transport opportunities are two-fold. Firstly the provisioning benefit associated with time and / or cost savings from, for example displacing freight transport away from the road network. Secondly, there is a regulating benefit arising from reduced carbon emissions where inland waterways are used in place of a more energy-intensive form of transport.

The use of these waterways for the transport of freight continues to generate an income for British Waterways and other responsible bodies. Graves *et al.* (2007) reported that British Waterways receives an income of around £500,000 per year from this activity. This is equivalent to £0.28 per tonne of freight transported, based on a figure of 1.8million tonnes of freight being transported annually (British Waterways, 2008).

Freight traffic is largely concentrated on the larger tidal waterways and ship canals, as well as on some of the British Waterways commercial waterways. The freight traffic on the inland waterways is comprised mainly of liquid bulks (for example oils) solid bulks (for example aggregates, cement, grain, waste and recyclables and materials such as steel). Unutilised traffic (containers and trailers) has continued to decline. Tonnage of freight transported by water has also continued to fall through 2004. However, in 2005 there was a small upturn in tonnage, both in terms of internal and seagoing traffics on the inland waterways. A report by AINA (2003) concluded that freight opportunities on the smaller, non-tidal inland waterways (with vessel capacity of less than 100 tonnes) were very limited but there was a potential opportunity for freight use in certain niche markets.

Grants are available from the Department of Transport to assist companies with meeting the additional costs of transporting goods by water; however it is assumed that these grants simply offset costs and do not provide any financial gains to the companies concerned.

Instead, these grants are intended to capture the environmental and social costs and benefits of road versus rail / water freight transport. The Department for Transport (DfT) has published guidance on the Mode Shift Benefits (MSB) of transferring freight from road to rail / water (DfT 2009b). The values are based on the disbenefits of congestion, accidents, noise, climate change emissions, air pollution, infrastructure, taxation and 'other' costs arising from each mode of transport. For the purpose of the assessment, it is assumed that the marginal external costs of water and rail freight movements are broadly similar in comparison to equivalent lorry miles; therefore the calculations have been based on rail freight components.

A summary of the values is presented in Table C.2 below, in 2010 prices. These figures have been recommended for use in the framework.

Table C.2 Benefit values of transferring freight from road to rail / water (£ / mile)

Motorways	High value	£0.86
	Standard value	£0.07
All A roads		£0.74
Other roads (all B, C and unclassified roads)		£1.43

Source: DfT (2009b)

Road congestion comprises the largest proportion of these values and has been calculated based on traffic forecasts from 2010 onwards. The climate change component is based on greenhouse gas emissions and has been valued according to the SPC in 2015 (£32.54 in 2010 prices). Noise pollution has been calculated according to the impact of congestion on traffic level noise. Similarly, the external cost of accidents is based on the change in accident costs caused by change in traffic levels. The infrastructure costs are based on the assumption that large articulated vehicles (e.g. road freight carriers) increase the frequency that road maintenance is required, thereby increasing cost.

Finally, the 'other' costs included are those that are "more difficult to value in a systematic" way and have therefore been calculated as an uplift across the range of external costs discussed above. These 'other' costs include up and downstream processes, soil and water pollution, nature and landscape, driver frustration / stress, fear of accidents, restrictions on cycling and walking and visual intrusion.

The cost categories have been assessed for an average articulated lorry and the similar values have been deducted for rail freight in order to arrive at the net benefit per mile of rail / water transport. In order to apply these values, the distance travelled by rail / water must be known as well as the road type of the most likely alternative road route. There are uncertainties surrounding the application in the context of inland waterways, as the assumption that rail and water freight transport externalities are essentially the same may be inaccurate (for example, noise pollution is likely to differ between the two modes). However, the level of inaccuracy cannot be determined without a more detailed assessment.

Chatterjee *et al.* (2000) assessed the impact of increased road traffic due to a temporary lock closure, including increased traffic delays, lorry-related accidents, pavement damage and air pollution. However, this study took place in the US and therefore very site / situation specific as the calculations are based on traffic modelling of a specific section of highway in Tennessee. Further, the unit values for the opportunity cost of time (congestion) and damage to life (accidents) used in the assessment are likely to be sufficiently different in the US compared to the UK that the results are not suitable for transfer.

In terms of other (non-freight) transport opportunities, the available physical data are limited. For example, the Thames Tideway in London provides a passenger transport function. Beyond this little has materialised outside local services, the majority of which are tourism related. Other examples include waterbus services in Birmingham, water taxis in Bristol, trip and restaurant boats in York and on the London canals and short boat trips associated with waterways-based tourist attractions or waterways under restoration (IWAC, 2007). There is likely to be potential to expand the provision of these services.

Canal towpaths can also be developed to become sustainable transport routes through and between communities both for commuting and recreational journeys by foot and bicycle. They also have the potential to become an important part of the safe off-road transport network being developed by local authorities and Sustrans, the sustainable transport charity (IWAC, 2007).

Towpaths can provide safer alternatives, displacing pedestrian and cyclist traffic from the road network and they may also provide valuable time savings – for instance for commuters using towpaths as a short-cut. British Waterways estimated that 62 million towpath visits (including 18.1 million cycling visits) take place annually with the explicit purpose of 'getting somewhere' along with an additional 18.1 cycling

visits, suggesting the number of travel journeys along BW waterways is somewhere on the order of 62m – 80m per annum (British Waterways, 2008).

NATA Refresh: Appraisal for a Sustainable Transport System (DfT, 2009a) provides guidance on the use of monetary values for assessing the benefit of shifts between modes of transport. These impacts include “time and operating costs savings for consumers and business users and for transport providers, valuations of changes in accidents, carbon emissions, levels of noise, journey time reliability and physical fitness” (DfT, 2009a).

Table C.3 shows the monetised impacts of shifting commuters from a car to cycling during commuter hours. This shift can have some disbenefits (i.e. time costs); however, the reduction in congestion and health benefits largely outweigh these.

Table C.3 Monetised benefits from switching from car to cycling for commuting purposes (p / km)

Level of congestion	Low	Average	High
Travel time costs	-34	-31	-15
Physical fitness benefits	26 to 40	26 to 40	26 to 40
Congestion reduction benefits	0	11	177
Greenhouse gas reduction benefits	0.3	0.3	0.3
Tax revenue loss	-4	-4	-4
Transport user resource gains	4	4	4
Other costs and benefits	-8	-7	-2
Net benefits	-16 to -2	0 to 14	187 to 201

Source: DfT (2009)

The congestion reduction benefits presented above relate to the time savings incurred by other drivers as a result of each car journey displaced. The physical fitness benefits include a range of health benefits associated with physical activity and also account for the comparable accident costs of using different transport modes. It is not clear what the ‘other costs and benefits’ category might include. Interestingly, walking for commuting purposes incurs positive net benefits only during high congestion periods as a result of the cost of time. For walking and cycling during the course of work, a higher opportunity cost of time (presumably related to productivity versus leisure time) has been incorporated, resulting in a negative net benefit, as shown in Table C.4 below.

Table C.4 Monetised benefits from switching from a car to an alternative travel choice (p / km)

Level of congestion	Low	Average	High
Cycle: in work	-161 to -148	-172 to -114	130 to 144
Walk: commuter	-61 to -36	-45 to -20	142 to 167
Walk: in work	-568 to -543	-534 to -510	-393 to -368

Source: DfT (2009a)

The data presented in Table C.4 above should be caveated by the fact that commuters may not *mind* the increased journey time of walking or cycling, perhaps viewing it more as leisure time which would carry a lower cost of time. This may render the results positive for the commuter journeys presented above. Such assumptions are difficult to make, as they are dependent on individual preferences.

(e) Provision of water

British Waterways sell water, primarily for commercial rather than residential purposes due to the infrastructure requirements of sourcing residential water supply. British Waterways generates an income of £4.3 million per year from the supply of raw water to commercial and other users (British Waterways, 2008). One third of

the commercial supply is returned and this provides a service which is unavailable through mains supplied water where all potable water supplies from the mains must return as waste water, incurring a high treatment cost and potentially associated environmental impacts. Sourcing water from inland waterways can therefore provide a positive environmental benefit by reducing pressure on other supply locations.

British Waterways offer a significant cost savings, estimating that their average charge for supplying raw water is £250 / MI compared to an average of £650 / MI charged for potable supply. The actual charges for abstraction are however a weak indicator of the true economic value, which might be better captured by WTP. British Waterways suggest that the CS value of the water supplied is approximately one-third (33%) of the charge, valuing the provision of raw water supply at £330 / MI. These estimates are recommended for use in the framework to value the benefits provided by the existing provision of water and any marginal change in provision resulting from a scheme.

Other examples of water charges in the literature are limited to Pretty *et al.* (2002) which report a median charge for abstraction licenses of £16.00 / MI for spray irrigation, £5.80 / MI for public water supply and £5.00 / MI for industry. The reason for the marked difference between these and the charges reported above is that abstraction licenses are levied by the Environment Agency and reflect a regulatory cost. These estimated are not indicative of the market price of water.

(f) Volunteering

Local residents and interested parties who volunteer contribute to a range of activities including towpath tidying, secretarial assistance to Canal Societies and Trusts and the provision of a range of professional skills to projects

The benefits of volunteering are two-fold. Firstly, there is a financial benefit in terms of cost savings to the organisations who can employ fewer staff as a result. The values recommended for use in the framework to estimate this benefit are taken from British Waterways (2008). The report suggests figures of £50 / day for unskilled labour where no training is required, £150 for skilled labour (where a minimum of 6 hours training is required), and £350 a day where professional skills are required to estimate the cost savings provided by volunteers.

Glaves *et al.* (2007) note that the economic value of volunteering is not fully recognised in relation to inland waterways, as no national figures were available. Instead, total values for general sport volunteering are quoted (£1.6 billion per annum or equivalent to 108,000 FTE). No attempt to disaggregate these values to waterways activity has been made, other than to note that “the importance of volunteers is recognised for sports generally, and in waterways in particular”.

Gaskin (2004) presents a more detailed methodology to estimate the value of volunteers. This is based on a concept called “Volunteer Investment and Value Audit “VIVA”. VIVA is a measurement tool that assesses the ‘outputs’ of volunteer programmes (the value of volunteers’ time) in relation to the ‘inputs’ (the resources used to support the volunteers). It therefore provides informative and readily grasped indicators of the scale and significance of voluntary work and the payback on an organisation’s investment in volunteering.

This method allows the estimation of a VIVA ratio. This is produced by dividing the total volunteer value by the total volunteer investment. For example, a total value of

£50,000 and expenditure of £10,000 yields a Ratio of 5. The Ratio has a simple meaning: 'for every £1 we spend on volunteers, we get back £5 in the value of the work they do', a five-fold return on the organisation's investment in volunteering. See 'The Institute for Volunteering Research' (2003) for details of how to calculate this ratio.

Secondly, there is the benefit of an improved sense of well-being, derived from increased self esteem, altruism, etc. This benefit has not been valued, but is discussed further in the section on cultural services.

(g) Utilities

British Waterways wish to exploit the full potential of the canal network, including using it as a route for utilities laying. Of British Waterway's top seven customers, six are utility companies. Installing utility cables under a towpath includes benefits of ease of access for installation, maintenance and upgrades; as well as reduced risk of damage or disruption as opposed to locating them beneath roads, which is largely the current practice (British Waterways, 2008).

The cost savings of using towpaths as opposed to an alternative option for laying utility cables, can be use as a proxy for this benefit. However, it has not been possible to recommend monetary values for the framework as no information is available on the costs of using alternative locations to lay utility structures.

In 2008, British Waterways reported charges of £3 / metre or £528 per apparatus. NFU / CLA charges are considerably less - £0.10 / metre or £6.30 / apparatus (British Waterways, 2008). This implies that utility companies would have to receive considerable benefit from ease of access or less risk of damage relative to alternative locations, resulting in lower maintenance costs. Therefore, the difference between British Waterway's costs versus conventional practice could be used as a proxy for benefits as utilities must consider the benefit to be equal or greater to the additional cost.

(h) Regeneration

Regeneration is the process of reversing economic, social and physical decline in areas where market forces would not do so without government intervention. This is thought to be captured through indicators such as, creation of business opportunities, job creation and property price uplift. However, in terms of a regional assessment, the presence of a waterway often acts as a catalyst for government investment. Benefits that are specific to regeneration will vary greatly by the area and type of project / activity undertaken. However, the same valuation methods apply such as expenditure multipliers that create FTEs.

Ecotec (2007) reports an EcIA of the development and rural / urban regeneration of the area surrounding the East Midlands inland waterways. A number of previous case studies were used to inform the assessment, producing a number of multipliers. For example, the total capital cost of a project was related to FTE by assuming one construction man year per £55k - £80k spent (lower figure for refurbishment / renovation projects, higher figure for new builds due to high capital costs). Ten construction man years are then equated to 1 FTE. The expenditure by boating visitors was similarly used to calculate jobs created / supported using a multiplier of £29k per 1 FTE. These figures are intended to aid in the identification of suitable multipliers and are not included in the framework specifically.

AINA (2003) in its best practice guide suggests using a value of £50-60K of expenditure as a multiplier with which to estimate construction employment.

Employment and wider economic benefits created by regeneration investment may, depending on the funding organisation, need to undergo Distributional Impact (DI) assessment, to reflect the added value of benefits realised by lower-income groups.

C.4.2 Regulating benefits

Regulating services provide benefits from the regulation of ecosystem processes. Specifically, inland waterway ecosystems might provide benefits such as drainage, flood protection and alleviation; water regulation, pollution dilution and reduction in carbon and air pollution associated with transport of freight / green transport routes. As discussed in Section 3, regulating services provide 'infrastructure' and 'insurance' values, requiring that a minimum set of these services are maintained in order to ensure a sustainable flow of the resulting benefits.

However, as noted in Section 3, regulating services and benefits are often difficult to measure or quantify. For many of these services there remains some scientific uncertainty around the biophysical relationship between ecosystems and the benefits they provide, especially in any general context. It is often also difficult to clearly identify the final benefits from these services. It is therefore unsurprising that the regulating are not routinely considered and monetised in existing studies.

(a) Carbon savings

As discussed in Section C.4.1, the provisioning services offered by inland waterways may result in carbon savings, thereby reducing the impact of climate change. These services include the provision of green transport and opportunities for renewable energy developments. The carbon savings can be valued in isolation, (as discussed below) or in combination with all other external benefits (e.g. congestion costs, accident etc) as outline in Section C.4.1

The extent to which carbon emissions will be saved or prevented from being emitted will depend largely on the scheme being developed or the nature of activity being undertaken.

Inland waterways provide capacity for renewable energy generation – the implications of which also result in carbon savings by displacing energy from the traditional grid which is still largely fossil-fuel based. Again, the number of tonnes of CO₂ saved or offset will depend on the specifications of a scheme.

Inland waterways also provide opportunities for transport. These include transport of goods by water freight and commuter links such as boating, walking or cycling routes. In the absence of these opportunities, road and rail are the most likely transport options. There may be direct carbon savings to be made, along with reductions in other air pollutants, such as PM₁₀ and SO₂ associated with displacing road / rail travel onto waterways or other green transport links. These reductions may also provide direct health related benefits which are considered under the discussion on health below.

Estimating transport-related carbon savings depends on calculating the difference in emissions between the type of transport that is offset (e.g. removing cars from the road) and the replacement or 'green' transport option. For example, researchers at the Tyndall Centre for Climate Change Research have estimated that freight transport produces one-quarter of the carbon emissions of road transport (0.02

tonnes CO₂ per thousand tonne-kilometres for water freight versus 0.08 tonnes for road freight) (IWAC, 2007). One tonne-km is the movement achieved by one tonne of cargo being transported by one km; therefore, a barge carrying 500 tonnes of cargo travelling for 10km would result in 5,000 tonne-km. The implied saving of 0.06 tonnes C⁶⁵ per tonne-km is included in the framework.

Oxera (2007, quoted in British Waterways, 2008) calculated that the external benefits of freight being carried on British waterways rather than by roads was £0.7 million per year. They consider this to account for climate change effects.

The Department of Transport recognises the environmental benefits, assumed to include carbon reductions, in transferring freight from road to water (or rail). They calculated the value of these benefits by taking the tonnage being committed to water over an agreed number of years and working out how many lorry journeys this will remove from the road. Standard rates, known as Sensitive Lorry Miles (SLM), are then used to calculate the value of the benefits.

IWAC (2008) estimate that road freight transport generates 0.08 tonnes of carbon per freight-kilometre, whereas water transport generates 0.02 tonnes per freight-km. The savings, therefore, is 0.06 tonnes of carbon⁶⁶ per freight km.

Passenger transport services (for example by ferry) as well as the use of commuter walking / cycling links would result in carbon savings. However, there is no readily available data to quantify the carbon savings provided by these trips, as this depends on what alternative route would have been taken and the distance of the trip. Where a carbon saving could be estimated, valuation would be completed as outlined above for freight related savings.

The shadow price of carbon is used to estimate the value of carbon savings in many government funded projects. The methodology is based on a damage cost approach and provides values for a tonne of carbon in any given year (£25.60 in 2008) and requires the costs to be inflated annual to account for increased damages over time. However, this methodology has very recently been updated.

Guidance pertaining to the monetary valuation of carbon emissions and savings has recently been updated (DECC 2008). Accordingly, all emissions and savings associated with sectors currently involved in the EU ETS should be valued at the market price of carbon, as opposed to the previously uniformly applied SPC. The market price of carbon is the value of an emissions allowance traded under the EU ETS, whereas the SPC is an actual damage cost per tonne associated with climate change impacts.

According the DECC (2008) all non ETS sector emissions reductions should still be valued according to the SPC.

Sectors currently covered by the EU ETS are:

- Electricity generation;
- Primary fuel use by EU ETS installations;
- Aviation emissions (starting from 2012); and

⁶⁵ Note, tonnes of carbon should be converted to tonnes of carbon dioxide by dividing by 3.667. This factor is based on the ratio of the molecular weight of carbon dioxide (44 g/mole) to the molecular weight of carbon (12 g/mole).

⁶⁶ Note this value is expressed in tonnes of carbon and must be converted to tonnes of carbon dioxide in order to apply the SPC.

- Nitros oxide from nitric acid and adipic acid production (starting from 2010).

Non-ETS emissions are:

- Primary fuel use where not an EU ETS installation;
- Road transport fuel; and
- Changes in greenhouse gas (GHG) emissions from land use, waste and agriculture (DECC 2008).

According to this guidance, therefore, the benefits of carbon savings arising from renewable energy production should be valued at the market price of carbon. The emission savings arising from green transport (which displaces road transport) should be valued at the SPC.

The rationale behind this methodology is that emission reductions occurring in ETS sectors do not result in a net UK or EU reduction; rather the result in the UK requiring to import less or export more allowances within a predefined limit.

The average market price of carbon in 2008 was £16.26 / tCO₂e; however this value is subject to market conditions. The SPC is currently higher than this MV, at £26.50 / tCO₂ (in 2007 prices) and is set to rise at 2% per annum above inflation.

Emission savings resulting from displaced road transport would be valued according to the SPC, as the road transport fuel is not currently covered under the EU ETS. This approach could be applied to estimate the value of carbon saving benefits realised by for instance commuters walking or cycling along inland waterways rather than travelling by car to work.

However, the benefit of carbon savings resulting from renewable energy generation would be valued according to the market price of carbon as described above.

(b) Drainage, water conveyance, flood protection and alleviation

Inland waterways provide flood protection and alleviation benefits through the presence and maintenance of bank side walls and locks, through the attenuation services provided by bank side habitats, and by acting as temporary storage reservoirs to reduce the initial impact of storm water run-off. Reintroduction of canals, reinstatement of sections of the canal or dredging can also deliver flood mitigation benefits by reducing the size of flood plain, subsequently decreasing the number of properties 'at risk'. Conversely, there is a risk that waterways can also present flood hazards in some locations where they are in close proximity to valuable property.

The values included in the framework are derived from Woodward and Wui (2001). This study is a meta-analysis of 39 international studies covering a range of valuation techniques including contingent valuation (travel cost and hedonic pricing) and market valuation techniques (net factor income, energy analysis, opportunity cost, cost savings and avoided damage costs, substitute costs, MV and net profits). Flood protection is valued at \$339 USD per acre per year (range from \$89 to \$1747 in 1990 prices) and applies to the addition or loss of 1 acre of wetland habitat. Although the benefit of flood protection is presented alongside many other disaggregated benefits, it is not clear what exactly this value captures (i.e. damage costs, or WTP for avoided flood risk, etc). The values are presented in the framework in 1990 UK sterling £ per hectare for ease of comparison.

There are a number of alternative approaches to value flood protection and alleviation benefits. The remaining literature available is discussed below.

The Multi Coloured Manual (FHRC, 2005) provides a methodology for estimating costs savings in terms of property damage avoided. This approach takes account of the number and type of properties within a certain area, along with estimated flood levels to calculate the cost savings provided by a given flood risk management activity or scheme.

Canals provide a surface drainage function, which can also provide indirect benefits in terms of flood protection. British Waterways (2008) present an analysis of the value of these benefits in the UK based on the cheapest alternative means of dealing with peak discharge (replacement cost approach). Using data originating from Fraenkel (1975), the total benefits of land drainage from the UK's waterways was estimated to be £67million. This is assumed to be a one off value as it presents capital cost savings, but may also include maintenance savings.

In addition to concerns over the age of the cost data, this cost-based estimate serves only as a proxy for the value of the flood protection and other benefits that may result from the drainage services provided as it is not a welfare measure. The estimate is not appropriate for use in the framework and a recommendation for further research into the drainage benefits provided by Inland waterways is provided in Section 8.

British Waterways (2008) note that flood prevention was identified as the overriding non-economic benefit of inland waterway⁶⁷ investment by stakeholders interviewed as part of IWAC's research into the value of inland waterways. Further, British Waterways estimates that the canals under their management drain 30% of the catchment area of England and Wales. This service will become increasingly important as the potential for flood risk events increase due to climate change, coupled with a possible decrease in the permeability of urban areas (e.g. due to development, residents paving their gardens, etc). For example, it was recognised that in the Pitt report that British Waterways management of the water level in the Gloucester and Sharpness Canal created sufficient capacity to enable the emergency services to pump water from Walham electricity switching-station in Gloucester in order to prevent it from flooding.

King and Lester (1995) compare the cost of maintaining current sea walls with the cost of maintaining differing amounts of salt marsh for flood protection. However, as discussed, costs are not reflective of economic value and should be used (as a conservative estimate) only where other forms of valuation data are unavailable. For example, Turner *et al.* (2005) examine the WTP values per person per annum (in the form of additional taxes) for preventing coastal erosion and associated flood damages through the protection of the Broadlands.

The alternative approach to valuing benefits is to use revealed or stated preference studies. First, the impacts must be quantified, for example ten houses avoid the risk of flooding because of the flood attenuation services provided by the waterway. These impacts are then valued by applying, through BT, the outputs of a primary study which assesses the WTP to avoid flooding.

A number of conceptual issues arise when considering the benefits provided by these services. For instance, in reality the benefits are only realised following a natural hazard event or heavy rain fall. There is therefore a probabilistic element

⁶⁷ It is not clear why these benefits are referred to as 'non-economic'.

involved. Also, the impact will often be dependent on the land management practices in place. With available data these variables can be built into the estimation of expected values.

To estimate the actual benefits, data are required on the frequency of the flood events and the role the waterways play in mitigating the impacts of such events. Where this data are not available or the assessment is being carried out at a regional or national level, it is often only possible to estimate the *potential* benefits provided by a given habitat. The level of the assessment and the stage at which it is undertaken therefore influences whether it is possible to estimate the actual or potential benefits provided by the waterways in terms of flood protection. This issue is discussed at some length in O’Gorman and Bann (2008).

The following studies relate mainly to coastal locations and involve both meta-analyses and guidance documents. They are not considered suitable for the framework.

Brander *et al.* (2003) completed a meta-analysis of wetland valuation studies covering a variety of benefits, including flood defence, generating an estimated value of £3,900 per hectare per year (2003 prices). The difference between this and the Woodward and Wui (2001) estimate might be explained by the fact that Brander *et al.* combined the services of flood control and storm buffering, whereas Woodward and Wui estimated flood control and storm buffering separately.

The Brander *et al.* (2003) also found significant decreasing ‘returns to scale’ in the values estimated whereby each additional unit of habitat provides slightly less benefit than the previous unit. This conclusion was backed up by Woodward and Wui who also found that by using multivariate regression analyses, this value per acre diminished rapidly as wetland size increased. Both studies found that urban wetlands have a significantly higher value than rural wetlands.

Brander *et al.* consider the transferability of their results and report that overall the average transfer error is 74%. This clearly suggests that these values should not be used for BT where a high level of accuracy is required. Woodward and Wui (2001) found that confidence intervals spanned thousands of dollars and also note that wetland locations chosen for valuation work will display selection bias – i.e. the locations may be favoured for one reason or another, so care should be taken when using the results in a BT exercise.

Both of these meta-analyses use data that is now fairly old, from a variety of international studies. It is therefore important to consider how individual preferences might have changed since the WTP studies were undertaken, especially given the recent increase in natural hazard events such as floods, which have occurred both in the UK and worldwide. Changes in preferences may not therefore be adequately accounted for simply by adjusting for income growth or purchasing power.

Under Defra’s Flood and Coastal Defence Project Appraisal Guidance (FCDPAG), flood defence benefits provided by wetland habitat can be valued using an avoided cost approach, whereby the money saved by not having to construct hard engineered defences to protect land and properties, is taken as the value of the benefits provided and used to justify the wetland. This guidance is under review and an update is expected soon. Since its production, the Environment Agency has produced guidance on how to value the benefits provided by wetland creation. This guidance was produced by Eftec. Eftec (2007) use the output of the Woodward and Wui analysis to estimate a total value for the benefits provided by the creation of

new wetland habitats. This value of £700 (with a corresponding sensitivity range of £200 - £2200) per hectare per year represents the benefits provided by a range of services as well as flood protection. It is therefore appropriate for estimating the total value of a habitat but not for estimating individual benefits.

Finally, Ghermandi *et al.* (2007) carried out a more recent meta-analysis of the benefits provided by wetlands. However, the only currently available paper reporting the results of this work contains no monetary values, but rather a discussion of potential correlations between dependent variables and values estimated.

(c) Water regulation and pollution dilution

In addition to the provision of water for drinking, water interacts with habitats and species in number of other roles within ecosystems. Inland waterways facilitate the transport of water and have a role to play in the water cycle. It is difficult however to separate out the role that inland waterways play in this process from that of other elements of the natural environment.

This regulation and transport of water can also provide water purification and waste treatment services, which result in the provision of clean or clearer water. This service provides a series of important benefits, including health related benefits, visual and aesthetic benefits and non-use benefits. The ability of habitat types to provide these services however will vary depending on its exact make up and the species present within it⁶⁸, and also on the processes and activities in surrounding areas which have resulted in 'pollution'⁶⁹ ending up in the waterway in the first instance.

The extent of the benefits provided is dependant on the current water quality and the habitats, species and human populations which rely on it. It is necessary to quantify the benefits provided prior to valuing them. It is the link between the waterway and how it provides pollution dilution benefits that has to be understood and quantified in this case. Given the dependant variables noted above, this is not a straightforward task.

The only suitable values for use in the framework capture the recreation and property related benefits associated with the avoidance of eutrophication of the waterways and are sourced from Pretty *et al.* (2002). This study assessed the environmental and social costs of eutrophication in freshwaters in England and Wales by conducting a series of loss-value estimates based on benefit transfers in order to estimate aggregate values.

The results reported include a figure of a 10% loss-value for properties adjacent to eutrophic waters. Care must be taken in applying this figure in the framework as it does not represent the income derived from higher property prices associated with adjacency to waterways, but rather the *loss* value when those waterways are eutrophic. This damage cost approach could be applied in cases where a scheme (e.g. regeneration or restoration) would result in reduced frequency of eutrophic events; the reduction in loss value could be applied as a proxy for the benefits of the scheme.

⁶⁸ For instance, filter feeding organisms can act to filter organic matter and pollutants from the water column.

⁶⁹ This might refer to pesticides, colouration or other potentially detrimental substances.

This study also includes a value of £16.90 per visitor day to estimate the recreational value loss due to water body closure. This was derived from average recorded expenditures over various water-based recreational activities (angling, canoeing, etc) and is aggregated according to the estimated number of visits per year, the frequency of closure and the net profit earned on such expenditure. This aggregate total is used as a net value for eutrophication loss without taking into account the possibility of displacement.

These values are recommended for use where it is possible to quantify the role inland waterways might play in avoiding eutrophication problems. For example, the unit expenditure values per visitor day could be used within the value-loss relationship functions provided to estimate the reduced value of recreation from eutrophication or conversely, the benefits provided by reducing eutrophication in waterways used for abstraction and recreation.

Further discussion of the available literature continues below.

The O’Gorman and Bann (2008) report presents a detailed review of the valuation data available to value the benefits of water purification and waste treatment services provided by ecosystems. Much of the literature is based around wetlands and the purification services they provide. Inland waterways themselves can act to dilute and transport pollutants downstream. The direct benefits of this may be realised by reduced treatment costs where water is abstracted, or improved environmental quality valued through non-use values.

For instance, McInnes *et al.* (2008) valued the removal of nitrogen and phosphorus by wetlands using a cost avoided approach. They apply unit costs of £8.32 kg / ha / yr for nitrogen and £12kg / ha / yr for phosphorus. These values could be used to estimate treatment cost savings at a local level where the extent of the benefit could be quantified. O’Gorman and Bann also provide an example of how water quality and waste treatment services might be valued at a local level using an abatement cost avoided approach.

(d) Water quality

As with habitat provision, water quality in and of itself is not an end benefit; rather use and non-use values are facilitated by good water quality (e.g. recreational opportunities, amenity values, existence and bequest values of wildlife populations supported).

Studies thought to largely capture non-use values only are discussed in the cultural services section below.

Georgiou *et al.* (2000) conducted a CV study of WTP for river water quality improvement related to fishing, plants and wildlife, and boating and swimming in the River Tame. At the time of the assessment, the condition of the River Tame was very poor. Fish stocks were virtually non-existent, plant growth, insects, birds and animal life were limited, and the river was unsuitable for boating and swimming. Three improvement scenarios were presented. The large improvement would see the return of trout and salmon fish with good game fishing opportunities, an increase in plant and wildlife with the possibility for the reintroduction of otters; and a river suitable for boating and swimming. The medium improvement involved some game fish species returning and the river quality improving enough for angling; a further increase in the number and types of insects, birds and wildlife; and lastly, a river made suitable for boating but not swimming. The small improvement scenario

involved a few fish species returning, more plant growth and waterfowl using the river, and water quality levels suitable for boating but not swimming.

Responses were elicited from 677 residents of the Birmingham area using a conceptual payment method of increased council tax bills. The mean WTP per household per year were £7.60, £12.07, and £18.12 for a small, medium and large improvement respectively (2000 prices).

This study is thought to be of high quality, with income constraints, distance decay and other potential biases systematically dealt with. It is not clear the extent to which the WTP elicited were driven by improved fishing, improved biodiversity and / or improved boating and swimming opportunities. However, the report suggests that the importance of protecting the environment was the main reason given for stating a positive WTP. Therefore, these values have been recommended for use in the framework to capture WTP for improvements in water quality, attributable to a range of regulating services. There is a risk that there is some double counting of use benefits however.

(e) Habitat provision

Habitat provision is not in itself an end benefit; rather it generates use and non-use benefits. Several studies estimate WTP values for habitat provision, biodiversity etc. These values are likely comprised of some elements of use value (e.g. wildlife viewing) and non-use value (e.g. existence, option use, bequest value).

For example, Spash *et al.* (2004) reported results of a CVM study which valued household WTP for improvements to biodiversity levels that had declined due to hydropower activity. The results are thought to largely capture non-use values and are therefore discussed in the cultural services section below.

Hanley *et al.* (2006) used a CE to examine WTP for improvements to three indicators of 'good ecological status', namely healthy wildlife and plant populations; absence of litter / debris in the river; and river banks in good condition with only natural levels of erosion. Two study sites were selected: the River Wear in County Durham, England and the River Clyde in Central Scotland, both of which were deemed to be broadly representative of water bodies in the UK where moderate improvements in water quality are likely to be needed.

The study focuses on the section of the River Wear flowing through the city of Durham, which has many man-made structures built in and across river channels. It is an important coarse and game fishery as well as a centre for other water-based recreation and tourism; however there are existing problems with water quality, including litter accumulation, acidity, flow alteration and a general decline in habitat. The section of the River Clyde chosen flows from Lanark to Cambuslang Bridge, which is mainly urbanised with many recreational and tourist attractions including areas of great natural beauty, but also includes some problematic stretches in terms of water quality.

Respondents were recruited from the local population living around the two case study areas, resulting in 210 responses for each river. Each attribute was described at two levels – 'fair' which was thought to be consistent with current conditions and 'good' to capture regulator's aspirations of good ecological quality status under the WFD. Respondents were asked to provide a WTP bid in the form of higher water rate payments by households to the local sewerage operator and were presented

with choices of £2, £5, £11, £15 and £24 (in 2006 prices) against three options which gave an improvement in at least one attribute.

The sample size taken is fairly small; however the authors note that it is “comparable to others reported in the CE literature”. The choice of ‘status quo’ whereby a zero-cost, zero-improvement is selected is analogous to ‘zero bids’ in CVM studies; however, unlike CVM, no statistical framework has been developed for handling this type of sampling bias in CE.

The survey produced values of £12.54 per household per year for improvements in river ecology from ‘fair’ to ‘good’ in the River Wear, £60.08 in the River Clyde and £20.17 for both rivers combined. This clearly demonstrates the inefficiencies of applying BT using either of these sample results, as both values and preferences elicited differed considerably over what were thought to be similar sites. Further, the River Clyde sample produced higher values for their local river than the River Wear sample despite a lower income. Other key findings were that respondents in the River Wear sample demonstrated preferences towards ‘river ecology’ above the other two parameters; whereas the River Clyde sample placed insignificantly different values on the three.

For comparative purposes, the values generated for an improvement in aesthetics from ‘fair’ to ‘good’ were £12.35, £42.38 and £16.91 for the River Wear, River Clyde and both rivers combined; improvements to bank side conditions from ‘fair’ to ‘good’ elicited values of £12.92, £67.08 and £21.53, respectively. These values should not be taken as additive – in other words, one cannot simply combine these values from each sample to arrive at a total WTP for improvements in all parameters. Such is the design of a CE which primarily facilitates the consideration of environmental trade-offs.

The water environment may be valued in terms of supporting a particular species, for example, a study by Lawrence and Spurgeon (2007) assessed the general public’s WTP for changes in salmon stocks across England and Wales and found that the mean WTP per household per year to prevent “severe decline in salmon populations across all of England and Wales” linked to a specific disease rather than general river quality, was £15.80 per household per year (in 2001 prices). However, the authors note that this may be an overestimate of WTP for salmon alone if respondents were also incorporating their WTP for general river quality and habitat, and conclude that at worst, WTP could be a third of these values.

Stated preference surveys were employed to ascertain the general public’s WTP for salmon stocks and other aspects of river quality. Both users and non-users of rivers were interviewed (911 interviews in total) and presented with a WTP scenario asking for additional spend each year on top of what respondents already pay. The results, therefore, can be interpreted to capture all aspects of TEV not currently paid for. The respondents were asked about real rivers in incremental distances from their place of residence – one river either <5km away, 5-20km away or 20-50km away and a second river either 50-100km, 100-200km or over 150km away. Certain river characteristics were tested for level strength as an influencing factor, namely length of river, whether in an urban or rural setting, and whether it was designated as a Special Area of Conservation (SAC).

WTP was found to decline for the first 70km away from the river, and then level off. Loss aversion was demonstrated by the CE – in that respondents were WTP more to avoid environmental degradation than to achieve an environmental improvement (2.6 times more according to illustrative analysis). Guidance is provided as to the

use of outputs in BT, namely adjustment factors that could be used to adjust WTP to allow for different degrees of change in the status of salmon stocks, other fish and general river quality; as well as to allow for different types of users (e.g. a lower average income sample). This study is not in the framework as the WTP elicited is not considered to fit with the benefits categories of interest

C.4.3 Cultural benefits

Cultural services provide the non-material benefits people obtain from the environment through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences. This category therefore includes both direct non-consumptive uses (such as recreation, aesthetic and cultural heritage and community aspects) and non-use values (NUVs).

There is a large amount of data available on the value of the **recreational use** of inland waterways. Values for *water based* recreation are all inland waterways specific, and many are from reasonably recent studies making them likely candidates for transfer. *Land based* recreation is also well covered in the literature with studies providing both CS and expenditure values along with total WTP values.

The main gaps in the literature are in the 'softer' cultural benefits, relating to **heritage values, education and training and community aspect**. This is an unsurprising finding as these benefits are difficult to quantify.

The **direct non-consumptive** uses provide benefits through a range of recreational activities from visitors enjoying the general setting (i.e. informal users), to serious sporting enthusiasts canoeing / kayaking on the inland waterways. Heritage values of the canal structures and buildings⁷⁰ along with benefits gained from education and training (including volunteering) conducted in association with inland waterways are also considered to be a non-consumptive use.

This section outlines the literature on non-consumptive use and non-use values. The discussion is grouped by benefits type starting with general land and water based recreation for all / informal users progressing through to more specific land based then water based uses, such as bird watching, boating and angling. Other values for non-consumptive uses follow, ending with a discussion of non-use values.

(a) Recreation

Recreational activities include in-stream or water based sports such as canoeing, angling, boating / sailing and swimming. Forms of land-based recreation include walking, dog-walking, cycling, picnicking, wildlife / scenery viewing.

As noted in Section 5, total WTP is made up MV (or expenditure) plus CS. Literature pertaining to both is discussed in turn below.

Consumer surplus values

While expenditure figures can be taken from recorded data (see expenditure values below), determining CS is less easy. There are several methods for estimating CS, including stated preference (CV and CE) and revealed preference (TCM and HP).

Willis and Garrod (1990) used the travel-cost method (a revealed preference (RP) technique), to determine visitor WTP for the recreational benefits of the Montgomery

⁷⁰ British Waterways is the third largest owner of listed buildings in the UK according to British Waterways (2008).

and Lancaster canals. In this case, the amount individuals are willing to spend on travelling to a recreation site is used as a lower-bound estimate of CS. The study reports travel cost values for the following users – dog walkers, shortcut takers, fishermen, boaters, visitors to attractions and walkers for both canals. ‘Casual’ users are found to have a lower CS than users where the canal forms an essential part of the activity, such as fishermen or boaters.

The data was collected from two separate surveys – one at the Lancaster Canal undertaken in 1987 (925 people interviewed) and one at the Montgomery Canal in 1988 (393 people interviewed). It is assumed, for the purposes of this report that the values relating to Lancaster Canal users are presented in 1987 prices and the Montgomery Canal in 1988 prices. The Lancaster Canal extends for 35 km and includes 19 locks, meaning it is navigable only along short routes by light craft. The Montgomery Canal, however, stretches for 41km and is lock-free.

The average values generated (based on truncated regression as recommended by the authors) were £0.092 per visit for Montgomery Canal and £0.112 per visit for the Lancaster Canal. Higher estimates were generated for rural stretches than those in developed areas. The highest values were generated at Frankton Locks – the site where two canals meet and which in addition, offers a pub, horse riding, a museum, boating, and good opportunities for wildlife viewing. The authors note that urban locations may offer some of the same amenities, but suspect that the increased presence of litter, dog fouling, etc., render the urban sites less attractive.

In order to calculate an aggregate total, the average CS values by recreational activity (informal users only) are multiplied by the estimated number of participants of that activity, resulting in totals of £106,533 per annum for the Lancaster Canal and £78,424 for the Montgomery Canal. However, the authors comment that these figures are still less than the financial deficit incurred by British Waterways and recommend the inclusion of the opportunity cost of time which would result in higher (and more accurate) CS estimates.

The values range from £0.007 per visit for short cut takers to £0.13 per visit for anglers (1988 prices). The authors note that the exclusion of time costs from the analysis means the CS values are likely to be *lower* than those for full-cost CS estimates. Also, the choice of a linear model function implies that the CS for those who visit just once is most certainly an underestimate, but is nevertheless applied across all users.

Willis and Garrod (1991) again used the travel-cost method to determine visitor’s WTP for the recreational benefits of various inland waterway sites throughout England. These comprised:

- Anderton – a semi rural location
- Gloucester and Sharpness Canals - runs through a number of locations thought to be primarily rural in nature
- Newark – a market town situated along the River Trent
- Weaver Navigation – a semi rural location
- West Midlands canals – various narrow canals covering a range of locations, thought to be primarily urban

This study employs the individual travel-cost method (ITCM), whereby observations of the number of trips completed by each individual visitor for a particular activity during any one time period becomes the dependent variable. Note, unlike Willis and Garrod (1990), this study incorporates the opportunity cost of time valued at 43% of

earnings⁷¹ with appropriate reductions for children and non-working individuals. Issues associated with this method of analysis include imperfect information regarding individual utility function – e.g. the extent to which the frequency of visits reflects that individual's demand for recreation. However, it is useful for determining the way user sub-groups value the waterway in terms of a specific activity.

These results were then compared against those generated by a CV question on the same survey, which asked respondents their maximum WTP for access to the canal to pursue their activity of choice, in order to confirm the 'ball park' magnitudes of the travel-cost CS estimates. The link between ITCM and CV was found to be "weak" as CV resulted in higher responses in some instances but not in others. The purpose of the study, which was to prove that ITCM results are 'reasonable' (i.e. in the same order of magnitude as CV and other WTP estimates), was realised; however, the authors ultimately conclude that the CV methodology may be more appropriate for use in future evaluations.

The CV results are summarised in Table C.5 below. The estimated average visitor CS is £0.55 per visit (1989 prices). In general, it revealed that "more local activities, like taking a short cut or shopping" generated a lower CS estimate than activities which are directly dependent on the canal.

Table C.5 Contingent valuation estimates of WTP for different types of informal recreation by canal (pence, 1989 prices)

Activity	Newark	Anderton	Weaver	Gloucester	Midlands
Canal scene viewing	37.65	64.43	39.51	38.94	28.48
Boating	38.57	79.76	-	37.40	35.00
Fishing	45.00	-	75.00	73.59	33.91
Walking	24.08	55.26	37.30	39.97	30.38
Shortcut taking	36.00	-	10.00	30.00	7.20
Dog walking	16.47	22.44	31.48	32.03	19.02
Wildlife viewing	36.50	62.50	35.76	37.24	44.17
Drinking	28.96	73.11	35.19	41.72	30.83
Shopping	37.03	90.00	55.00	36.45	35.09
Visiting attractions	33.04	91.11	37.30	36.35	-
Eating	-	-	-	41.97	-
Cycling	-	-	-	-	30.56

Source: Willis and Garrod (1991)

Table C.6 shows a comparison of the average CS results for ITCM versus CV. The travel cost estimates are noticeably higher than those generated in Willis and Garrod (1990). This may be partially, if not wholly, explained by the inclusion of the opportunity cost of time into the results. Still, the average CV results are higher than the average ITCM results (using the truncated maximum likelihood over ordinary least squares (OLS) regression as recommended by the authors) for nearly every recreation type.

⁷¹ As recommended by the Department of Transport, 1987.

Table C.6 Comparison of contingent valuation and travel cost estimates* averaged over all canal survey locations (1989 prices)

Activity	Lower bound CS estimate	Valuation method	Upper bound CS estimate	Valuation method
Canal scene viewing	£0.33	TCM	£0.42	CVM
Boating	£0.23	TCM	£0.48	CVM
Fishing	£0.02	TCM	£0.57	CVM
Walking	£0.32	TCM	£0.37	CVM
Shortcut taking	£0.21	CVM	£0.21	CVM
Dog Walking	£0.15	TCM	£0.24	CVM
Wildlife viewing	£0.43	CVM	£0.46	TCM
Drinking	£0.38	TCM	£0.42	CVM
Shopping	£0.22	TCM	£0.51	CVM
Visiting attractions	£0.49	CVM	£0.75	TCM
Eating	£0.48	CVM	£0.48	CVM
Cycling	£0.31	CVM	£0.31	CVM

Source: Willis and Garrod (1991)

*Note: travel cost estimates are average results calculated by the truncated maximum likelihood as recommended by the authors over the OLS regression results.

Using the CV results, the highest WTP estimates were generated at Anderton. The ITCM results, however, produced the highest results at Gloucester and Sharpness canals. This can be rationalised by the fact that respondents are likely to have travelled farther (therefore incurring a higher travel cost) to rural locations, as opposed to those which are right on their doorstep. This does not necessarily infer a preference for rural settings.

Generally, the authors surmise that variations in results between survey sites may be attributed to the amenity of the location of these sites, the area of Gloucester and Sharpness canal around Frampton elicited the highest CS estimate which “might be explained by the undoubted charm of the village and its environs”. However, the study does not explain low CS estimates by the disamenity of the location, rather it estimates that responses recorded at Hawksbury and Tardebigge, for example, may be due to the high concentration of locals visiting with negligible travel cost. This is an inherent issue with the individual travel cost method: that its results are biased against local users and favours those from further afield.

This study is of reasonably high quality. Issues to consider include the omission of substitute sites, which could be significant and potentially lead to overestimation of the values when aggregating over several locations. Further, the lack of information on non-visitors means that the results are biased toward positive responses, generating an over-estimate of CS per visitor. This has been adjusted for by fitting a model which derives the maximum likelihood of visits from the data. However, the choice of a linear function is such that it under-estimates CS for those visitors who made only one visit to a canal. Thus the application of this value to approximate total CS per visitor, regardless of the number of visits made, results in a definite **lower-bound estimate** as stated by the authors.

Both of the Willis and Garrod (1990 and 1991) papers are heavily referenced in later secondary valuation studies and the BT literature (see discussion below). Furthermore, despite now being nearly 20 years old, they remain the most relevant and robust estimates of the CS value of recreation of inland waterways. However, there is no reason to assume that the preferences held in the early ‘90s still hold today given the changes in our society since that time, specifically relating to disposable income, the growing awareness about the value of the environment in

providing recreation and other benefits, and the increasing scarcity of our natural resource base.

At a minimum, the opportunity cost of time could be adjusted according to current average earnings, along updating the value of petrol – a key travel cost; however, having consulted with the author it is recommended that the values are uplifted to 2009 prices only. Therefore, in doing so, these values should be treated with caution as they are likely to represent lower bound estimates of the current WTP values.

In conducting an appraisal of the potential economic benefits of a restoration project along the Cotswold Canal, Ecotec (2003) borrowed values from Willis and Garrod (1990) to estimate the benefits to all canal users ‘without a charge’. They take the average of £0.507 / trip for all visitors using the CV and TCM results, and uplift the price to £0.79 (in 2003 prices). This figure is then aggregated across the estimated informal users anglers and cyclists. No further adjustments are made. Similarly, Harrison (1999) references the 1990 study, taking the average CV estimate for informal visits across all sites and uplifting the price to £0.48 (1996 prices). However, no attempt to further adjust or aggregate this figure is made. Pretty *et al.* (2002) also reference the study, presenting a high-level range of £0.30-£0.40 / trip to value the CS benefit of informal visits to canals in the UK.

GHK (2005) adopts the Willis and Garrod (1991) values to determine CS for canal side recreation (including informal users / walkers), resulting in a range of £0.57-£0.72 (2004 prices). The lower bound estimate is claimed to be derived from the average response to the CV question and the upper bound by the average travel cost given by walking visitors over all the canal locations. However, this is not evident in the original text, given that the average travel cost estimate presented for walking visitors (calculated by the truncated maximum likelihood) is clearly lower than the CV estimate. No adjustment, other than price uplift has been made.

GHK (2005) justifies the use of higher CS values (suggesting £2.00 - £5.00) for angling and boating / canoeing as the Willis and Garrod survey estimates “are based on limited sample sizes and appear unusually low, particularly when compared to estimates from other studies.”

Ecotec (2007), in their economic assessment of the Welsh canal network, use a BT to apply the values derived in Willis and Garrod (1991) to quantify the recreational benefits of informal visits and cycling visits. They use the average WTP over all canals of £0.362 / visit and uplift this value to 2007 prices (£0.70 / visit). For in-stream recreation (boating, angling and canoeing) Ecotec (2007) refer to GHK (2005), taking the line that these activities command a higher CS value of £2.00-£5.00. This range is applied directly, without adjustment, to the estimated visitor numbers by activity type.

As demonstrated, secondary studies which reference the original Willis and Garrod 1990 and 1991 studies are not always entirely transparent in their choice and use of benefit values. However, little adjustments seem to be made, adjustments other than uplifting the value to the current price level to account for inflation.

Expenditure values

Values taken from a handful of studies have been recommended for inclusion in the framework to inform average expenditure estimates for various recreation types. In addition, the British Waterways IWDVS collates data on expenditure values. The literature reviewed is discussed here, however the average value from the IWDVS is also provided in the framework.

Ecotec (2006, update of 2002) completed an economic assessment of the restoration of the Kennet and Avon Canal which assessed the economic benefits of additional tourism and leisure activity. The study presents the average visitor expenditure per visit for boating (hired and owned) (£13.32), canoeing (£3.20), cycling (£7.01), angling (£6.50), and informal visitors (£4.57). These findings support, in general, the studies reviewed throughout this section, in that visitors whose use explicitly involves the waterway value the waterway more than informal users and are possibly therefore happy to spend more undertaking these activities. However, the value presented for canoeists, taken from a 1995 British Waterways survey of unpowered boat owners, seems contrary to this correlation.

GHK (2005) estimated the value of a number of benefits from the restoration of the Bedford Milton Keynes Waterway. The majority of the values are expenditure values per specific usage per person per visit. For example, informal visitors / walkers spend £5 per visit compared to anglers who spend £6.50. Visitors who hire private boats spend the most - an average of £38 per visit. These estimates of expenditure are surprisingly similar to those estimated by Ecotec above except however in the case of boat hire costs which seem to vary greatly for no obvious reason. The 2006 Hire Boat survey (quoted in British Waterways, 2008) estimates an average expenditure of £95.10 per day for boat hire.

Jacobs-Gibb (2001) conducted an EcIA of four restoration options along the Chesterfield Canal. Varying expenditure figures were applied by the authors depending on the nature of activity, including £9.00 / £11.80 average daily spend per boating visitor for owned boats and £13.00 average daily spend per hire boat visitor. These estimates were used to value the benefit of increased boating activity arising as a result of the restoration schemes.

Glaves *et al.* (2007) compiled over 200 reports on the assets, uses and benefits of the inland waterways. The majority of the values are either expenditure or income values relating to the FTE jobs created or the average expenditure per visitor per visit. The expenditure values found are very similar to those values listed above for example, walkers spend on average £6.21 per visit, general day visitors spend an average of £4.50 per day, and visitors to waterside pubs and restaurants spend an average of £2.62 per visit. Where estimates are found to be reasonably consistent in different locations, this might increase the transferability of such estimates.

In order to estimate the FTE generated as a result of recreation / tourism expenditure, there are a number of multipliers used throughout the various EcIAs. As previously discussed, expenditure figures should be adjusted to account for direct, indirect and induced spend. In a recent EcIA study, Ecotec (2007) applied factors of 1 FTE per £40,000 general visitor spend (including, direct, indirect and induced expenditure) and 1 FTE per £80,000 boating expenditure. These have been identified for use as multipliers, but are not incorporated in the framework explicitly.

British Waterways (2007) apply a factor of 1 FTE per £35,000 visitor spend as a result of a restoration project (assuming that the benefits will be generated 5 years after restoration is complete). Ecotec (1996) applied a factor of 1 FTE per £25,000 visitor spend, as did Jacobs-Gibb (2001); however it is not clear whether these figures include indirect and induced expenditure.

British Waterways (2008) assume high levels of displacement for FTE associated with recreational activity. For example, due to a reasonable degree of

substitutability, FTE associated with angling is assumed to correlate to 50% displacement, informal recreation to 80% displacement (due to numerous alternative locations for walking, sightseeing, etc). However, boating is assumed to have no alternative locations within a region; therefore gross FTE associated with boating activity is assumed to be entirely attributable to waterways at a regional level.

Further discussion of specific recreation types is continued below.

Running, walking and dog walking

There are a handful of studies which consider the value of recreational walking / dog walking associated with inland waterways.

GHK (2005) estimated the average spend per visit to be £5.00 (2004 prices) for walking visitors. This value is recommended for use in the BT framework.

Similarly, Graves *et al.* (2007) reported an average value of £6.21 (2007 prices) reported throughout the literature.

As previously discussed, both the Wills and Garrod (1990 and 1991 studies) estimate CS values for walking visitors. These studies (applying both the CV and TCM results) are recommended for use in the framework, forming a range of values to estimate the benefit.

There are no studies identified in relation to running specifically however expenditure values are provided in the IWDSV. There is potentially a large benefit as yet unrealised in terms of exploiting tow paths for use in organised events such as competitive runs or charity runs.

Cycling

Studies which consider the recreational benefits of cycling specifically are relatively sparse.

Ecotec (2006) refer to the British Waterways Kennet and Avon Tow Path Survey (2005) which found average expenditure for cycling visits to be £7.01 / day (2005 prices). This figure is 40% higher than that reported for 2002, revealing an increase in expenditure substantially above inflation. GHK (2005) estimated average cycling expenditure to be £5.00 per visit (2004 prices).

The only WTP study concerning cycling is Willis and Garrod (1991), with estimated CS values of £0.31 per visitor per day (1989 prices).

These two estimates are used to form a range of average expenditure values associated with recreational cycling trips in the framework.

Cycling is associated with values beyond recreation. For example, towpaths provide excellent green transport links, particularly in urban areas. The health benefits of green exercise are also touted throughout the literature, as discussed further in the 'other' services section below.

Wildlife watching

Waterways serve as important habitats for many species, and also bring nature right to the doorstep of otherwise urban locations.

British Waterways conducted a national online survey of waterway wildlife by visitors to canals and rivers in August 2004⁷². The information was collected in order to help manage and protect the wildlife habitats which inland waterways provide as well as contribute to the national biodiversity database. Hundreds of sightings of herons, mallards, swans, coots, geese, moor hens, toads and dragon flies were recorded, along with rarer species such as water vole, bats, grass snakes, kingfishers, terrapins, otters and osprey.

There are many invertebrate species inhabiting the waterways, as well as fish and a number of protected mammals, whose populations in the UK are dwindling. As such, many canals and their surroundings have been designated as wildlife sites of local, national and international importance. These designations include Special Areas of Conservation (SACs) under the Habitats directive, Sites of Special Scientific Interest (SSSIs) and Species Protected Areas (SPAs) for breeding birds.

The wildlife and biodiversity of inland waterways will generate several forms of economic values, the majority of which is likely comprised of non-use values. However, wildlife viewing can be valued separately as a type of informal recreation. The literature on this is limited; O'Gorman and Bann (2008) found no available participation data for this activity in England. This gap therefore limits the valuation of these benefits.

Bird watching specifically generates significant benefits to the economy, as documented in a number of studies.

Dickie *et al.* (2006) assessed the economic impacts of bird watching in the UK associated with ten spectacular bird species. For example, the admission charge to the RSPB centre to view capercaillie was £3.00 in 2006. Expenditure attributed to Rutland Osprey Project Wild Life Trust Reserve per person for day trippers / holiday makers was £7.86 and £52.95, respectively. Visitor expenditure to the Isle of Mull specifically attributed to sea eagles was estimated at £1.4m - £1.6m per annum. This is based on recorded average expenditures of £119.55 per day for holiday visitors and £55.78 per trip for day visitors and attributing 75% of expenditure to those who indicated sea eagles were 'main reason' for visit and 20% for those who said 'one of the reasons'. Using a multiplier of 1FTE per £38,650 tourist spend, Dickie *et al.* estimate that 320 FTE are supported by the presence of sea eagles.

An average expenditure figure of £7.17 per person per day for bird watching has been recommended for use in the BT framework. It should be noted that this study relates to 'spectacular' bird species which are likely to command higher tourism value.

The RSPB estimated average daily expenditure per bird watching visitor to be £4.00 - £13.00 depending on the location (RSPB, 2001 as quoted by Graves *et al.*, 2007).

Woodward and Wui (2001) conducted a meta-analysis of wetland valuation studies, resulting in an estimated benefit value of \$578 - \$2,782 per hectare of wetland habitat per year for birdwatching (1990 USD). The Handbook for Flood and Coastal Erosion Risk Management (Eftec, 2007) incorporated the results of this study into a valuation framework, producing a benefit value of £2,750 per hectare of wetland habitat per year (2005 prices). The framework recommends the use of this value for creation of wetland habitat that is suitable for specialised recreation / tourism such

⁷² British Waterways National Wildlife Survey Results, October 2004.
<http://www.britishwaterways.co.uk/newsroom/all-press-releases/display/id/1466>

as birdwatching or similar. However, it also includes ecosystem goods, biochemicals and genetics with no attempt to disaggregate by benefit category.

Other studies have been conducted in relation to bird and wildlife watching but these studies either determine WTP for additional amenities (such as bird hides) rather than for the animals themselves or are not UK focused and as such, are considered inappropriate for application here (Hanley, 1989; Walsh *et al.*, 1990; Clayton and Mendelsohn, 1993; Shafer *et al.*, 1993; and Hanley, 1998).

In terms of valuation studies relating to the broader category of wildlife viewing, WTP estimates have been elicited by Christie *et al.* (2006) for different forest recreation types including nature watching. Nature watchers (visiting forests) were found to have a WTP of £8.64 per visit. This value is considered to be conservative as it is significantly lower than the WTP estimated within this study for the other forest activities. This estimate is not considered suitable for the BT framework, however, due to the low benefit consistency resulting from the different environmental attributes being valued (i.e. forest versus inland waterway).

Field (2008) references Willis and Garrod (1991), which generated average CS estimates of £0.45 - £0.88 (updated to 2001 prices) for the recreational activity category "wildlife viewing". Willis and Garrod (1990) recorded only one estimate of WTP of £0.04 (1989 prices) for wildlife viewing taken from the Montgomery canal survey. Again, this seems unusually low compared to the 1991 study, for reasons which are discussed in above.

Waterways may also provide a dis-benefit in that they may serve as transport corridors for invasive non-native species, thereby aiding their spread. The literature on this has not been considered here, it is simply added as a point of information.

Visitor attractions

Inland waterways may command higher visitor expenditures and CS values where visitor attractions are available; such as the Anderton boat lift and Standedge tunnel. However, the literature review revealed a relative scarcity of valuation studies relating to visitor attractions on or adjacent to waterside locations.

GHK (2005) estimated average visitor expenditure to a new attraction planned (an "innovative lift facility" likable to the Falkirk Wheel) to be £4 per person per day (2004 prices) based on a previous study by British Waterways on visitor expenditure to the Falkirk Wheel in 2004.

Again, expenditure figures are not truly illustrative of economic value and should ideally be added to CS in order to obtain total WTP. Entrance fees may be taken to represent lower-bound estimates of CS, as the entrance fee plus expenditure gives an indication (albeit conservative) of the benefit derived from a particular visit.

Glaves *et al.* (2007) reported the average entry fee to the 28 National Waterways Museums to be £4.75 - £8.50 per visit (2007 prices). Referring back to Willis and Garrod (1991), the estimated CS for visiting attractions is reported to be £0.49 - £0.75 per trip (1989 prices); however, it is not clear what this broad category definition might encompass.

Efttec (2005) conducted a literature review in order to inform the economic valuation of historic built heritage. While none of the studies quoted relate directly to inland waterways, their discussion may be useful in gauging the reasonableness of the figures above. For example, the study quotes the range £0.90 - £1.20 for entry fees

per person to visit Warkworth castle from Powe *et al.* (1994), as well as £0.80 entry fee per person to visit Durham Cathedral from Willis and Garrod (1994). Eftac (2005) do not adjust these figures directly (presented in 1994 and 1993 prices, respectively), but apply them as a proxy for valuing access / visitor benefits. Cultural heritage values are further discussed below.

Note that many of the figures quoted relate to fairly significant attractions which would expect to draw high amenity value and are unlikely to be transferable. Further, WTP for visiting sites which are of historic or cultural importance may include elements of preservation or bequest value beyond the value of a recreational visit; for example, if entrance fees contribute to the management or restoration of a heritage asset. For these reasons, only Willis and Garrod (1991) values are recommended for inclusion in the BT framework which are thought to best represent a broad range of canal / river side attractions.

Canoeing

There were 1.05 million canoeing participants in the UK in 2007⁷³, illustrating that rowing and canoeing are popular sports. However, both the Amateur Rowing Association and the British Canoe Union (BCU) believe that with greater opportunity and advice, participation could increase substantially.

Consequently, the Broads Authority is implementing a sustainable tourist strategy for canoeing and biking routes. The Environment Agency is also seeking to improve canoe access to inland waterways and other water areas through local access agreements. These voluntary agreements have consolidated and extended access arrangements in four pilot areas. The BCU argue however that it will not be possible to make voluntary agreement in more difficult locations and that the only solution is open access legislation on the Scottish model.

As previously discussed, Ecotec (2006) presents average visitor expenditure figures for canoeing of £3.20 per trip (2006 prices). This value seems contrary to the correlation between WTP for a particular form of recreation and that from directly relying on the waterway. This could be due to the nature of canoeing / kayaking, for example perhaps there is less opportunity to stop for refreshment breaks, etc, rather than canoeists truly valuing the experience less than other users.

In comparison, GHK (2005) estimated average daily expenditure for canoeing / kayaking to be £5.00 per visit along a proposed canal restoration site (2004 prices). These two estimates are recommended for use in the BT framework to form a range of values to capture this benefit.

As previously discussed, CS values can be added to expenditure to estimate total WTP. Jacobs-Gibb (2001), for example, estimated CS to be £6.00 per person per day for boating visits (2001 prices). However, no such value has been identified for canoeing / kayaking recreational visits specifically.

Pretty *et al.* (2002) refer to FWR (1996) in citing a WTP value of £1.38 for freshwater canoeing (1999 prices); however no further information about this primary study or the derivation of the WTP estimate is provided. Presented within a broad survey of valuation studies, this value appears quite low; indeed Pretty *et al.* adopt a range of £8 - £14 per trip (1999 prices) to reflect the CS for all forms of recreational visits. Even this range, they surmise, is "conservative".

⁷³ Watersports and Leisure Participation Survey 2007
<http://www.bcu.org.uk/files/RYA%20Watersports%20Participation%20Survey%202007.pdf>

Angling

For reasons which are not considered further here, angling rates have declined on navigable waterways. British Waterways are trying to reverse this decline through investment in services and promoting recreational opportunities, particularly in less popular areas, in order to maximise the potential of the waterways which they manage (IWAC, 2007). However, it is not clear if the decline in angling activity is due to a change in the nature of the sport, or a lack of adequate provision. For example, there seems to be unmet demand for off-line moorings, but because of unreliable information, it is not clear whether this under-supply is valid for much of the system or just for hotspots.

As a specialised form of recreation, angling has a considerable economic value associated with it. Again, average expenditure can be considered alongside CS to provide an indication of welfare gain or total WTP per angling visit.

The values recommended for use in the framework to capture the benefits of recreational angling are taken from Spurgeon *et al.* (2001). This study is the second of a two-part assessment and involved a national CV survey of 806 anglers. The anglers were drawn from six regions within England and Wales and were asked for a WTP estimate relating to their usual angling site. Combined with expenditure, the average total WTP per coarse angling trip was found to be £21.10 for rivers and £15.70 for canals (2000 prices).

The results varied by type of waterbody and angling type as reported in Table C.7.

Table C.7 Anglers total WTP by type of angling and type of waterway (£ / trip) (2001 price)

	Course Angling			Game Angling		
	Expenditure	CS	Total WTP	Expenditure	CS	Total WTP
River	18.00	3.10	21.10	26.00	4.30	30.30
Canal	13.00	2.70	15.70	-	-	-
Lake	17.00	2.40	19.40	27.00	3.10	30.10

The authors also produced estimates (using the 5% trimmed mean) of £2.10 per angling trip for coarse fishing and £2.70 per trip for game fishing. These can be applied across all water body types as conservative estimates. These values “represent the additional value gained per angler for each angling trip, as measured by their WTP more for it.” The study notes that the WTP values are likely to contain an element of anglers’ option and existence values in addition to their use values.

This is a reasonably high-quality study with outputs that are considered appropriate for use within the framework. A pilot study was undertaken, socio economic information of the sample was gathered in order to inform the validity of assessment and respondents were asked to consider substitute sites. Because this is a national study, rather than site-specific, the outputs are useful for determining representative values.

A further discussion of the available literature concerning angling benefits is continued below.

Average expenditure estimates for angling are fairly consistent at £6.50 / trip (2005 prices) from Ecotec (2006), £6.50 / trip from GHK (2005) and £5.85 / trip daily expenditure including permits, travel and food (2000 prices) from Jacobs-Gibb (2001). Similarly, Glaves *et al.* (2007) in their literature review of 200+ studies, reported average individual expenditure per angling visit to be £1.80 – £7.00 (2006 prices).

Jacobs recently carried out the first of a two-part assessment of the economic value of inland fisheries in England and Wales for the Environment Agency (Environment Agency, 2007). Module A involved the use of both CV and CE surveys to quantify the general public's WTP for salmon (with some additional information elicited on their WTP for other freshwater fish and for general river quality). The CV survey estimated a WTP to maintain salmon stocks of £15.80 per household per annum; however no attempt was made to split this value between use and non-use.

The WTP estimates in this 2007 study are significantly larger than those generated by Spurgeon *et al.* (2001). This is likely to be in part due to the nature of the valuation – asking a WTP for *all* salmon stocks, rather than a specific water body. The report does recommend calculating a value per river by simply dividing the total WTP per household by the number of rivers in England and Wales. This calculated value may be more appropriate to use when considering inland waterways as it reflects the benefits of a wider range of waterways and fish stocks.

Jacobs-Gibb (2001) give an estimate for CS per angling visit of £1.96 (2000 prices). This is taken from the MEP, GIBB and PAS (2000) report of an economic model that calibrates WTP values according to the type of water body, regional location, water quality and fishery quality. However, this primary study could not be located; therefore no further information can be provided as to the derivation of the CS figure. Jacobs-Gibb (2001) apply this value directly to the expected number of angling visits per annum in order to determine the economic benefit to anglers resulting from the Chesterfield canal restoration project.

Johnstone (2003) conducted a WTP study for rivers in ten English Nature 'natural areas' and estimated an average CS value of £6 - £30 per angling trip. This is quoted from Eftec (2005). Johnstone (2003) also reported WTP for a 10% change in various river water quality indicators to range from £0.01 - £0.84 (2003 prices). This is the only study uncovered which values WTP for a marginal change in water quality relating specifically to angling. Unfortunately, this primary study could not be located; therefore no further information is available as to the appropriateness of these figures being incorporated in the framework.

Other estimates of angling CS include the values derived in Willis and Garrod (1990 and 1991) which, as previously discussed, have been dismissed as more recent and appropriate values have been identified.

Boating

Boating is a lucrative industry in the UK, with £4.5m spent on holiday boat hires and £1.6m spent on day hires in 2002 (Ecotec 2002, as quoted by Field, 2008). Boating generally elicits higher expenditure values than other forms of recreation associated with inland waterways, as boats are costly to own or hire. Aside from the purchase price, licensing and mooring fees and annual maintenance costs, etc. can be substantial. Graves *et al.* (2007) found that annual licence fees range from £135 - £787 (2006 prices) depending on the boat type and location. Jacobs-Gibb (2001) estimated that the average annual income for a hire boat in the UK is £15,000 (2000 prices).

The majority of data found on individual boating expenditure and CS is contained within studies already discussed in this section. The average expenditure values recommended for use in the BT framework are taken from GHK (2005) who reported an average expenditure per boating day of £38.00 for hired boats and £11.00 for owned boats (2004 prices). Similarly, Jacobs-Gibb (2001) estimated

expenditure for hire boat users to be £13.00 / day (2000 prices) and £9.00 / £10.80 per day expenditure for owned boats for cruising / non-cruising, respectively. These values are used to compare the economic benefit of several restoration projects by aggregating them against the expected rise in owned / hired boating activity in the vicinity.

Reported CS values are similar to those for other recreational activities. For example, Field (2008) references Willis and Garrod (1991), taking the upper and lower bound estimates of WTP for boating (£0.23 - £0.48 in 1989 prices) and uplifting them to 2001 prices. Again, attention is drawn to the point made in the original study that even lower-bound estimates of CS exceed government subsidies for canals and waterways. For reasons already explained, GHK (2005) justify the use of a higher CS value of £2.00 - £5.00 (2004 prices) for in-stream activity.

Similarly, Jacobs-Gibb (2001), referring to The Environment Agency (1997), recommend a CS value of £5.00 per visitor day for 'recreational navigation' (2000 prices). Unfortunately, the referenced study could not be located, so no further information on the derivation of this value has been obtained.

It is therefore recommended that the Willis and Garrod (1991) values for CS are incorporated into the framework, as they are based on a thoroughly executed study. Water scenes which include boats are also generally found to have a higher amenity value for those participating in other forms of recreation on or adjacent to the waterway. British Waterways (2008) note 'from some contingent valuation' undertaken on the Kennet and Avon Canal in the early 1990s that in some cases, CS increased by 40-50% for informal visitors to canalside sites as a result of the presence of boats. British Waterways (2008) instead adopt a more conservative figure of a 25% increase in CS.

No literature was identified in relation to sailing on inland waterways.

(b) Visual amenity

Inland waterways can provide significant benefits in terms of visual amenity, increasing the appeal of the landscape to some.

There are no valuation studies which isolate this impact in terms of a total benefit; however Garrod and Willis (1998) conducted a CR study to estimate the marginal loss in amenity value associated with the presence public utility service structures.

Five English canals sites were chosen to represent different canal types and user populations. The 1,000 respondents were asked to rank a set of four alternatives, each specifying a particular mix of reductions in the level of pipe bridges, pylons and other overhead cables. WTP estimates were then generated, estimating the annual price per household that respondents would be willing to pay (in the form of increased utility bills) for the reductions. Based on 932 usable responses, the study resulted in values of £0.04 per household per year for a 1% reduction in pipe bridges, £0.09 for pylons and £0.10 for other cable crossings (1995 prices).

These values are included in the BT framework. However, the authors note that the figures are useful for estimating marginal changes (either gains or losses) in visual amenity but should not be aggregated to form a WTP for removal of all services, or to capture the total amenity provided by inland waterways.

Hanley *et al.* (2006) also estimated household WTP for improvements from 'fair' to 'good' in the aesthetic aspects of the Rivers Clyde and Wear (as previously discussed). The study produced results of £12.35, £42.38 and £16.91 for the River Wear, River Clyde and both rivers combined, respectively. However, as previously noted the authors do not recommend the use of these values in BT due to the inconsistency of the WTP estimates generated between two similar sites.

(c) Heritage and cultural benefits

According to Glaves *et al.* (2007) there are 2,555 listed buildings and structures, 69 scheduled monuments, 1,549 locks and 1,036 lock cottages and dwellings associated with inland waterways in the UK. British Waterways owns the third highest number of listed building and other listed structures in the country and is also involved in the conservation of historical vessels (IWAC, 2007).

Waterways are also an integral part of many esteemed landscapes; for example canals and windmills together form a landscape of significant heritage value in the Broads. Heritage assets once lost, are lost forever (British Waterways, 2008).

Cultural and heritage values can be comprised of:

- Aesthetic value
- Spiritual value
- Social value – traditions, shared beliefs in a community
- Historic value
- Symbolic value
- Authenticity

Source: British Waterways (2008)

There are two ways of examining the value of these cultural and heritage resources. The first is through the recreational benefit enjoyed by visitors from seeing and experiencing these sites and the second is through the preservation and non-use values they generate.

Studies relating primarily to non-use values are discussed in Section C.4.3 (g) below.

Adamowicz *et al.* (1995) estimated the passive use value of Britain's canal system for visitors and non-visitors. Here, the term passive use encompasses cultural, heritage, industrial, archaeological, ecological and wildlife value of canals and excludes direct uses such as open access recreation, amenity and property price uplift. Therefore, the passive use benefits resemble a preservation value and in this instance can be considered to reflect the use value of canals as a heritage resource. At the time, this study was the first of its kind and subsequently, there have been no other studies identified which attempt to value such benefits from inland waterways.

The study consisted of an open-ended CVM question to generate respondents' WTP to maintain the canals in their current state. Two scenarios were presented – the current situation of high level maintenance (preserving boating, heritage and towpath aspects) and one in which the Government no longer had sufficient funds to sustain the existing maintenance regime, allowing a lower level of maintenance to resume. Respondents were then asked for their maximum WTP (in the form of additional taxes) each year to ensure that canals were retained for boating (i.e. the high level maintenance option).

A simplified version of the stated preference technique was also employed for the purpose of comparison. Two specific attributes were examined, maintenance of towpaths and retention of boating activity, each at two levels of provision (either present or absent).

The survey sample consisted of 758 households (377 participating in the CVM sample and 381 in the CE sample) throughout England, Scotland and Wales. A pre-test survey was conducted in order to determine appropriate values to present alongside the alternative options. An interesting point that was drawn from the survey was that the majority of respondents indicated that environmental concerns are at least equally as important to economic interests. However, the sample was further divided when it came to prioritising national heritage concerns over economic interests. Just over half of the respondents had visited a canal within the last 5 years, with the largest user group corresponding to 'casual' uses such as dog-walking and short cut taking. Only 7% indicated that boating was the primary reason for visiting.

Surprisingly, the correlation between frequency of canal visits and participation in water-based recreation was not statistically significant. In fact, the dominant factors in determining the level of household use appeared to be accessibility (i.e. distance from a canal and / or ownership of a car) and awareness of the canal network. The authors note that because the interviews were conducted in homes, rather than at canal-sides, the number and duration of visits recalled is likely to be underestimated as respondents will tend to relate only the most recent or memorable visits, omitting functional trips like dog-walking and / or commuting.

The CVM results produced 154 zero bids, which is quite a high proportion but not unusual for this type of survey. Of those who provided positive WTP bids, 61% said they were in favour of preserving the environment and 41% said they were in favour of preserving national heritage. The responses of those who stated that the government should pay (but nevertheless suggested that canals are important) were removed from the calculation. Similarly, positive responses from those who indicated that they "do not actually have to pay the amount" were removed in order to eliminate strategic behaviour.

Of the participants, 40 indicated that they "view canals as a heritage resource" – it is their WTP bids which are recommended for use in the BT framework to broadly capture heritage benefits. These values are £7.47 / £1.50 (mean / median) per household per year.

A key point is that factors which affected the level of visitation (e.g. distance to a canal, car ownership and recreational participation) did not affect WTP, demonstrating that WTP results capture more than just the use value.

The CE results were generated by asking respondents to choose between alternative scenarios: the first choice involved a situation whereby boating would *not* be maintained, or would be maintained at a cost (requiring the respondent to pay additional taxes); the second involved a choice between towpaths being maintained or not maintained; and the last involved both boating and towpaths being maintained or not. The authors found the CE results to be somewhat unreliable – e.g. the WTP value for boating maintenance exceeds that for boating and towpath maintenance. This is possibly explained by the attributes presented not adequately reflecting the public's utility value associated with canals – i.e. people may value canals over and above these two attributes. However, in all of the scenarios, the utility associated with the "improved" option was higher than that for the unimproved option.

The authors conclude that the CVM results are the more robust of the two sets and are therefore used to calculate aggregate benefits. The mean value of £6.78 per household (1995 prices) was multiplied by the number of households in Great Britain in 1991 to arrive at a total of £145,377,000. As the £6.78 value is derived from the mean of all responses, including users and non-users (with strategic responses removed), the aggregated figure represents a total preservation value, or the total non-market benefit.

Interestingly, 66 respondents indicated that they “view canal as nature” and gave lower WTP values of £5.26 and £0.87 (mean and median, respectively) per household per year. These figures should not be considered additional to those given for the heritage aspect of inland waterways, but serve as an interesting comparison – some people value the canals mostly in terms of their heritage and some mostly in terms of the environment; however those who place priority on the heritage aspects may provide higher WTP bids, as suggested in this study.

There are also a number of literature sources which have attempted to value the benefits received through the restoration of heritage sites. Whitehead *et al.* (2006), for example, examined the effect of urban quality improvements on economic activity and estimated a WTP per household (via tax) of £10-14 of the renovation of historical buildings in Grainger Town. Eftec (2005) refer to this study, pointing out that those who participate in recreational activities in Grainger Town were WTP more than those who didn't, suggesting elements of both use and non-use values formed the respondents' WTP bids. However, the report is lacking in detail regarding the proposed physical changes resulting from the restoration work, thus limiting its suitability for BT.

Eftec (2005) also present varying values for the:

- renovation of historical buildings;
- damages from traffic-caused air pollution on historical buildings;
- impacts of road improvements upon Stonehenge;
- damages from air pollution;
- aesthetic changes to Lincoln Cathedral due to air pollution; and
- maintenance actions to address air pollution damages.

However the key issue is whether these values can be related to the benefits provided by inland waterways. In many cases respondents were asked their WTP for increased maintenance of large heritage sites or reductions in the risks posed to these sites from air pollution. These estimates are therefore unlikely to be suitable for use in the framework.

The recreational benefits have largely been discussed above in the section concerning visitor attractions. In summary, select reported expenditure values and entrance fees, which can be taken as lower-bound estimates of WTP are as follows:

- Entrance fees to National Waterways Museums: £4.75 - £8.50 (2007 prices) (Glaves *et al.* 2007);
- Entrance fees to Warkworth Castle: £0.90 - £1.20 per person per visit (1994 prices) (as quoted by Eftec 2005); and
- Entrance fees to Durham Cathedral: £0.80 per person per visit (1993 prices) (as quoted by Eftec 2005).

British Waterways (2008) quoted 'Taking Part', a National Survey of Culture, Leisure and Sport which found that 70% of respondents had visited at least one type of historic environment site in the past 12 months – more than had participated in sport.

Aside from direct expenditure, Eftec (2005) also include discussion of other valuation studies, for example Brown (2004) found WTP to avoid congestion via a compulsory surcharge congestion charge at Chartwell House, Kent to be £3.00 per person per visit (2001 prices). Brown (2004) also conducted a choice experiment to elicit WTP for the characteristics of three National Trust Properties: Chartwell House in Kent, Upton House, Warwickshire and Stourhead House in Wiltshire. The study found an estimated WTP range of £8.70 - £9.00 per visit to the gardens of these respective properties, £2.60 - £4.80 to visit the houses themselves, and £2.70 - £5.20 to view collections belonging to the properties.

This study may be useful in terms of gauging visitor WTP for specific characteristics of heritage sites; for example, the gardens elicited the highest values, which due to their natural setting, are perhaps most similar to inland waterways. Further, WTP values more accurately reflect the true economic value of a good or service, rather than entrance fees or expenditure figures which do not include CS.

The WTP values generated in Brown (2004) are likely comprised of both use and non-use values, i.e. the recreational benefit of visiting the heritage sites, as well as a preservation / bequest value. Unfortunately, the original study could not be located so further exploration into the transferability of these values has not been possible.

It should be noted that where visitors undertake a number of recreational activities on a one day trip, for instance walking, boating and visiting a museum, it may be inappropriate to sum the expenditure values for each activity. Eftec (2005) generally conclude that there appears to be limited scope for value transfer applications in heritage related appraisal and evaluation exercises; however this does not mean they should be avoided altogether.

(d) Education

Inland waterways can provide valuable opportunities for education and training in history and nature etc. However, this benefit is as yet unquantified.

Glaves *et al.* (2007) note that it has been demonstrated that inland waterways provide educational (and behavioural) benefits through activities such as angling for disadvantaged or problem young people, however, further research is required in order to quantify and value such benefits.

There is also evidence that outdoor education contributes to children's creative development and ability to cope in real-life situations. Outdoor education improves exposure to a range of cultures, talents and interests as well as improving social skills through participation and interaction. This is particularly important for children from low-income or disadvantaged backgrounds. British Waterways (2008) note that 68% of the top 10% of the most deprived communities in England live within 5km of a waterway, increasing the potential to maximise these benefits.

There are a range of publically funded programmes which support community involvement and children's education through involvement in waterways projects.

The Living Water, Active Water programme supports community involvement in a range of education, environmental, training and other activities, (IWAC, 2007). British Waterways, the Environment Agency, Inland Waterways Association (IWA) and the Waterways Trust have also jointly funded and promoted the Wild Over Water (WOW) project, targeting children via learning resources and child centred events. The aims of this program are to support delivery of activities, encourage children, school groups and families to visit waterway destinations and to facilitate relationships between primary schools and the organisations which manage Britain's inland waterways.

British Waterways (2008) compares the outputs from WOW to those of the Preston Water Racket Project which resulted in a clear increase in awareness of the heritage and environmental provisions of canals. It is estimated that 27,740 students through KS2 level will benefit from the WOW curriculum.

Education is also of high importance in terms of environmental protection, as evidence has shown that the better informed or more knowledgeable the public is, the higher their WTP to participate, protect and preserve (British Waterways, 2008). The Museums Association⁷⁴ purports that increasing schools' use of museums and other out of class room learning venues has long terms effects in that people who visit regularly as children are much more likely to return as adults. It notes that broader school use helps to ensure that as many people as possible benefit from national cultural and natural resources throughout their lives.

O'Gorman and Bann (2008) considered these benefits as they are received from ecosystems in general. This assessment confirms the findings of Glaves *et al.* (2007) that data to enable quantification of the value of education benefits is not currently available. Nevertheless, they present evidence of the possible significance of these benefits. For instance, outdoor fieldwork is found to positively reinforce the link between affective and cognitive learning. Outdoor adventure activities were also proven to improve student's personal efficiency and social skills. Overall, strong evidence of the benefits of outdoor education was demonstrated, with both short term and long-term positive effects. For more information on this and further references, see Rickinson *et al.* (2004).

Jacobs (2005) made a qualitative assessment of the educational benefits provided by certain protected areas in Scotland. No quantified data was presented within that study however. Economics and Funding special interest group (SIG) (2007) also discusses this category of benefit and provides agreement that the value is difficult to quantify in monetary or other units.

As discussed in Section 2, the framework attempts to capture the final benefits realised by the services provided by inland waterways. However there are both theoretical and methodological issues in identifying the appropriate 'final products' from this category of benefit. These relate to the difficulty to delineate any actual products due to the fact that these benefits manifest themselves in a number of ways, from an individual's ability to appreciate and care for their environment, through to the ability to conduct experiments and gain a detailed understanding of specific ecosystem processes or historical values provided by inland waterways.

There is, of course, a body of evidence to suggest that education results in a real and substantial increase in earnings over the course of a lifetime. However, the information is lacking in order to draw clear links between the number of outdoor education visits (and specifically those taking place around waterways) and the

⁷⁴ Museums Association <http://www.museumsassociation.org/ma/10295>

pursuit of higher education beyond minimum requirements. Perhaps further research is merited in this area; however earning potential is clearly only one aspect of the value of education.

(e) Volunteering

In addition to the provisioning benefit of cost savings delivered by volunteerism (discussed above in Section C.4.1 on provisioning services), volunteering and attendance at events can also help build or reinforce social capital by increasing individual / community empowerment and strengthening the sense of attachment residents feel to their local areas.

A review of the available literature has revealed a lack of primary data with which to value these benefits. It is likely that the benefits generated by inland waterways will be similar to those generated in other natural environments; however, no relevant studies have been identified.

It stands to reason that the use of standard wages may provide an indicator of the well-being or consumer surplus benefit derived by the individual – in the sense that if he or she were not volunteering, he / she could otherwise be working in paid employment and earning £X per day. This relates back to the notion of the opportunity cost of time. However, it is inappropriate to use the same £X per day value as a proxy for both the benefit gained by the organisation (in avoidance of paying an employed staff member for the work) and by the individual (in foregoing the wage he / she could otherwise be earning). Clearly more research is required in this area.

(f) Community benefits

Good quality public domain can play an important role in enhancing civic pride and the image / perceptions of town and city centres. To illustrate this point, Swindon and Derby are putting waterways at the heart of their revitalisation plans recognising that waterways give communities a distinctive character, enhancing community self confidence.

There are no sources of valuation data identified to quantify this benefit, however water provides additional benefits through:

- Providing local character and identity; diversifies towns / regions giving them a competitive edge;
- Transforming use of town centre away from current dominance of pub / club culture to a more family-friendly setting;
- Connectivity – the linear nature of canals provides pedestrian corridor, a relaxed and safe atmosphere shared by workers and visitors;
- Enhancing first impressions - the quality of town gateways is a key indicator of quality of the place itself – first impressions to visitors;
- Improving productivity, health and satisfaction of workforce through good design. Less absenteeism and lower staff turnover; and
- Attracting further investment by enhanced public realm.

Source: British Waterways, 2008.

Organisational bodies such as British Waterways can provide institutional benefits by facilitating interaction within and between communities. For example, AINA has published “Making More of Our Waterways”, which contains guidance about social inclusion initiatives for its members. British Waterways has provided financial

support for outreach activities such as the National Community Boats Association (NCBA), whose members run almost 100 boat projects for some 250,000 socially and economically disadvantaged users, and for projects targeting minority ethnic communities.

The Environment Agency has also made access to recreation for disenfranchised groups a priority by developing local projects, many of which involve the water environment. These include angling projects aimed at serial offenders, and creating partnerships with the many voluntary clubs along the river navigations.

Inland waterways, by their connective nature, provide links between more prosperous areas with disadvantaged ones (British Waterways, 2008). The opportunities for waterways to contribute directly to the reduction of economic disparity are therefore large. Developers are often attracted to the prospect of developing waterside land due to the potential property premiums and increased rental values associated. These opportunities boost employment through both construction and increased recreational expenditure.

Waterways can act as a catalyst for regeneration, whereby investment is redistributed to areas of need. This does not represent an increase in wealth to the UK as a whole, as investment would likely have occurred on substitute sites in the absence of waterways; however, the value of the investment return can be greater when benefiting lower income groups⁷⁵.

There are, however, no studies available which attempt to quantify these impacts in monetary terms. A study by the New Economics Foundation, "Prove it! Measuring the effect of neighbourhood renewal on local people" (NEF 2000) acknowledges the difficulty in measuring the impact of community projects in terms of outcomes. A project may be measured in terms of inputs (e.g. funding, number of man-hours invested) and to a certain extent outputs (e.g. the level of participation); however quantifying the end benefits is not straightforward. Many outcomes will not become evident on a short time scale (e.g. reduced crime rate) while others are more qualitative – how people feel about themselves and their neighbourhood.

NEF therefore recommends collecting qualitative evidence where relevant, and using indicators to represent the potential impact of long-term benefits. They use the analogy of measuring the effect of exercise on reducing heart disease – such impacts may be long term, and therefore can be measured, to a certain extent through indicators such as resting heart rate.

Indicators are designed to provide a dimension to an issue, and also to simplify it. NEF (2000) notes that indicators are most useful in terms of communicating a message when they are used comparatively – i.e. comparing one neighbourhood to another or a trend over time.

In terms of measuring human and social capital, there are many indicators to look for, including:

- Confidence;
- Attitudes towards open space;
- Morale;
- Satisfaction and enjoyment;
- Community cohesion and identity;

⁷⁵ As explained by the law of diminishing return.

- Reduced feeling of isolation;
- Optimism and energy;
- Sense of control;
- Skills and knowledge;
- Physical activity;
- Whether residents choose to stay in the area;
- Trust;
- New friendships;
- Networks and connections – places to meet;
- Reciprocity – e.g. people helping one another;
- Changes in community interaction;
- Inter-age group co-operation; and
- Exposure to and appreciation of diversity.

These may be scored through participatory surveys, asking respondents to provide scores of 1-5 representing 'very bad', 'bad', 'don't know', 'good' and 'very good'.

Such techniques may be generally more applicable in assessing the benefits of specific regeneration / restoration schemes of programmes implemented by British Waterways or organisational bodies.

(g) Non use values

Non-use values (NUVs) are values that are not associated with actual use, or even the option to use a good or service. They are comprised of (a) altruistic value, or the value derived from the knowledge that something exists for others to use, (b) existence value; the value derived from knowing that something exists and (c) bequest value; the value of knowing that future generations will have the opportunity to enjoy something.

NUVs are one component of TEV; however they are often difficult to disaggregate from total WTP values or from other methods of valuation. NUVs are a 'special case' in that they are not dependent upon any particular service as such, but the existence of a species, habitat, landscape or aspect of cultural heritage. They are likely to be very context specific, depend heavily on the survey or valuation method and be influenced by the 'popularity' of the good or service in question. Identifying the role that a landscape or service, or any aspect within these contributes to NUVs is therefore a difficult conceptual exercise.

O'Gorman and Bann (2008) nevertheless found that non-use values are likely to represent a significant proportion of the overall value of benefits provided by England's ecosystem services. The same might be assumed for inland waterways, specifically.

For example, Spash *et al.* (2004) reported results of a CVM study which valued household WTP for improvements to biodiversity levels that had declined due to hydropower activity. The study site is the river Tummel, which consists of 1,253km of river channel and 77km² of standing waters. At the time of the study, it was provisionally designated as a heavily modified water body (HMWB). A number of implementation measures were identified to achieve good ecological status or potential, including the introduction of a compensation flow regime to mimic natural flows and thereby restore the diversity and abundance of species in the river catchment.

The survey was designed so that a range of impacts to the water environment due to hydropower schemes were described, including reduced flows, turbine injuries to animals, flooding of habitat up-stream and reduced diversity. Respondents were asked to consider two scenarios; a 'business as usual' scenario, with biodiversity at 14% of natural levels due to reduced flow in the catchment and an improved scenario in which biodiversity increased to 70% of natural levels. Respondents were then asked to provide a maximum WTP bid consisting of 4 increased utility bill payments in order to make these improvements.

This study is of relatively high quality, with a pre-test survey having been carried out by an accredited survey company, a good sample size (1,012 face-to-face interviews) and ample consideration paid to the socio-economic characteristics of the sample. Respondents were asked a 'payment in principle' question in order to reduce protest bids and to separate the general concept of paying for environmental improvement from the detailed scenario in question. However, the authors note a persisting problem with respondents accepting payment in principle then answering "don't know" to the specific restoration proposal, skewing the data such that large numbers of respondents may be treated as protest bidders when in fact they do value environmental change.

Of those who answered "yes" to the payment in principle question, the mean WTP was £5.62 per quarter (2004 prices) and the median was zero, indicating that over 50% of the sample was unwilling to increase their electricity bills. This may well reflect more of an objection to rising energy costs than not valuing the environmental improvement under consideration; indeed, the most heavily cited reasons for non-payment related to the payment vehicle. The application of this median value may be taken as an indication of the political unwillingness to accept a compulsory fee, particularly in the form of increased electricity bills, rather than to infer a low or non-value.

The study reports that the majority of respondents were unfamiliar with the study area, *suggesting that the WTP bids recorded reflect more non-use than use value*. The results of Spash *et al.* (2004) are therefore recommended for use in the framework to capture the non-use value of biodiversity.

Also interesting to note is the extension of the standard CVM in this study to include social psychological drivers and to test their power in explaining WTP. Four ethical categories were captured in the model – "strong species rights", "weak species rights", "consequentialist favouring animals" and "consequentialist favouring humans". Of these, the most significant in terms of contributing to WTP was the "strong species rights" position.

Msharafieh *et al.* (2008) used a choice experiment to estimate WTP for general water quality improvements in the Manchester Ship Canal, dominated by non-use values. Respondents were asked to value a range of attributes relating to the number and location of sites affected by water quality improvements, the number of days with a bad smell each year (from 4 to 16) and the extent of the ecological improvement, by providing a WTP bid in the form of increased annual water bills. A total of 602 responses from 13 districts throughout greater Manchester provided a mean WTP of £6.00 per household per year for a marginal change in ecological conditions.

Responses were clearly driven by the ecological condition of the waterway, as opposed to the length of river improved or the number of 'bad smell' days. This, combined with the majority of responses having been elicited from 'non users', infers

that the WTP can be broadly attributed to the non-use value of improved water quality.

The quality of this study is thought to be high. A “cheap talk” script was used to highlight to respondents the tendency to give a higher WTP bid than they would actually pay if the situation were real. This explicit consideration of income constraints is likely to provide a more accurate value estimate. The results are therefore recommended for inclusion in the BT framework to capture the non-use value of improvements in water quality.

Interestingly, results of the study showed that WTP *increased* with increasing distance from the canal between the <1mile and 10-20mile distance band, then decreased to zero beyond the 30 mile distance band. A possible explanation to this distance decay anomaly is that a large percentage of the respondents (59%) had never visited the canal; therefore these respondents are thought to have a worse perception of its water quality.

Adamowicz *et al.* (1995) (which is reviewed extensively in Section C.4.3(b) above) presented WTP estimates for both users and non-users. Non-visitors were found to have an average WTP of £8.86 / £1.00 per household per year (mean / median) for the non-use benefits of heritage, boating and tow path aspects of canals. These estimates are also included in the BT framework.

A further discussion of the literature continues below.

Ecotec (2007) examines the impact of maintaining and investing in waterways in Wales through three types of analysis: examining the total income generated against the financial cost of maintaining the network; assessing the impact of maintaining waterways on the local economy (increased visitor expenditure and creation of jobs); and, estimating the impact of canals on the quality of life of people in Wales through use and existence values (intrinsic environmental and cultural qualities and water management). The overall conclusion is that, although the financial cost of maintaining the canal network exceeds income generated, benefits related to non-use values are of such significance that they outweigh the costs.

British Waterways (2007) estimates the aggregated CS value of the full restoration of the Stroudwater, Thames and Severn Canals to be £400,000 per annum. It can be assumed that this CS value is in addition to the value captured by visitor expenditure at the site, and may include elements of non-use values (for example existence or bequest value).

GHK (2005) attempted to split the non-use and use components by subtracting a total use value from the preservation value derived in Adamowicz *et al.* (1995). The use value is calculated based on Willis and Garrod (1991) which found an average WTP over all canals of £0.84 per visit (2004 prices) using the ITCM. Multiplying this figure by the estimated number of visitors per year gives an aggregate use value over all canals of £103.1m. This value is then subtracted from the annual preservation value of £193.2m (the original total uplifted from 1995 to 2004 prices) to derive a total non-use value of ~£90m per annum or £45k per mile.

Adamowicz *et al.* (1995), it should be noted, is referred to in a number of secondary valuation studies, including Eftec (2005), Ecotec (2007) and Harrison (1999) which states an approximate existence value of canals as £145m; however is not explicitly quoted in Adamowicz *et al.* (1995).

Garrod and Willis (1996) assessed the WTP for two scenarios involving flow levels in the River Darent and 40 other low-flow rivers in England. In the first scenario, the current flow level, corresponding to 70% of permissible abstraction rates, would be maintained, with the alternative being 100% of permissible abstraction further deteriorating flow levels. In the second scenario, the baseline flow level (of 70% permissible abstraction) would be improved according to the Environmentally Acceptable Flow Regime (EAFR) in order to allow fishing and enhance scenery and wildlife.

Face-to-face interviews were conducted with 325 households along the Darent River, 335 visitors to the river and 758 households located within 60km of the river. These elicited a mean WTP to maintain flows at their current level of £7.16 / £10.19 / £3.85 per household per year for visitors, residents and non-visitors, respectively (1993 prices). The mean WTP to improve flows according to the scenario described above were £4.85 / £6.25 and £3.00, respectively.

Similarly, annual WTP values were collated to maintain / improve flows in all 40 low-flow rivers in England and Wales. These were £15.06 / £18.45 / £17.18 for visitors, residents and non-visitors to maintain flows and £9.76 / £12.32 / £12.92 to improve flows, respectively (1993 prices).

This study is of fairly high quality with reasonable 'benefit consistency' for use in the framework. Sufficient pre-testing was conducted, along with due consideration of the socio-economic characteristics of the sample population. However, care must be taken in aggregating these values due to the age of the study. It is not clear the extent to which the WTP responses correspond to a specific benefit category. It might be assumed that visitors and residents' responses correspond to use value (e.g. some form of recreation) as well as non-use value; where as non-visitors are demonstrating non-use value only (e.g. biodiversity).

There is a clear asymmetry between environmental losses and gains demonstrated by respondents, by providing higher WTP values to avoid a loss than to receive a gain. This phenomenon is frequently seen in CVM literature and is possibly explained by the tendency to prefer the 'status quo' over change - whether an improvement or a deterioration. In this study, benefits were aggregated for the whole of the Darent River by multiplying non-users' mean and median WTP by the number of non-visitor households located 2 to 60km from the river.

C.4.4 Other

(a) Health

A growing body of evidence suggests that green spaces such as those associated with inland waterways provide many benefits to human health and wellbeing. These benefits are 'cross cutting' in that they are realised through a suite of services provided by inland waterways, either individually or in combination.

In relation to ecosystems generally, direct benefits associated with health may include provision of food, medicinal materials and fuel for generating heat. The benefits particularly relevant to inland waterways are however indirect – such as the assimilation of atmospheric pollutants, provision of clean water, renewable energy generation which results in decreased air emissions and opportunities for physical activity which promotes both mental and physical well-being.

Physical activity within a natural environment ("green exercise") may bring additional benefits. These benefits are by no means restricted to natural or semi-natural

settings; the advantages of green spaces in the urban environment are also well documented, though rarely quantified.

Pretty *et al.* (2005) documents the effect that green exercise has in combating Type II Diabetes, Osteoporosis, stress and mental illness and other health concerns arising from physical inactivity. Estimates are provided as to the costs of these illnesses to the NHS; for example 9% of the NHS annual budget (£5.2billion) is spent on all forms of diabetes per annum. The risk of Type II diabetes is 33%-50% higher for inactive people. Treatment of mental illness also takes up £3.8billion of the annual NHS budget. In total, he estimates that 6% of the total NHS budget (of £70billion in 2005) is spent as a result of inactivity.

British Waterways (2007) quotes an earlier report by (Bird, 2004) estimating the health benefits of recreation in terms of avoided costs to NHS, work absence and early mortality at £310 per annum per inactive person (2006 prices). GHK (2005) also undertook a literature review and, referring to Bird (2004), and found a potential cost saving of £0-£0.64million per annum from additional people becoming physically active. This is based on up to 226,000 people (25% of expected visitor numbers) becoming active due to proximity to a waterway who would otherwise be inactive. Further attempts to relate health benefits to physical scale can be found in Peacock *et al.* (2005) which found that the addition of 3km of footpath generates £0.1million- £1.0million based on 16% usage by local residents.

British Waterways (2008) report the results of towpath visitor surveys conducted in 2003 which found an average 62% of respondents indicated that the presence of a canal increased the amount of physical activity they regularly undertake. However, this is very difficult to quantify as only changes in total physical activity should be considered. For example, improvement to towpath access might encourage some people to cycle when they would have otherwise jogged in a park; in this instance the associated health benefits cannot be attributed to the waterway itself.

An English Nature research report on nature and psychological well-being (Seymour, 2003) documents the many health benefits of the natural environment. The literature review found evidence that aspects of the urban living environments such as high population density, stress, anxiety, aggression, noise and information / stimulus overload have negative impacts on mental well-being. Conversely, positive indicators of well-being such as trust, tolerance, participation and feelings of safety were found to increase in rural settings and in built-up areas with access to gardens / green spaces. Rates of mental disturbance in children and adolescents are also lower in rural areas – for example conduct disorders (e.g. truancy, vandalism and anti-social behaviour) are 4% in rural areas and 9% in urban areas. Also reported are the results of a 1995 survey in which 9 / 10 people indicated that they value the countryside, with the most important benefits being the sense of relaxation, well-being, peace and quiet.

The impacts of mental health and emotional well-being are strongly linked with physical health also. Chronic stress has been found to have negative health impacts, ranging from depression, increased susceptibility to infection, diabetes, high blood pressure and high cholesterol with associated risks of heart attack and stroke. Equally, exercise has been shown to reduce anxiety and improve recovery from stress disorders. The report concludes that although a range of mental health and other policies have relevance for programmes which benefit the natural environment, agencies and organisations have yet to make the link between the positive impacts that nature can have on well-being as a discrete outcome.

Bird (2004) also concludes that contact with nature generally can improve behaviour and self-discipline, enhance emotional development, reduce crime and aggression and improve community integration. The benefits provided by the natural environment in tackling and preventing crime is also evidenced by the Forestry Commission's 'Offenders and Nature' schemes (Forestry Commission, 2007). More than 1,000 offenders have been involved in forest conservation as part of their custodial sentence. The report notes that this programme reduces the risk of re-offending "by equipping offenders with life and work skills and improving health and wellbeing". There is no such programme known to take place in or around inland waterways; however the relevance and capacity certainly exists.

Other benefits include the potential decrease of pedestrian and cyclist traffic on roads, potentially reducing the number of traffic accidents. Further, those that walk or cycle on canal towpaths are likely to be less at risk from the health impacts of traffic-related air pollution (British Waterways, 2008). Journeys made using green transport options such as walking or cycling which would have otherwise been undertaken using conventional modes of transport (e.g. cars) may also result in the benefit of decreased air pollution. Further research is required as to the magnitude of these benefits.

There are difficulties in apportioning these benefits, as the full benefit may be only partially derived by inland waterways. Outdoor exercise, for example, is beneficial for health and many people exercise in 'green spaces'. No studies were identified that have attempted to disaggregate the proportion of health benefits of exercise that can be attributed to green spaces. Some benefits are likely to be more closely tied to specific locations than others, such as the wellbeing / psychological benefits gained from being surrounded by or looking at nature. These benefits are likely to be more tied to the quality or status of natural systems in their entirety rather than to any specific element of it. This means that valuation becomes a more complex task and that care is required in undertaking it.

In addition to the positive health related benefits provided by inland waterways, it is worth noting that inland waterways may also result in negative health outcomes. These could take the form of increased risks of accidental drowning due to the regular use of the waterways for recreation purposes; or the exposure of people to pests or insects which can have negative health implications including hay fever or allergies. The significance of these negative aspects is thought to be low overall and any WTP to avoid them likely to be very subjective.

(b) Tourism

In a similar way to health, inland waterways provide tourism benefits through a range of final benefits. In this case they are considered to include the provision of business opportunities and associated job creation and also through the provision of recreation facilities and associated expenditure.

Also, waterways provide incentive for British nationals to holiday in the country, rather than travel overseas. British Waterways (2008) quote an earlier British Waterways publication ("Research Matters", Vol.4, 1995) which estimated that the expenditure retained in the UK due to Britons holidaying here instead of abroad is of a similar order of magnitude to the level of expenditure made by overseas visitors to the UK, which British Waterways (2008) estimated to be £16m in 2006.

Appendix D – Benefits Transfer Framework

The framework, supported by the literature matrix, attempts to capture all the available information needed to appropriately carry out a BT. The framework only contains studies suitable for use in a BT assessment of the benefits of inland waterway, as identified through the literature review.

The framework captures information on the robustness of the original valuation data and the transferability of this data. All studies listed in the framework are considered to be transferable, however some may be more easily transferred than others.

See Sections 5 and 6 for guidance on the use of the studies in the framework.

Care is required if values for different benefits are being combined, as some of the values presented in the framework contain elements of other types of benefits, for instance use values contain some element of the users' non-use value.

The framework is presented in a separate Excel File.