THE ECONOMIC CONTRIBUTION OF THE MERSEY FOREST'S OBJECTIVE ONE-FUNDED INVESTMENTS

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The Economic Contribution of The Mersey Forest's Objective One-Funded Investments

A Final Report by
Regeneris Consulting

The Mersey Forest

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October 2009

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Acknowledgements

Regeneris Consulting would like to thank The Mersey Forest team for their assistance in completing this study. In particular, we would like to thank Paul Nolan for his guidance and input throughout, and Tom Butlin and the GIS team for their hard work in generating essential data for the modelling work.

1. Executive Summary

i. The Mersey Forest is the largest of England's 12 Community Forests and has been delivering a wide range of interventions, funded in part by the EU's Merseyside Objective One Programme, with a total cost of over £7 million. These have included new tree planting, land reclamation, bringing woodland into management, creating access to greenspace and recreational facilities, managing and improving habitats, engaging local communities and business support activity for forestry businesses.

ii. Regeneris Consulting was commissioned by The Mersey Forest in early 2009 to undertake an economic assessment of its interventions funded under the Merseyside Objective 1 Programme. The purpose of the study was to provide an initial quantitative assessment of the range of social, economic and environmental benefits generated by these interventions. The study has been based on a review of the literature and the development of an economic assessment model; no primary research (e.g. visitor surveys) has been carried out.

iii. The economic assessment model is based on the Natural Economy North West's framework of the economic benefits of Green Infrastructure. See sections 3 and 4 of this report for details of this framework, the existing evidence and our model. A detailed discussion of the methodology is provided in Appendix B.

A Summary of the Results

iv. The Mersey Forest's Objective One Programme of investments is estimated to generate, on an annual basis, a gross monetised benefit of **£5.5 million** (in 2009/10 prices).

v. Some of these benefits are displaced from one part of Merseyside to another. Our work estimates that the investments deliver a net additional monetised benefit of **£2.0 million**, once these displacement effects are taken into account. On a net present value basis this equates to around **£71 million**. The table across shows how this breaks down by type of benefit.

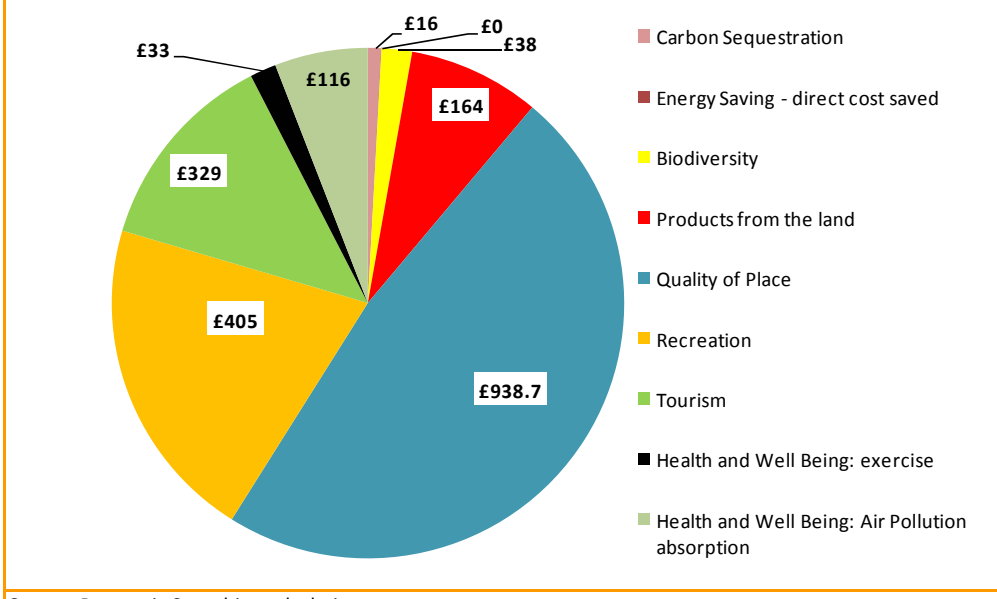
Table 1-1: Total Net Additional Monetised Benefit of The Mersey Forest's Objective One Funded Investments, by Source of Benefit (£000s)

Source of benefit	Annual	NPV
Carbon Sequestration	£16	£1,388
Energy Saving - direct cost saved	£0	£10
Energy Saving - carbon cost saved	£0	£5
Biodiversity	£38	£1,375
Products from the land	£164	£5,964
Quality of Place - landscape (views from home)	£412	£15,001
Quality of Place - landscape (views while travelling)	£527	£19,193
Recreation	£405	£14,754
Tourism	£253	£9,199
Health and Well-being: exercise (GVA)	£20	£722
Health and Well-being: exercise (cost saving)	£13	£474
Health: Air Pollution absorption	£116	£2,717
Total Monetised Benefit	**£1,963**	**£70,800**

Source: Regeneris Consulting calculations
Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

vi. As the table shows, the relative scale of the benefits varies considerably. This is also illustrated in the chart below, for the annual net additional benefits from the investments.

Figure 1-1: Annual Net Additional Benefit by Type of Benefit, £000s (2009/10 prices)



Source: Regeneris Consulting calculations
Note: Benefits are assumed to apply at the point of maturity of the site.

vii. The key points on the estimated benefits are as follows:

- **Quality of Place**[1]**:** the benefits created from increases in woodland views (both from home and while travelling) account for the greatest share of the total net additional benefit, amounting to £940,000 in annual net additional terms. This is because the literature ascribes a large benefit to a woodland view for households in proximity to the sites (£312 per household, in 2009/10 prices) and for households travelling regularly past the sites (£264 per household, 2009/10 prices).

- **Recreation and Tourism:** in gross terms these effects amount to £1.5 million and £2.6 million respectively, or 75% in total. On a net additional basis, recreational benefits amount to £405,000 and tourism benefits £252,000 or 34% of the total. This is because the additionality of these benefits is highly sensitive to the availability of alternative recreational opportunities.

- **Health and well-being (exercise)**: The exercise benefits generated by the sites are potentially considerable, at £122,000 in total, in gross terms. This is composed of GVA benefits from reduced absenteeism and premature death (60%), with the remainder accounted for cost savings to the NHS. Again, the important thing to consider is the net additional impact – the extent to which the sites are likely to be generating new physical activity, which, in the absence of the intervention at the site, would not otherwise have taken place. Taking account of the existing stock of

[1] In the Natural Economy North West framework, Quality of Place covers a range of benefits, including recreation and landscape amenity. We have concentrated on the landscape amenity aspect here, and covered recreation separately.

accessible greenspace, we judge that there is a net additional benefit of £33,000, consisting of £20,000 in GVA benefits and £13,000 in cost savings.

- **Health and Well-being (air pollution)**: at £116,000, the benefits from air pollution absorption account for 2% of the gross benefits and 6% of the net additional benefits.

- In contrast, the model produces relatively small values for annual **carbon sequestration** benefits - largely a function of the social cost of carbon - and **energy saving** benefits - this impact is very sensitive to the proximity of the sites to houses and the positioning of the trees.

viii. Note that this assessment does not cover any of the following effects, which are known to be important but have not been possible to quantify:

- Economic Growth and Investment: effects of Green Infrastructure (GI) on improving the image of local areas and hence ability to attract highly skilled workers and knowledge based businesses.

- Flood Risk Alleviation: the effect of GI on reducing run-off, therefore reducing the risk of flood events, and thereby avoiding costs of flood damage

- Mental well being: the effect of GI on stress reduction, thereby increasing economic output and avoiding costs to the NHS.

ix. It should also be noted that this assessment does not cover the impact of the business support activity carried out under the Programme by The Mersey Forest.

Type of Economic Value

x. The assessment considers market and non-market effects. The total monetary value generated by the sites is composed of GVA benefits, cost savings to society and other well being benefits. The figure below illustrates the relative scale of these. The key points are:

Gross Benefits

- **GVA:** The majority of the gross benefits are GVA benefits (£2.8 million), composed of GVA from tourism spend, from direct jobs (Products from the Land), and from improvements in health. The largest of these is the tourism impact, accounting for 90% of the GVA benefit.

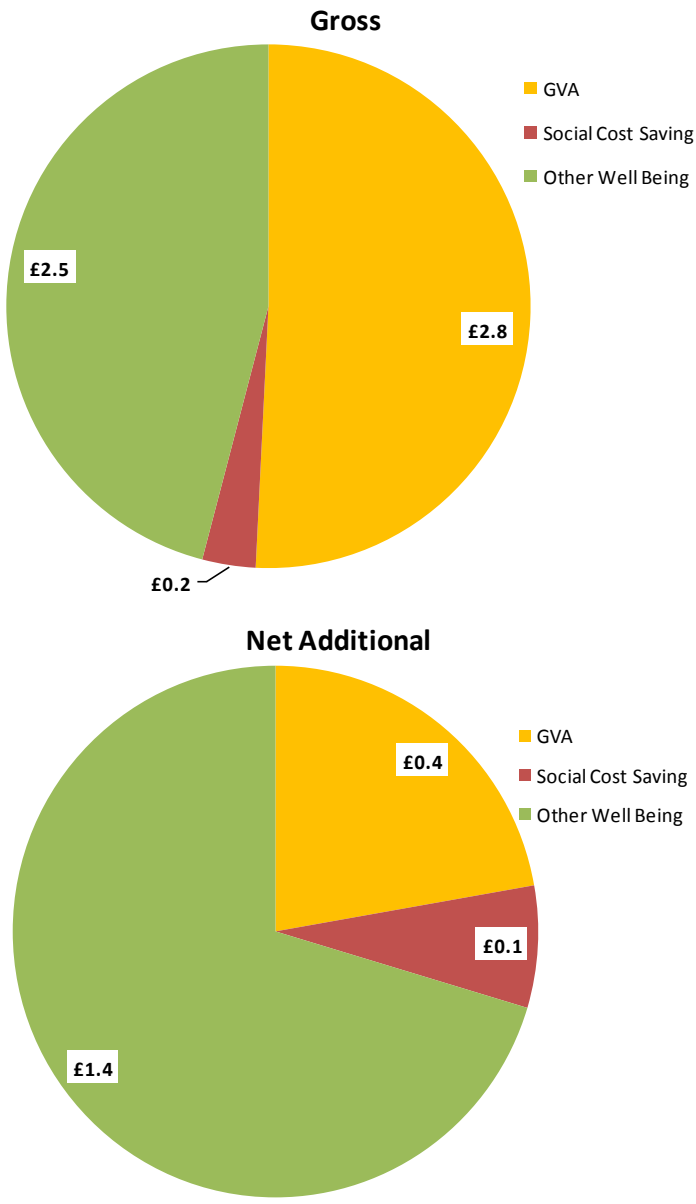
- **Other Well-being** benefits amount to £2.5 million. These are composed of the non-market benefits derived from recreation, quality of place and biodiversity. By far the largest element in this, in gross terms, is the recreation benefit (61% of the total well-being benefit), followed by quality of place (37% of the total well-being benefit). Biodiversity benefits amount to £38,000.

- **Social cost savings** amount to £181,000 (3% of the total monetised benefit). Of these, the air pollution absorption component is the largest, at £116,000.

Net Additional Benefits

xi. The picture is somewhat different when we look at the net additional benefits. On this basis, **other well-being** benefits dominate, at £1.4 million (70% of the total), followed by **GVA** (£436,000) and **social cost saving** (£146,000). The reason for this shift is that the displacement effect is relatively high for the GVA benefits, especially for tourism benefits. The exercise-related GVA impact follows a similar pattern. By comparison, 46% of the well-being benefit is displacement (of the recreation benefit) and only 16% of the cost savings are displaced (this is the cost saving element of the exercise benefit).

Figure 1-2: Total Annual Monetised Benefit by Type of Economic Value (£ million, 2009/10 prices), Gross and Net Additional



Source: Regeneris Consulting calculations
Note: Benefits are assumed to apply at the point of maturity of the site.

Value for Money

xii. Based on our modelling work, the Merseyside Objective One funded programme of investments yields a positive return on investment in terms of net additional GVA created, and when the other benefits are added into the mix, the return on investment improves**. Every £1 invested in the Programme will it is estimated generate over the lifetime of the investment:**

- £2.30 in increased GVA and £3.00 in increased GVA and social cost savings
- **£10.20 in increased GVA, social cost savings and other non-market well being benefits.**

xiii. This, in our view, represents excellent value for money.

Concluding Observations

xiv. The results of this study reinforce the importance of location in the benefits of green infrastructure. The dominant benefits are from quality of place and from recreation and tourism. The former are maximised when the new planting is located in close proximity to housing, and/or on road routes which do not already have good access to views of woodland. The latter are maximised by creating sites that are both close to and easily accessed by the local population, and located in areas where there is a lack of existing greenspace.

xv. Given the importance of the recreational and tourism benefits that green infrastructure brings, a key imperative for the Community Forest network and partners should be to improve intelligence on the level of usage of the sites and of the profile of visitors in terms of their origin, purpose and frequency of visit and so on. Visitor surveys should also be used to better understand the health-related benefits from the sites.

xvi. In addition, the potential benefits related to flood risk alleviation and image enhancement for inward investors and skilled workers are areas which we have been unable to quantify in this study. Further research into these effects would be beneficial.

2. Introduction

2.1 Regeneris Consulting was commissioned by The Mersey Forest (TMF) in February 2009 to undertake an economic assessment of its interventions funded under the Objective 1 Programme. The Mersey Forest Team has, over the past 6 years, delivered a programme of support for the forestry sector on Merseyside through the Objective 1 programme. The purpose of this work has been to provide a robust, independent assessment of the range of economic benefits supported by the Programme, in order to supplement the existing monitoring data on outputs achieved.

The Mersey Forest

2.2 The Mersey Forest is the largest of England's 12 Community Forests (www.communityforests.org.uk), covering 465 square miles. It was launched in 1994 as the Community Forest for Merseyside and North Cheshire, and is a partnership between seven local authorities, landowners, the Forestry Commission, Natural England and businesses including United Utilities.

2.3 The aim of The Mersey Forest is over 30 years *to create 8,000 hectares of new community woodlands and a wide range of associated environmental, economic and social benefits through sustainable landscape improvements to The Mersey Forest area.*[2] This aim is expressed as five goals:

1) As a concept TMF will provide opportunities for organisations and individuals to work together to deliver the common vision captured in The Mersey Forest Plan.

2) Sustainable economic benefits will be realised through the creation and management of TMF resources to assist in the process of generating and safeguarding jobs, markets and assets.

3) The creation and management of TMF resources will generate sustainable social benefits through the facilitation of people's involvement in health, leisure and environmental activities.

4) The transformation of TMF will be brought about through the creation of a natural, well wooded landscape involving a range of site-based activities.

5) Through the creation and management of TMF resources, sustainable wildlife benefits will be realised by protecting and improving biodiversity.

[2] The Mersey Forest Plan

The Objective One Funded Programme of Projects

2.4 To deliver these goals The Mersey Forest has been delivering a wide range of interventions, including new tree planting, land reclamation, bringing woodland into management, creating access to greenspace and recreational facilities, managing and improving habitats, engaging local communities and business support activity for forestry businesses. The EU Objective One Programme has provided funding for a large number of activities. Total spend on the programme amounts to £6.8 million on land-based interventions and £0.6 million on business development activity, spread across over 100 projects. The Objective One money has been matched by contributions from DEFRA, the European Agricultural Guidance and Guarantee Fund, voluntary sector contributions and various other public and private funding sources. The progress of the programme in delivering outputs has been monitored on an ongoing basis, and the following outputs have been achieved:

- 263.72 hectares of New Planting
- 98.21 hectares of derelict, underused and neglected land (DUNL) Reclaimed
- 417.79 hectares of Habitat managed / improved (ha)
- 357.28 hectares of Woodland Managed (ha)
- 24.16 hectares of Ancient Semi-natural Woodland (ASNW) managed
- 51,118 metres of Access created
- 495 Community Engagement
- 26 Enterprises Assisted
- 2 Businesses supported to develop new products
- 12 New recreational facilities
- 1,450 Additional Tourist Visits
- 40.37 Km Routes Improved

2.5 As well as the land based projects the Mersey Forest objective one programme also directly supported business development related to the forestry sector; this has safeguarded and created jobs and GVA in the sector.

Purpose of this Study

2.6 The monitoring data above is compulsory for ERDF funded projects of this sort. Whilst these indicators provide an appropriate and useful framework for measuring progress in delivery against targets, they do not capture the full range of *outcomes* from this project activity. The socio-economic outcomes of the business development support delivered through the Programme have been covered in economic evaluation work discussed above. The Mersey

Forest recognises that "forestry brings considerable benefits beyond the trees themselves."[3] It is increasingly recognised in policy circles that trees, woods and forests have an important role to play in supporting economic prosperity and well-being.

2.7 Whilst it is relatively straightforward to describe these benefits, it is less straightforward to quantify them. The purpose of this study is to provide an initial quantitative assessment of the full range of social, environmental and economic benefits which are generated by the Objective 1 interventions. In the study these benefits are monetised and thereby expressed in a common currency. This provides a useful way of measuring the value of the benefits achieved relative to the cost incurred in securing them, in line with Government appraisal approaches.

2.8 The study was not commissioned in order to carry out primary research. It is based on the existing stock of literature. It therefore takes what is known as a *benefit transfer* approach to valuation: applying the economic values derived from other studies generated in one particular context to the sites in The Mersey Forest.

2.9 We have taken a three phase approach to completing the work:

- Phase 1 – Scoping and developing a model, using available literature
- Phase 2 - Testing the model on a small number of sites
- Phase 3 – Extending the model to a larger sample of sites.

2.10 This report sets out the findings of our modelling. The remainder of the report consists of:

- A review of the literature on the economic value of Green Infrastructure;
- An explanation of the economic model developed;
- A discussion of the findings from the analysis and assessment of the value for money of the Objective 1 Programme; and
- Concluding observations

2.11 Detailed results of the modelling are set out in Appendix A and a discussion of the methodology is provided in Appendix B.

[3] Mersey Forest Business Plan 2005-10, p3.

3. The Economic Value of Green Infrastructure

3.12 Money may not grow on trees, but trees, woods and forests have a considerable value to society. They support a range of social, environmental and economic benefits. But the evidence base on these benefits is only nascent and is often not fully taken account of by decision makers. Forestry is a key delivery mechanism for Green Infrastructure. Before we look in detail at the economic contribution of The Mersey Forest's Objective One funded investments, we look in detail at the sorts of economic value that are supported by Green Infrastructure investments and their sources.

3.13 This section therefore sets out a summary of our review of the available evidence on the economic value of Green Infrastructure.[4] The section covers the following:

- Why measure the economic contribution of Green Infrastructure?
- What do we mean by economic value, and what are the techniques for measuring it?
- The Natural Economy North West Framework, and
- A review of the evidence.

Why measure the economic contribution of Green Infrastructure?

Policy Drivers

3.14 It has become increasingly recognised in policy circles that forestry is able to deliver multiple benefits for society. The England Forestry Strategy published in 1998 shifted the focus away from timber production and the associated job creation towards the delivery of public goods, in particular in relation to recreation, access and tourism, conservation and economic regeneration. Since then, the forestry agenda has moved on further to encompass a wider range of policy agendas, including health, climate change, landscape and amenity, soils and water and renewable energy.[5] The first aim of the latest national strategy, published in 2007, is

"to provide, in England, a resource of trees, woods and forests in places where they can contribute most in terms of environmental, economic and social benefits now and for future generations."[6]

[4] In the North West Regional Spatial Strategy Green Infrastructure is defined as "the network of green and blue spaces that lies within and between the North West's cities, towns and villages which provides multiple social, economic and environmental benefits."

[5] CGC Consulting (2005) *Review of Evidence for Forestry Policy Formulation in England*

[6] DEFRA (2007) A Strategy for England's Trees, Woods and Forests, p4.

3.15 This increased policy emphasis on the multiple benefits of forestry underlines the importance of understanding the nature and scale of these benefits. Decisions on the allocation of forestry resources need to be taken in light of their expected impact on all of these benefits. Hence they need to be measured in some way, and compared to the cost incurred in achieving them.[7] A further driver is the increasing need for local authorities and policy makers to balance sustainability and environmental concerns with the need to safeguard jobs and attract investment. Environmental improvements increasingly need to be underpinned by a strong economic case. This makes understanding the economic value of green infrastructure all the more vital.

3.16 Despite this increased emphasis on the range of benefits that forestry brings, the evidence base on these benefits has only been emerging relatively recently. As the Delivery Plan for the national strategy puts it,

"*while trees, woods and forests are clearly valued by society, our evidence on the benefits that they provide is not always as good as it should be*."[8]

3.17 More importantly, the use of the existing evidence in cost-benefit analyses is not as widespread as it could be. To date, efforts to understand the value of Green Infrastructure investments have not been given sufficient attention by decision makers.[9]

What do we mean by Economic Value?

Part of the reason for this lack of attention is due to the lack of a coherent, accepted framework for capturing or measuring these benefits. There is an inherent uncertainty as to what constitutes economic value in this context.[10] Standard economic indicators used to capture economic value include jobs, income, and Gross Value added. But many of the sources of economic value supported by GI investments cannot be expressed in these terms, because they do not directly involve economic transactions or lead to increases in economic activity per se. Given that some of the goods and services supported by these investments are not marketed, there is no readily available, objective mechanism for ascribing a value to them; the market does not price these goods and services.[11] As the HM Treasury Greenbook suggests, "*There will be some impacts, such as environmental, social and health impacts, which have no market price, but are still important enough to value separately*."[12]

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[7] DEFRA (2007) *An Introductory Guide to Valuing Ecosystem Services*, p13.

[8] *Delivery Plan 2008-12 England's Trees, Woods and Forests*, Forestry Commission, 2008, p9. CEM University of Nottingham (2006) also acknowledges that there are gaps in relation to the valuation of ecosystem services (CEM University of Nottingham, (2006) *The Ecosystem Concept and the Identification of Ecosystem Goods and Services in the English Policy Context – A Review Paper* http://www.defra.gov.uk/wildlife-countryside/natres/pdf/ecosys-concept.pdf)

[9] ECOTEC (2008) *The economic benefits of Green Infrastructure: Developing key tests for evaluating the benefits of Green Infrastructure*, commissioned by The Mersey Forest on behalf of Natural Economy North West, p4.

[10] As Cullen (2007) states, "practitioners frequently plunge into valuation exercises with no clear idea of what value is."

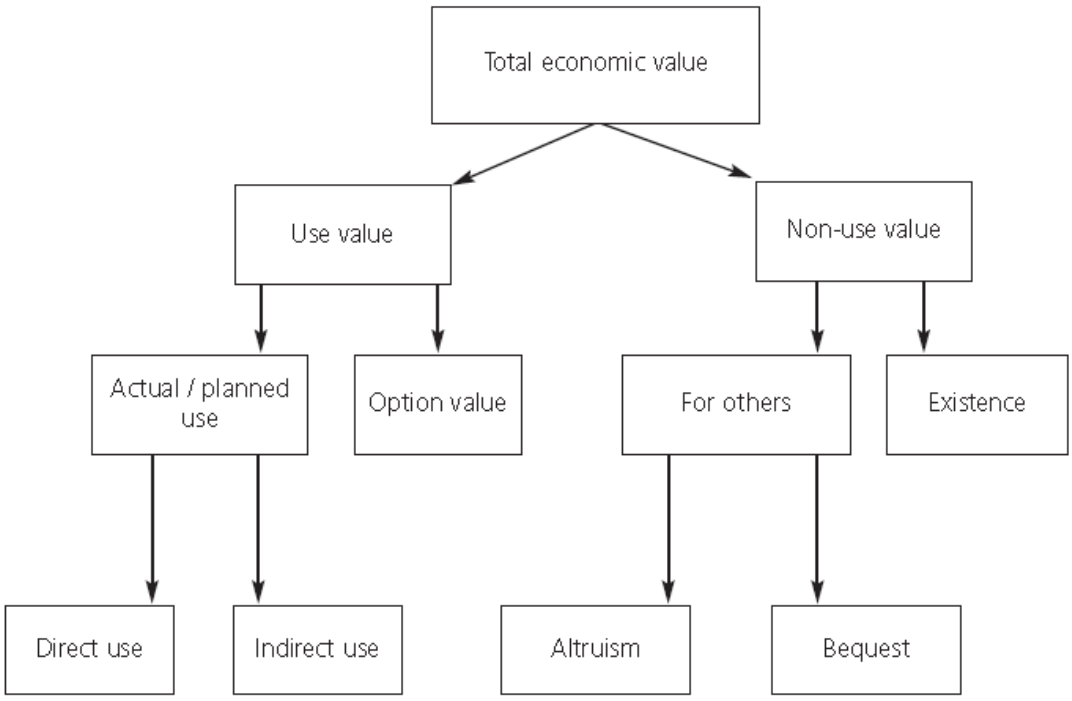
[11] There is a further philosophical dimension to the valuation of Green Infrastructure. Using contingent valuation methods for valuing GI is an *anthropocentric* approach; it assumes that a green entity has value only in so far as it has the ability to serve or suit human preferences or purposes (e.g. Hill (2006) and Cullen (2007)). This debate is beyond the scope of this report; we take it that given that we are focusing on value from a public policy perspective, this approach is appropriate.

[12] HM Treasury (2003) The Green Book: Appraisal and Evaluation in Central Government, cited in ECOTEC (2008)

3.18 Indeed there has been an increasing amount of attention paid to the limitations of GVA as a measure of economic well being and therefore as a basis for policy making. As a response to this, Regeneris Consulting (2007) developed a Sustainable Prosperity Index, an index of Sustainable Economic Well Being (ISEW) at the local, sub-regional and regional level. This captures the a range of factors, including costs of commuting and congestion, costs of living, non-marketed domestic labour and greenhouse gas emissions, that are not captured in normal output measures.[13] Recently, the Commission on the Measurement of Economic Performance and Social Progress has argued that well being is a multi-dimensional and GDP is a limited measure of well being.[14]

3.19 How, then, do we measure the value of these important public goods and services created or supported by Green Infrastructure? Ultimately policy makers want to be able to understand the value of an investment in monetary terms, so that they can easily compare what they expect to get out of an investment to what they are putting in.[15] The Total Economic Value Framework is often used in environmental economics to describe the sources of value for ecosystem services. This is illustrated below. The following explanation is based on that provided by DEFRA (2007).

Figure 3-1: The Total Economic Value Framework



Source: DEFRA (2007) *An Introductory Guide to Valuing Ecosystem Services*

[13] Regeneris Consulting (2007) *The Regeneris Sustainable Prosperity Index*

[14] Stiglitz et al. (2009) *Report by the Commission on the Measurement of Economic Performance and Social Progress*

[15] There has also been debate around whether values used in decision making should be monetary or more conceptual (Cullen (2007)). The latter are referred to in DEFRA (2007) as deliberative or participatory approaches. These are qualitative approaches to understanding impact. In practice, an appraisal should take these into account along with the quantitative data.

Use value

3.20 There are three components to this:

- Direct use value: refers to the value of a resource to individuals in terms of actual or planned use. This covers consumptive use of the ecosystem (e.g. food, timber) and non-consumptive use, that is, use of the services without extracting any elements from the ecosystem (e.g. recreation, landscape amenity). Direct use value covers both market goods (e.g. timber) and non–market goods (e.g. recreation or the inspiration people find in directly experiencing nature).

- Indirect use value: this refers to the benefit that individuals get from ecosystem services supported by a resource without directly using it. These services include climate regulation; water regulation; pollution filtering; soil retention and provision; nutrient cycling; waste decomposition; and pollination etc. It is generally much harder to measure indirect use value than direct use value.

- Option value: Having the option to use a resource in future (either directly or indirectly) has a value. For example, people may value the option of using a local park even though they have no specific intention to visit at the moment.

Non-use value

3.21 The source of non-use value is the value that individuals place on the knowledge that the natural environment is maintained. There are three main components:

- Bequest value: individuals attach value to the fact that the ecosystem resource will be passed on to future generations.

- Altruistic value: individuals attach values to the availability of the ecosystem resource to others in the current generation.

- Existence value: comes from the very existence of an ecosystem resource, even though an individual has no actual or planned use of it. The example used in DEFRA (2007) is of people's willingness to pay for the preservation of whales, through donations, even if they know that they may never actually see a whale.

Techniques for measuring Economic Value

3.22 As discussed earlier, ascribing a value to non-traded goods is problematic. Economists have used a number of techniques to try to measure the economic value of non-traded goods. These main ones include:

- Willingness to Pay/stated preference: consumers are asked (through surveys or focus groups) how much they would be willing to pay for a good, if they had to do so in order to secure it. The flipside of this is how much individuals would be willing to accept in compensation in order to forgo a gain, or tolerate a loss, of the good. The reasoning is that if individuals are willing to pay for a non-market good, then that good has a well-being value for them. The technique of surveying individuals to find this out is termed stated preference/contingent valuation.

- Revealed Preference: Consumers' actual behaviour is used to infer the value they place on a particular non-market good. The rationale is that the market good also gives access to non-market goods. House prices are often used in this way.[16] Housing is a marketed good, but individuals base their valuation of a house not only on its structural features but also on its locational attributes, including access to greenspace, for example. This pricing of a good in terms of values attributed to its components is known as *hedonic pricing*. Another example of the revealed preference technique is the Travel Cost method, the basic premise of which is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site.[17] Peoples' willingness to pay to visit the site can therefore be deduced from the number of trips that they make at different travel costs.

3.23 Other methods of valuation, which, strictly speaking, are outside the Total Economic Value framework, include

- Pricing approaches. These use observed market prices either as direct measures of economic value of an ecosystem service (e.g. expenditure averted, damage costs avoided) or as a proxy for the value; and

- Cost-based approaches. These consider the costs that arise in relation to the provision of environmental goods and services, including opportunity cost; cost of alternatives, and replacement costs.

3.24 Some of the limitations in these methods are discussed at the end of section 4 of this report.

The Natural Economy North West Framework

3.25 Natural Economy North West (NENW) is a £3m partnership led by Natural England, the Northwest Regional Development Agency and the SITA Trust. It was formed in recognition of the important role that Green Infrastructure plays in supporting economic, social and environmental benefits, and its purpose is to provide direction and leadership, to collect and disseminate data and intelligence and helps in the delivery of projects. NENW is the lead body for the delivery of the Transformational Action 113 in the North West Regional Economic Strategy, which is to *develop the economic benefit of the region's natural environment through better alignment of environmental activities and economic gain*.[18]

3.26 NENW has been leading a research programme looking at the economic benefits of Green Infrastructure. Their review of the evidence has identified eleven benefits:

- Climate Change Mitigation and Adaptation: Trees absorb carbon and provide natural air conditioning for urban areas, reducing the need for heating and cooling.

- Flood Alleviation and Water Management: Greenspace provides canopy cover, reducing run-off and improving absorption rates, resulting in less dramatic flood

[16] A good example is the study by CABE (2005) *Does Money Grow on Trees?*

[17] http://www.ecosystemvaluation.org/travel_costs.htm

[18] NWDA (2006) *North West Regional Economic Strategy*, p7.

events for urban areas.

- Quality of Place: Green infrastructure offers an improved living environment, including opportunities for recreation, visual amenity and empowerment through community action.

- Health and Well-being: Green infrastructure provides improved air quality, reduced stress levels, increased opportunities for informal and formal physical activity and recreation.

- Land and Property Values: Developing green space and undertaking environmental improvements in key locations within urban and semi-urban areas has significant benefits for housing and land values.

- Economic Growth and Investment: The creation and development of green spaces and landscaping can encourage and attract high value industry to a locality or region.

- Labour Productivity: High quality accessible Green Infrastructure can provide opportunities to develop a more productive workforce for employers through improved health, stress alleviation and enhancing motivation/attracting and retaining motivated people.

- Tourism: Green Infrastructure plays a strong role in the generation of new tourism opportunities in town and country, as well as stimulating economic activity within agriculture, forestry and public services.

- Recreation and Leisure: Green Infrastructure generates the provision of leisure and recreational opportunities, stimulating investment in rights of way and publicly accessible greenspace and woodlands.

- Land and Biodiversity: Green Infrastructure plays a strong role in supporting direct and indirect employment in agriculture, forestry land management and conservation, as well as improving and protecting habitats and encouraging and maintaining biodiversity.

- Products from the land: the vast majority of existing Green Infrastructure takes the form of land in productive use in the countryside: agricultural/horticultural/managed woodland and managed moorland.

3.27 This provides a comprehensive framework for assessing benefits. Subsequent work by NENW has included developing tests for evaluating the benefits of Green Infrastructure and investigated how to deliver, measure and demonstrate economic contribution of the natural environment at a project level.[19]

[19] http://www.naturaleconomynorthwest.co.uk/resources+reports.php

A Review of the Evidence

3.28 The first phase of our work in quantifying these benefits for The Mersey Forest – the feasibility stage - has been to develop a model for capturing the economic benefits of a green infrastructure investment, at the level of an individual project. We have used the NENW framework as the starting point for our economic model. Essentially our task in this first phase was to operationalise this framework; to develop a practical model for expressing these benefits as monetary values. To do this, we reviewed the available literature and derived useful benchmark figures in relation to the benefits. Here we set out a summary of this literature.

Climate Change Mitigation and Adaptation

3.29 Carbon sequestration is an important benefit of woodland management and creation. Research suggests that the net amount of carbon sequestration attributable to forestry depends on a number of factors including the tree species, the rotation period, thinning, and productivity and volume of timber growth or yield class of the timber by species and the previous use of the soil. A realistic average over a full rotation (from planting to harvesting) is estimated to be around 3 tonnes of carbon per hectare per year.[20]

3.30 There has been debate on the value of carbon sequestered, with a wide range of values, from £6.67 per tonne[21] to £59 per tonne.[22] The Stern Review calculated the current marginal social cost of carbon at £25 (2007 prices). This increases by 2% in real terms per annum, to reflect rising damage costs from higher greenhouse gas concentrations.[23]

3.31 Trees also have a climate change *adaptation* value. The evidence shows that climate change is already occurring and the next 30-40 years of climate change has already been determined by historic omissions. Thus there is a need to prepare for and adapt to its effects. Climate change scenarios for the UK suggest that there could be an increase in average annual temperatures by between 1°C and 5°C by the 2080s.

3.32 A major study by Gill et al (2007) looked at the potential for green infrastructure to moderate the effects of climate change in urban areas. In particular, the study conducted modelling work to investigate the effects of green infrastructure on urban surface temperatures, using a case study of the Greater Manchester conurbation. This found that if the amount of greenspace were increased by 10 per cent in high-density residential areas and town centres, maximum surface temperatures would be held at or below 1961–1990

[20] Forestry Commission (2003) Forests, Carbon and Climate Change: the UK Contribution Information Note, p4 and Forestry Commission (2005) *Stern Review on Economics of Climate Change, response from the Forestry Commission*, p2.

[21] Brainard, J., A. Lovett and I. Bateman (2003), Carbon Sequestration Benefits of Woodland, *Social and Environmental Benefits of Forestry Phase 2,* Report to Forestry Commission, Edinburgh, Newcastle, Centre for Research in Environmental Appraisal and Management, University of Newcastle Upon Tyne.

[22] Willis, Garrod, Scarpa, Macmillan and Bateman (2000), Non-Market Benefits of Forestry: Phase 1. A review by Downing et al (2005) for DEFRA found a range from £0 per tonne to £1,000 per tonne (Downing, T.E., D. Anthoff, R. Butterfield et al. (2005): 'Social cost of carbon: a closer look at uncertainty'. London: DEFRA)

[23] Stern, N. (2006) *Stern Review on the Economics of Climate Change,* HM Treasury

baseline levels up to, but not including, the 2080s High Scenario.[24] This is due to shading and cooling effects from vegetated surfaces. The same study also looked at the effects on surface run off, which we discuss under Flood Alleviation and Water Management below.

3.33 Trees provide a natural air conditioning effect for local areas: when planted in a suitable way, they can have the effect of reducing energy costs in nearby buildings. This works through shelterbelt effects (by reducing wind speed and thus reducing the need to heat buildings) and through shading effects (by reducing solar exposure and hence the need for air conditioning).

3.34 There has been a fair amount of research done in the US on the air conditioning effect.[25] The U.S. Department of Energy estimates that just three trees, properly placed around the house, can save an average household between $100 and $250 in energy costs annually.[26] Recently released research has found that the energy saving effect of street trees in New York amounted to $28 million annually.[27] We have not identified any research on this effect in the UK, although guidance from the Town and Country Planning Association notes that "Greenspace and trees offer a way to cope with hot weather (through shading and evaporative cooling)."[28] Given the climatic differences with the US the results of these studies cannot be easily transferred to the UK. However, the shelterbelt effect has been studied in the UK. For example, Liu and Harris (2007) studied the effect of shelterbelt trees on energy consumption in offices in Scotland, and found that a reduction of up to 18% in heating costs could be achieved by optimum placement of trees.[29]

3.35 Guidance from what was the Department for the Environment, Transport and the Regions stated that energy savings by planting shelter belts typically range between 3 and 9%.[30] As well as resulting in direct financial savings for households, this also creates social cost savings through the reduction in carbon emissions. The Carbon Trust states that 0.185kg of carbon are emitted per kwh of gas consumed.[31] This can then be valued using the shadow price of carbon.

3.36 It has been beyond the scope of the present study to transfer the methodology in the Gill et al (2007) modelling work to The Mersey Forest. However, our model does capture the shelterbelt and consequent energy saving effects from trees. Clearly for our model this

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[24] Gill, S.E., Handley, J.F., Ennos, A.R., and Pauleit, S. (2007) Adapting Cities for Climate Change: The Role of the Green Infrastructure in *Built Environment*, Vol. 33, no. 1.

[25] For example, McPherson (1992) Accounting for Benefits and Costs of Urban Greenspace in *Landscape and Urban Planning*, 22, 41-51

[26] The U.S. Department of Energy estimates that just three trees, properly placed around the house, can save an average household between $100 and $250 in energy costs annually.

[27] Ibrahim, M, (2009) "US benefit analysis snared over $220m for Trees" in *Horticulture Week*, October 2nd 2009.

[28] Shaw, R., Colley, M., and Connell, R. (2007) *Climate change adaptation by design: a guide for sustainable communities*.

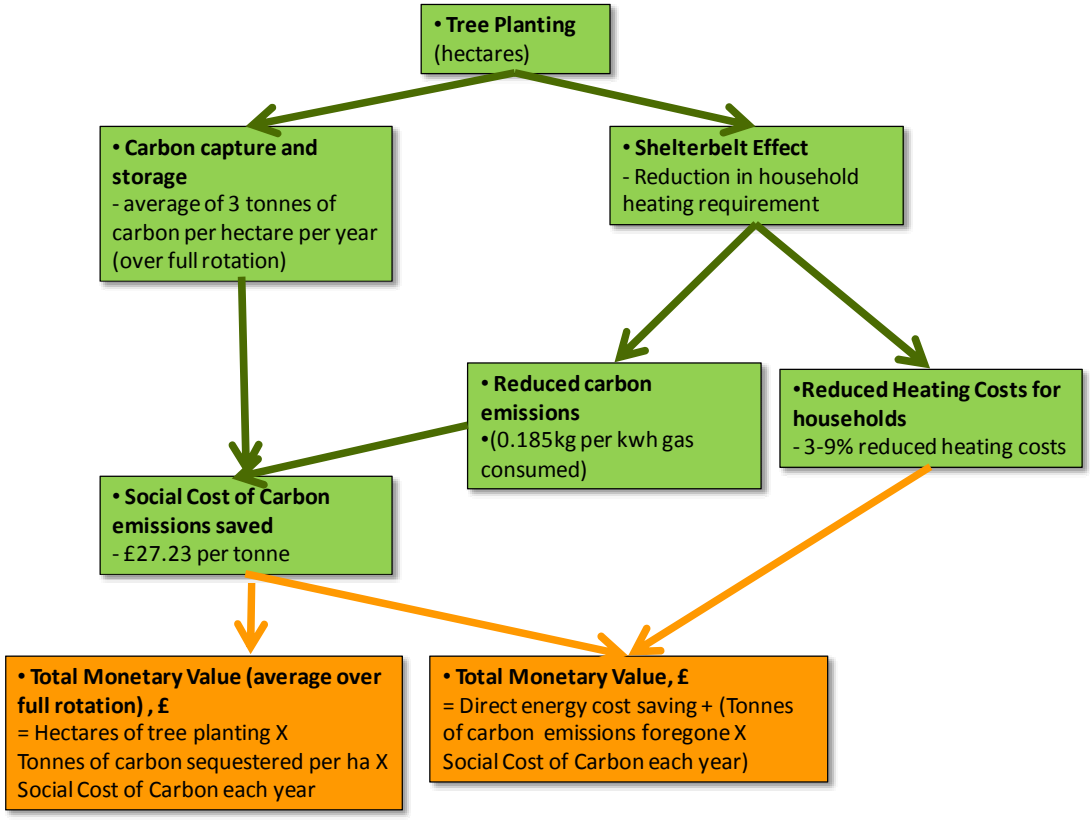
TCPA, London, p9.

[29] Liu,Y. and Harris, D.J. (2008) Effects of shelterbelt trees on reducing heating-energy consumption of office buildings in Scotland, in *Applied Energy*, 85, p115-127

[30] Rawlings, R. *Environmental Rules of Thumb* Technical Note TN 12/99 The Building Services Research and Information Association for DETR

[31] http://www.carbontrust.co.uk/resource/conversion_factors/default.htm

effect is highly context-specific and depends upon the proximity of the trees planted to buildings as well as their exact placing so as to block wind. The diagram below summarises the climate change mitigation and adaptation effects captured in our model.



Flood Alleviation and Water Management

3.37 There are several studies of the role played by forests in watershed regulation. Functions include: soil conservation - and hence control of siltation and sedimentation, water flow regulation - including flood and storm protection, water supply, water quality regulation – including nutrient outflow.

3.38 In a study of the potential role of floodplain woodland in flood alleviation in the South East of England, models predicted a reduction in water velocity within the woodland, increasing water level by up to 270mm and creating a backwater effect that extended nearly 400m upstream. Flood storage increased by 15% and 71%, for two scenarios modelled.

3.39 Total surface run off in urban areas is expected to increase as a result of climate change, which is expected to bring increased precipitation. Gill et al (2007) found that:

- increasing green cover by 10 per cent in urban residential areas reduces runoff from these areas from a 28 mm precipitation event - expected in the 2080s High Emissions Scenario - by 4.9 per cent and

- increasing tree cover by 10 per cent reduces the runoff by 5.7 per cent.[32]

3.40 Our literature review has found little in the way of benchmarks that could be used to model this impact for The Mersey Forest interventions, and it has not been possible to transfer the Gill et al (2007) methodology to this study. A large economic study for DEFRA in 2003 concluded that "There is limited information on the impacts of forestry on water supply and water quality… The WGS [Woodland Grant Scheme] evaluation concludes that 'there is not much scope for WGS to influence flood risk…we attribute no net benefit or cost to forestry with respect to water but note that further evidence on this aspect would be useful."[33] Therefore, our model does not quantify any of these possible effects, but this is a potential area for future research.

Quality of Place

3.41 The NENW concept of the Quality of Place value of greenspace encompasses a range of effects:

"Green Infrastructure investment creates an improved sense of quality of place, providing opportunities for recreation, empowerment through community ownership, and visual amenity, improving the attractiveness of a neighbourhood with effects upon property prices, land values, investment, employment opportunities and social capital and social equity."[34]

3.42 It captures the interactions between some of the other effects in the framework (recreation and leisure, land and property values, economic growth and investment) and the overall impact this has on the quality of an area. For the purposes of our model, under this heading we have concentrated on the *visual amenity* effect of greenspace. The presence of forests and woodland in an area can have the effect of enhancing the visual quality and appearance of the landscape. They can enhance the views from people's homes and/or on journeys to and from work, hence increasing quality of life.

3.43 Several studies have valued by looking at impacts on local house prices of proximity to greenspace. As discussed earlier this revealed preference approach starts from the premise that if people value this green space then this will be reflected in a willingness to pay a premium for it through higher house prices. Studies into this effect have been found a range of values from the

- Local trees add 4% to house prices (Anderson and Cordell, 1988)[35]
- Local trees add 6% to house prices (Morales, 1980)[36]

[32] Gill, S.E., Handley, J.F., Ennos, A.R., and Pauleit, S. (2007) Adapting Cities for Climate Change: The Role of the Green Infrastructure in *Built Environment*, Vol. 33, no. 1.

[33] CGC Consulting (2003) *Economic Analysis of Forestry Policy in England*, p9.

[34] ECOTEC Consulting (2008) *The economic benefits of Green Infrastructure: The public and business case for investing in Green Infrastructure and a review of the underpinning evidence,* Commissioned by The Mersey Forest on behalf of Natural Economy North West.

[35] Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A.): A Survey based on Actual Sales Prices. *Landscape and Urban Planning*, 15:153-164

[36] Morales, D (1990) The Contribution of Trees to Residential Property Value, *Journal of Arboriculture* 6 (11)

- 20% general tree cover adds 7.1% to house prices (Garrod and Wills, 1992)[37]
- Having a park nearby adds 6% to house prices (Luttik, 2000, cited in CABE, 2004)[38]

3.44 Of course, these results are to some extent context-specific, in that the scale of any percentage increase depends on the base house prices in an area (a 6% increase in house prices in Kensington and Chelsea would amount to a lot more than in total monetary terms it would in a remote area of Wales, for example).

3.45 Our analysis concluded that house prices are best viewed as a proxy value for measuring a range of benefits which greenspace delivers to local areas. As we saw earlier, individuals base their valuation of a house on a range of factors. The locational attributes are one of these factors, including proximity to greenspace. But within this, some of the value will come from simply being able to have a pleasant view of the greenspace (landscape value) while some will come from the ability to access and use it for recreational and health purposes.

3.46 A major study for the Forestry Commission in 2003 explicitly separated the visual amenity value from the recreational use value.[39] This study carried out a new survey of over 400 residents across England, Scotland and Wales to estimate the value of woodland views from properties and on journeys. This used a stated preference approach, asking respondents about their willingness to pay for forested landscapes. A number of different configurations of forested landscapes were used in the questionnaire, as well as the same landscape without forestry, to assess net values. The images used formed the basis of a choice experiment. Respondents were asked to make choices between various hypothetical alternatives offering different levels of particular attributes. As one of these attributes is price, the respondents' WTP for other attributes can then be inferred. Overall, the study concluded that

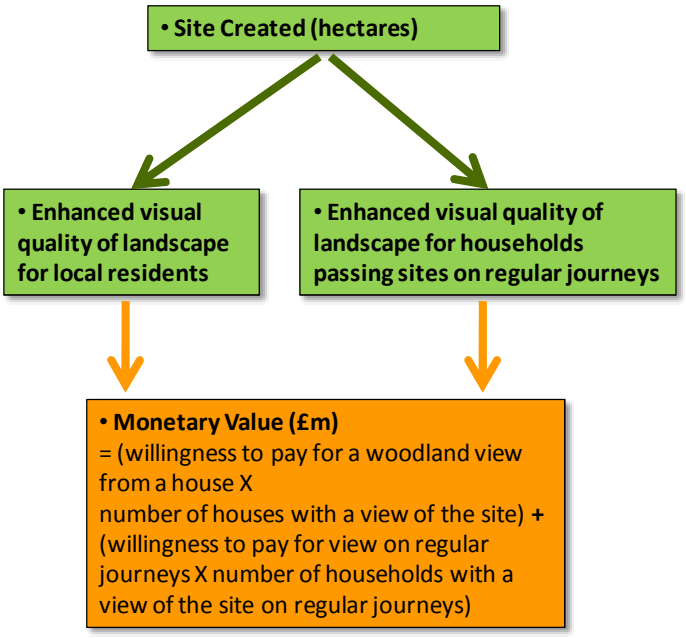
- the value of a woodland view for houses on the urban fringe is £269 per annum per household (2003 prices), and
- those who could view greenspace while travelling would be willing to pay £226.56 per annum per household (2003 prices).

3.47 For the purposes of our model, we are using a *benefit transfer* approach. This involves applying the economic values derived from other studies generated in one particular context to the sites in The Mersey Forest. We are using the WTP figures from this study to generate values for sites in The Mersey Forest (uprating to current prices), based on an assessment of the number of households benefiting from views of woodland that they would not have otherwise had.

[37] Garrod, G. and Willis, K. (1992) Valuing Goods' Characteristics: An Application of the Hedonic Price Method to Environmental Attributes, *Journal of Environmental Management*, 34(1):59-76

[38] CABE (2004) The Value of Public Open Space

[39] Garrod, G. and Macmilan, D. (2003) Social and Environmental Benefits of Forestry Phase 2: Landscape Value of Forests and Woodland Report to Forestry Commission, Centre for Research in Environmental Appraisal and Management, University of Newcastle.



Recreation and Leisure

3.48 Publicly accessible greenspace and woodlands provide leisure and recreational opportunities for local residents, for example for the purpose of walking, viewing wildlife, cycling and so on. Given that for the most part these visits are not charged for, there is no direct economic impact associated with them. However, they do have an economic value in the form of a use value (both a direct use value and an option value - see the Total Economic Value framework above): people value greenspace in terms of actual or planned use.

3.49 The latest study to look at the recreation value of woodlands in the UK was conducted in 2003 by Scarpa. This used a contingent valuation approach. A new survey was carried out of visitors to various woodland sites in England and Wales, asking them the maximum they would be willing to pay for access to the woodland for recreational purposes, if not paying anything meant going without recreation in that woodland. This was combined with data from a previous study from 1994.

3.50 This value depends on the characteristics of the forest, the recreational opportunities that it provides, the availability of alternative recreational opportunities in the surrounding area and of course the characteristics of those who are surveyed (their income and preferences). The research found that the average value placed on a day visit was £1.66, which would equate to around £1.95 in today's prices.[40] This overall average varied, depending on how far visitors travelled and how frequently they visited:

- Visitors who travelled less than 10 miles were willing to pay less than the average (90p in 2003 prices), compared to those who travelled more than 10 miles (£1.80, in 2003 prices)
- Visitors who used the sites frequently (more than 50 times per year) were only

[40] Scarpa, R. (2003) Social and Environmental Benefits of Forestry Phase 2: The Recreation Value of Woodlands Report to Forestry Commission, Centre for Research in Environmental Appraisal and Management, University of Newcastle

willing to pay 60p per visit (2003 prices).

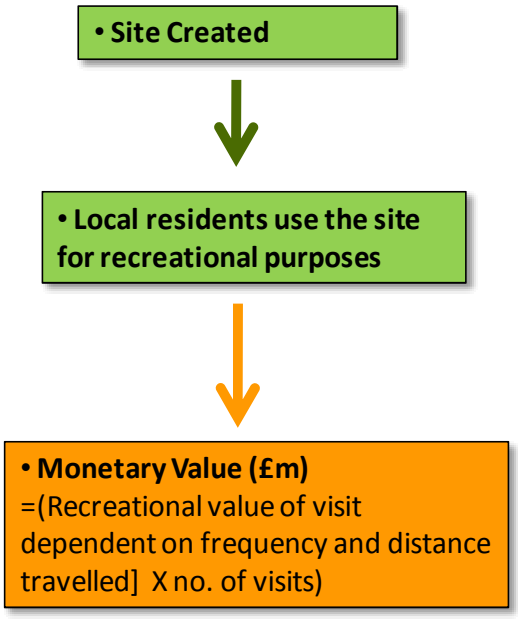
3.51 The relationship between the distance travelled for the visit and the mean WTP is set out in the table below: generally speaking, as the distance travelled increases, so does the willingness to pay.

Table 3-1: Mean Willingness to Pay for a Woodland Visit by Distance Travelled (2003 prices)

	Willingness to Pay
frequent (>50 times per year)	£0.60
Distance Travelled	
< 10 miles	£0.90
11-25 miles	£1.50
26-50 miles	£1.80
51-75 miles	£1.80
76-100 miles	£2.10
101-150 miles	£2.50
> 150 miles	£2.40

Source: Scarpa (2003) Social and Environmental Benefits of Forestry Phase 2: The Recreation Value of Woodlands Report to Forestry Commission, Centre for Research in Environmental Appraisal and Management,

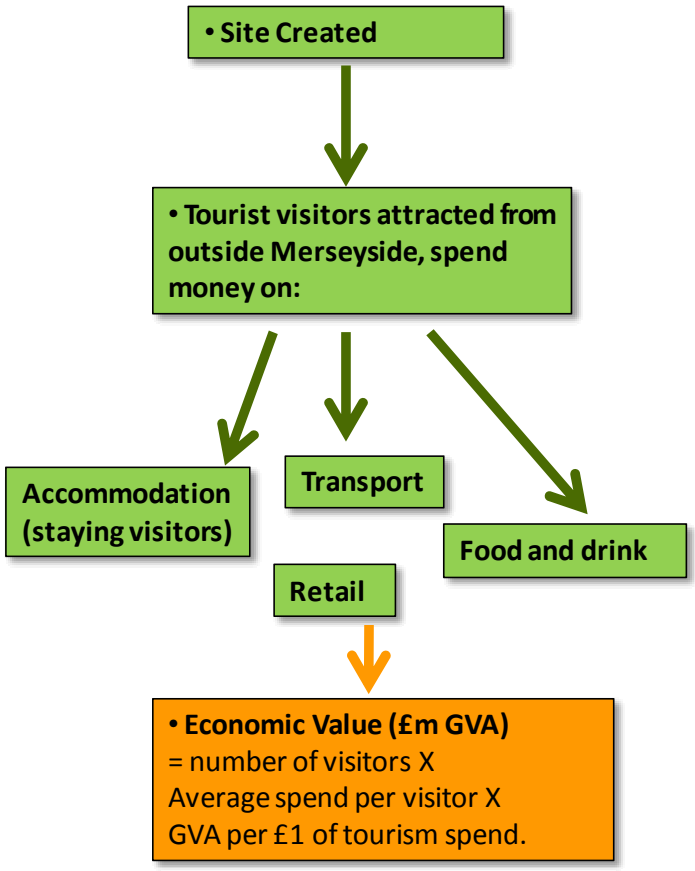
3.52 Again, we are using a benefit transfer approach here, taking these results and applying them to The Mersey Forest sites.



Tourism

3.53 As well as stimulating recreational visits, Green Infrastructure can also generate new tourism opportunities. Tourist visits differ from recreational visits in that they are undertaken less regularly, last longer and generally involve more travel. The England Leisure Visits Survey defines a tourist visit as one with a minimum of 3 hours and not taken regularly.

3.54 Unlike many of the other benefits identified in our model, the tourism benefits are market-based and can be expressed in terms of Gross Value Added and jobs. Tourists spend money in the local economy around the woodland site they are visiting: on transport, retail goods, food and drink etc. This spending generates economic impact both directly and through indirect (supply chain) and induced (the spend of employees on goods and services) effects. The England Leisure Visits Survey indicates that the average spend per tourist visit to the woods/forests was £28. This equates to £31.04 in 2009/10 prices.[41]



3.55 For the model, we have defined a tourist visit as any purposeful visit to a site which is made from outside the Merseyside sub-region.

Health and Well-being

3.56 Green infrastructure provides improved air quality, reduced stress levels, along with increased opportunities for informal and formal physical activity and recreation. In addition to the recreational and leisure value placed on the site by its users, the sites can generate more direct health-related impacts. The main effects are as follows:

Impact on rates of initial exercise among the population

3.57 Research has found that the cost to England's economy of poor health due to lack of exercise could range from £2bn[42] to £6.5bn[43] per year. A 10% points increase in adult

[41] England Leisure Visits, Report of the 2005 Survey

[42] Sport England (2002) *Game Plan: A Strategy for Delivering Sport and Physical Activity*

activity (i.e. a reduction in the proportion of those aged 16+ who are sedentary from 37% to 27%) could benefit England by £500m per year (Sport England, 2002). The economic benefit of increased activity is calculated by considering:

- Cost savings to the NHS
- Increased economic output due to a reduction in ill health and absence from work
- Increased economic output due to a reduction in the incidence of premature death.

3.58 Research by Regeneris Consulting (2005) found that improvements in public rights of way in the North East caused a 4% points increase in adult activity, and that an increase in levels of physical activity by 10% points in adults in the North East would deliver savings of at least £25m pa in the economic benefits from improved health.[44]

Pollution absorption

3.59 Research for the Forestry Commission found that woodland has an impact on air quality, and this can be valued through improvements to health. Research has found that trees have a considerable air pollution absorption capacity.

- A study for the Forestry Commission examined the economic cost reduction value of air pollution absorption by trees.[45] This found that woodland in Britain had a net cost reduction of between £199,367 and £11.7m. However, when looked at on a marginal basis - per hectare - the effect is de minimis. Indeed, the same study concluded that "the effect of woodland on air pollution is negligible and can effectively be ignored."

- We have, however, identified research from the US, which looks at the impact in a different way, in terms of cost savings on pollution control. This suggests that the impact could be more significant. A case study of Lincoln Park[46] looked at the value of urban greenspace in reducing air pollution. This estimated the absorption rate of particulates, nitrogen dioxide, sulphur dioxide and carbon monoxide by trees in the park and valued these using data on the costs of pollution control. The premise is that given that trees have an absorptive capacity, the value of this absorption is best estimated by considering the costs of alternative approaches to achieving this level of absorption (i.e. the costs of pollution control): "control costs are assumed to estimate the price that society is willing to pay to reduce the pollutant."[47] The study produces an annual average value per hectare of air pollution absorption of £577, in 2009/10 prices. The study applies the caveat that information on the pollution

[43] Department of Health (2004) *Choosing Health? Choosing Activity*, p.4.

[44] Regeneris Consulting (2005) *Economic and Social Benefits of Countryside Access Routes in the North East*

[45] Powe, N and Willis, K (2002) Social and Environmental Benefits of Forestry Phase 2: Mortality and Morbidity Benefits of Air Pollution Absorption by Woodland, Report to Forestry Commission, Centre for Research in Environmental Appraisal and Management, University of Newcastle

[46] McPherson and Nowak (1993) *Value of Urban Greenspace for Air Quality Improvement: Lincoln Park Chicago*, Arborist News

[47] Ibid.

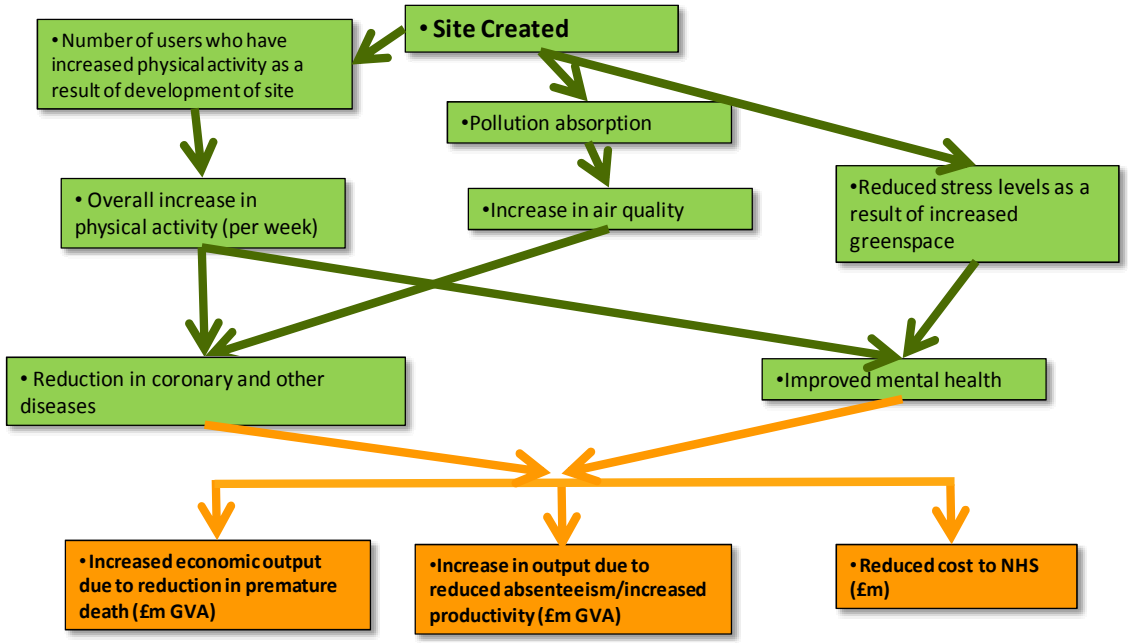
interception and absorption capacity of trees is hard to come by and that therefore the figures in the study should be considered preliminary estimates. It should be noted that that this **excludes absorption of carbon dioxide; therefore there is no double counting with the value of carbon sequestration**.

Impact on Mental health

3.60 Forests and woodland have been shown to have a positive impact on mental health, through restorative effects[48], through facilitating stress recovery, especially for urbanites (1991), and in particular for children and young people.[49] According to the Sainsbury Centre for Mental health, mental health problems cost the country over £77 billion (2002/3 prices).[50] This figure is made up of:

- £12.5 billion for care provided by the NHS, Local authorities, private services and family and friends
- £23 billion in lost output in the economy caused by people being unable to work
- £42 billion in the human costs of reduced quality of life

3.61 Our literature review has not identified any research that has valued the impact of greenspace on mental health. Therefore our modelling has not quantified this impact.



[48] Kaplan (1995) The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology* 15, 169–182.

[49] Box, J. and Harrison, C. (1993). Natural spaces in urban places. *Town and Country Planning* 62, 9, Taylor, A. F., Kuo, F. E. and Sullivan, W. C. (2001). Coping with ADD: the surprising connection to green play settings. *Environment and Behaviour* 33, 54–77.

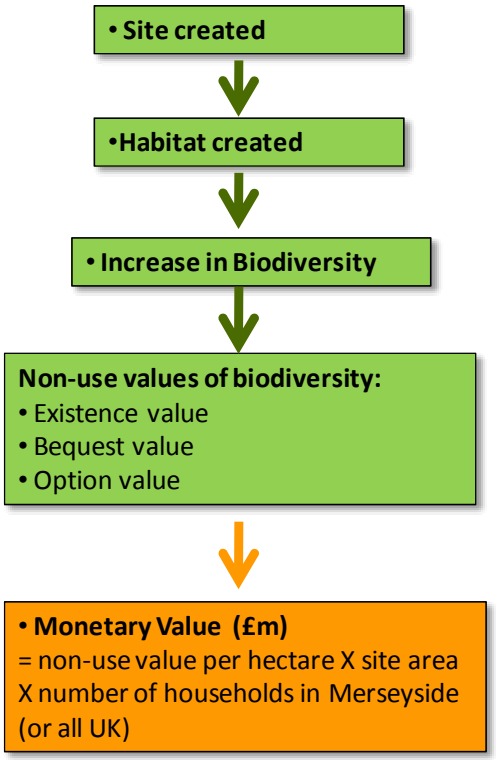
[50] The Sainsbury Centre for Mental Health (2003), Policy Paper 3: The Economic and Social Costs of Mental Illness. London: The Sainsbury Centre for Mental Health.

Biodiversity

3.62 Forestry sites can have the effect of supporting and enhancing biodiversity by preserving and providing natural habitats. A study for the Forestry Commission[51] looked at the value of biodiversity. Again this is a non-market benefit. The principal value that this has to individuals is a non-use value, which comes from the value to individuals of knowing that the resource exists (existence value), the desire to protect it for future generations (bequest value) as well as the value of maintaining the option to use the resource (option value). This study used willingness to pay methods for eight focus groups in England, Scotland and Wales to determine people's valuations of biodiversity. It concluded that biodiversity had a range of marginal benefits, depending on the type of forest:

- £0.35 per household per year for enhanced biodiversity in each 12,000 ha of commercial woodland
- £0.84 per household per year for a 12,000 ha increase in lowland new broadleaved native forest
- £1.13 per household per year for a 12,000 ha increase in ancient semi-natural woodland

3.63 Our model uses these values and assumes that the marginal per hectare value is proportional to the values found here.



[51] Hanley, N, Willis, K, Powe, N and Anderson, M (2002) Social and Environmental Benefits of Forestry Phase 2: Valuing the Benefits of Biodiversity in Forests, Report to Forestry Commission, Centre for Research in Environmental Appraisal and Management, University of Newcastle

Land and Property Values

3.64 The NENW work notes that "proximity to high quality and accessible greenspace directly impacts positively upon house prices."[52] There is considerable evidence to support this – see the evidence cited above under *Quality of Place*. As we discussed in this section, our analysis concluded that, rather than being seen as an economic benefit in and of itself, house prices capture more than one benefit and should be seen as a proxy for measuring a range of public goods, including visual amenity, access to recreation, health and well-being and biodiversity. Therefore, we do not quantify house price impacts in our model.

Economic Growth and Investment

3.65 Research on the locational preferences of highly skilled workers ("knowledge workers") indicates that the quality of the local urban environment is an important factor in their location decision. The same therefore applies to the locational decisions of knowledge based businesses. By improving the local environment, the presence of greenspace can therefore increase the economic competitiveness of an area, in terms of the area's ability to attract and retain knowledge based workers and businesses. This is neatly summed up in the same study by CABE cited above:

"As towns increasingly compete with one another to attract investment, the presence of good parks, squares, gardens and other public spaces becomes a vital business and marketing tool: companies are attracted to locations that offer well-designed, well-managed public places and these in turn attract customers, employees and services."[53]

3.66 However, a 2003 scoping study looking at the evidence on this effect concluded that there was a "lack of real evidence on this topic, despite many claims in the professional literature about the importance of this link"[54] and a review of the literature conducted by Greenspace Scotland published in August 2008 found that

"several aspects where there might be expected to be economic impacts, such as inward investment into an area in part as a result of environmental quality…are missing from the research base…Some reports can be found claiming an impact on inward investment but these do not place numbers on the impact."[55]

3.67 A research project funded by Inter-reg has attempted to address the lack of evidence on this, by examining the links between landscape quality, the location decisions of investors and occupiers and the value of land at commercial property development locations. Research was carried out in the UK, Germany and Belgium. In brief, their findings were as follows:[56]

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[52] ECOTEC Consulting (2008) *The economic benefits of Green Infrastructure: The public and business case for investing in Green Infrastructure and a review of the underpinning evidence,* Commissioned by The Mersey Forest on behalf of Natural Economy North West. p21.

[53] CABE (2004) The Value of Public Open Space

[54] South Yorkshire Forest Partnership et al (2008) *Creating a Setting for Investment*, Project Report, p63.

[55] Greenspace Scotland (2008) Greenspace and quality of life, a critical literature review

[56] South Yorkshire Forest Partnership et al (2008) *Creating a Setting for Investment*, Project Report

- Landscape quality plays an important role in determining the perceived image of a location and this can influence business confidence in it. The greatest impact on investment decision making is at the regional level, where landscape quality can contribute towards enhancing image and thereby contributing to regional competitiveness.

- Research with professional land valuers found that there was not a clear, statistically significant relationship between landscape quality and land value, although qualitative responses indicated that landscape quality does have a modest impact on value.

- A retrospective cost benefit analysis of landscape quality in and around former Brownfield sites found no direct relationship between high landscape quality and increased land values. However, as has been demonstrated in previous studies (see *Quality of Place* above), an impact on surrounding residential property prices was identified.

- Research on community perceptions found that communities do pay attention to the quality of their local environment and to landscape quality, and that better landscape quality is likely to increase local community acceptance of Brownfield site redevelopment into new economic settings.

3.68 Whilst these findings offer useful strategic and policy insights, the research does not provide us with any quantitative benchmarks that can easily be applied to The Mersey Forest interventions. In the absence of specific surveys of businesses in proximity to the site it is very difficult to capture this benefit quantitatively. As a proxy measure we investigated the effect on commercial property prices in the locality of the site: data is available at Super Output Area on the rateable value of commercial property from ONS. However, at this geographical level a significant amount of data is suppressed. We have therefore not modelled this effect.

Labour Productivity

3.69 The NENW work notes that "high quality accessible greenspace can provide opportunities to develop a more productive workforce for employers through improved health, stress alleviation and enhancing motivation/attracting and retaining motivated people."[57] There are a number of effects at work here. The health and stress alleviation dimensions have already been covered in our review on the evidence on health and well-being, whilst the effect on attracting and retaining motivated people has an overlap with *Economic Growth and Investment*. The effect on productivity at work is partly captured through reduced absenteeism as a result of increased physical activity. There is, however, a further dimension to this effect: Psychologists have found that access to plants and green spaces can provide a sense of rest and that this allows workers to be more productive.[58] Our literature review has

[57] ECOTEC Consulting (2008) *The economic benefits of Green Infrastructure: The public and business case for investing in Green Infrastructure and a review of the underpinning evidence,* Commissioned by The Mersey Forest on behalf of Natural Economy North West. p25

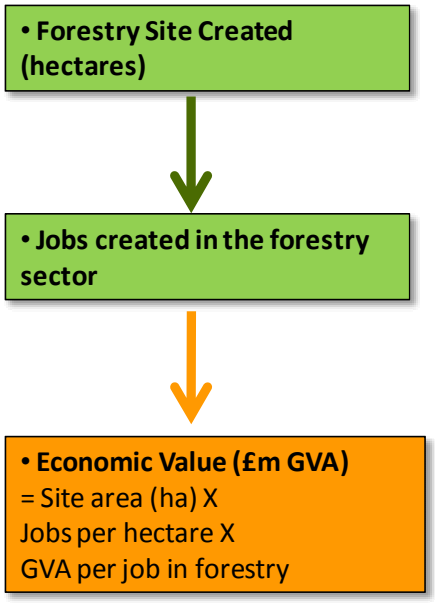
[58] Virginia Cooperative Extension: The Value of Landscaping http://www.ext.vt.edu/pubs/envirohort/426-721/426-721.html#TOC

not found any research valuing this effect. This is an interesting area and a possible area for future research.

Products from the Land

3.70 Forest sites can be used for direct economic activities in the forestry sectors, including for planting, harvesting, restocking, farm woodlands, and for indirect activities including haulage, wood processing, pulp and paper, for example. If a site is used for this purpose then it has a direct use value.

3.71 The Annual Business Inquiry provides data on GVA and employment in the forestry sector. According to the latest data (for 2006) there are 4,588 full time equivalent (FTE) employees in forestry[59], and Gross Value Added (GVA) per FTE job is £46,600. Given that there are 1.21 million hectares of forestry cover in the UK, this gives an employment density of 0.004 FTE jobs per hectare, or just over 4 jobs per 1,000 hectares. Although there is no specific data available, it is arguable that the average jobs density within the Mersey Forest area is higher due to the higher number of jobs in urban areas arising from the scale and the need for more intensive management. For the model, we use the figure of 4 jobs per 1,000 hectares.



[59] This is from SIC 02 : Forestry, logging and related service activities.

4. The Economic Assessment Model

4.72 In developing our model we have taken the key benchmarks from the literature identified above, and used these to estimate the value of the various benefits for The Mersey Forest Objective One sites. Some of the benchmarks are expressed on a *per hectare* basis (e.g. carbon sequestration, biodiversity); others are not (e.g. visual amenity, recreation). This section sets out the important issues related to the model, along with a summary of how it works. The section covers:

- Double counting issues
- Time period
- Additionality
- Data Used
- Type of monetary value
- A summary of the model and
- Potential limitations to the model.

Double Counting issues

4.73 A key consideration in our work has been the concern not to double count economic values. In developing our model, therefore, we have made sure that each of the benefits represents a distinct source of value and that there is no potential overlap between them. In our review of the evidence we identified the following potential sources of overlap between the NENW benefits:

- Land and property prices and quality of place, recreation and leisure and biodiversity. As discussed above, in our view, land and property prices are essentially a revealed preference proxy measure of these other effects, rather than a separate economic benefit.
- Health and Well-being and Labour Productivity. Increases in labour productivity are one aspect of health and well-being.

4.74 As noted above, the values associated with the absorption of carbon and the absorption of pollutants are distinct.

Time Period

4.75 The time period which the model covers is an important issue. Some benefits do not occur until the trees planted have grown for some years (e.g. quality of place, biodiversity) while the rate at which other benefits occur varies depending on the maturity of the trees have been growing for (e.g. carbon sequestration). To attempt to overcome these issues, we have calculated an annual value for each of the benefits, occurring at the point where the trees

have matured.

4.76 We have also calculated a net present value for each of the benefits). In calculating the net present value, we have assumed that for some of the benefits, the marginal value will increase in line with the growth in real incomes (this is discussed in Appendix B). We have used a period of 50 years, in line with Government practice for appraisals of these kinds of investments.[60]

Additionality

4.77 A key issue that the model has to address is the difference between gross and net additional impacts. In assessing the impact of the Objective One investments, the important consideration is the extent to which any particular site is delivering benefits that are net additional to the current situation, that is, the additionality of the benefits. This is especially relevant for:

- Recreation/leisure and tourism: the level of additionality crucially depends on the extent of existing accessible greenspace in proximity to the site, before the site was created/extended/enhanced. If there was already a reasonable amount of accessible greenspace before the intervention, then a large amount of the gross recreational benefit supported will simply be displacing recreational activity from existing sites. Given that recreational benefits can be large, in order to assess the level of additionality we have conducted a GIS-based analysis of the existing accessible greenspace in proximity to the sites, using a range of sources, including:
  - The Woodland Trust's Woods for People dataset
  - Registered Common Land
  - English Heritage Parks & Gardens
  - Countryside Right of Way Act open access land
  - Dedicated Land

  This data allowed us to construct a reasonable baseline picture of the population which already had access to greenspace before the Objective One sites were created. Given that there is also some overlap between the catchment areas of the O1 sites, we took account of when the sites were created, in order to understand potential displacement between sites. This also feeds into the assessment of the exercise-related benefits.

- Visual Amenity: the level of additionality depends on the extent to which residents who have a view of a particular site were able to have a woodland view before the intervention. To assess this for views from home, we have conducted a Viewshed Analysis using GIS. This has helped us to analyse the number of households who

[60] See for example Maxwell, S. (1994). Valuation of Rural Environmental Improvements Using Contingent Valuation Methodology: A Case Study of the Marston Vale Community Forest Project *Journal of Environmental Management*, 41: 385-399.

have a view of the site, and did not have before.[61] For views while travelling, we used GIS to assess the extent to which Merseyside's major roads network was close to woodland prior to the Objective 1 programme, combined with Census Travel to Work data to estimate the length of woodland people on average saw on their journey prior to the Obj 1 programme. This was then compared to the length of the sites parallel to the roads, which was used to apportion the overall willingness to pay for the additional view. More detail is provided in Appendix B.

Data used

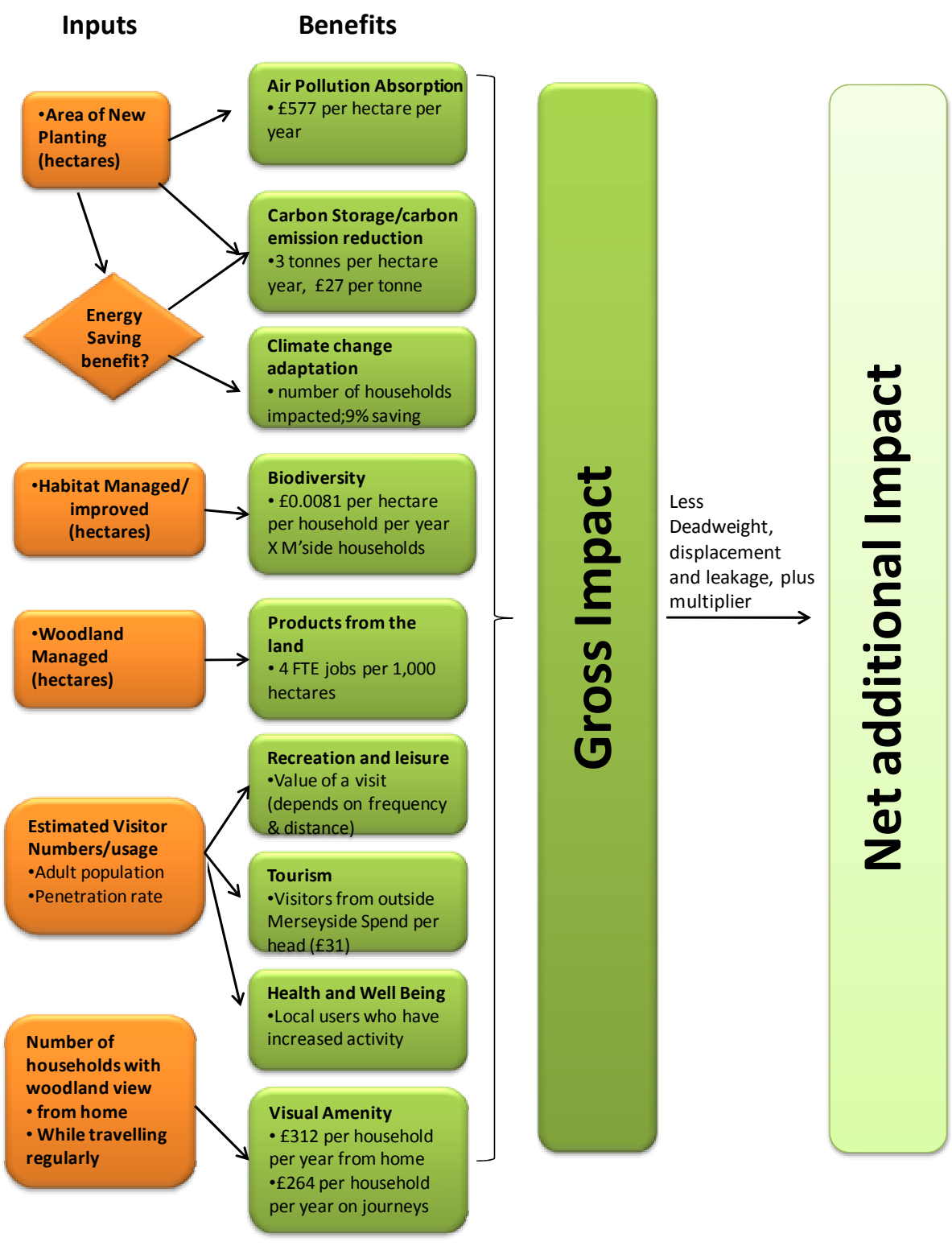
4.78 We have used a variety of data as inputs to the model. These include:

- Area of new planting
- Area of habitat managed/improved
- Area of woodland managed
- Visitor number/usage estimates
- Number of households with a woodland view from home
- Number of households with a woodland view while travelling

4.79 Figure 4-1 shows how these inputs are used and the broad structure of the model.

[61] The original work for Forestry Commission (Garrod, 2002), recommended that this Viewshed analysis is the most accurate method for calculating aggregate landscape amenity value. It was not used in the original report, since this was attempting to aggregate across all of England, and hence was not possible given the budget.

Figure 4-1: Structure of the model



Type of Monetary Value

4.80 As we saw earlier, one of the main complicating factors in assessing the value of Green Infrastructure is the fact that many of the benefits are non-market goods, and cannot therefore be expressed in terms of direct Gross Value Added. Our model aggregates all of the benefits into a Total Monetised Benefit, which consists of three types of economic benefit: direct GVA, social cost savings and other well-being benefits. These are explained below:

- GVA: Direct increases in economic output in Merseyside. This applies to
  - ➢ Products from the land – this captures the direct economic output from forestry management activities.
  - ➢ Tourism – the money spent by tourists in the local economy generates economic output.
  - ➢ Health and well-being – an increase in output is supported via a reduction in ill health and absence from work, and a reduction in the incidence of premature death.
- Social Cost Saving: Social costs avoided (relating to traded or non-traded goods in Merseyside and elsewhere)
  - ➢ Carbon sequestration – a reduction in the amount of carbon in the atmosphere and therefore a saving in the social cost of carbon emissions.
  - ➢ Energy Saving – a direct financial saving to households and a fall in the total social costs of carbon.
  - ➢ Health and well-being – A fall in costs to the NHS as a result of improved health.
  - ➢ Air pollution absorption – a saving of costs of pollution control that would otherwise have to be borne by society.
- Other Well-being: Non-traded goods for which society is willing to pay in Merseyside
  - ➢ Biodiversity – the non-use and use value attached to the conservation of biodiversity
  - ➢ Quality of Place (Landscape/visual amenity) – the use value that households place on woodland views
  - ➢ Recreation – the use value that individuals have for accessible greenspace.

Summary

NENW Benefits	Benefit in our model	Type of Value	Key literature	Input Data used	Additionality issues
Climate Change Mitigation and adaptation	Carbon Sequestration	Social Cost Saving	Brainard, J., A. Lovett and I. Bateman (2003)	Area of new planting	n/a
	Energy Saving	Social Cost Saving	Rawlings (1999)	Number of households affected (using OS address Address-Point)	n/a
Flood Risk Alleviation	Not able to quantify				
Quality of Place	Landscape/amenity value	Other well-being	Garrod and Macmillan (2003)	Number of households with a woodland view/ with view on regular journeys	Need to net off households which previously had a woodland view anyway.
Recreation and Leisure	Recreation	Other well-being	Scarpa (2003)	Number of local users of the site (estimated)	Needs to net off visits displaced from other locations (using ANGST indicators)
Tourism	Tourism	GVA	England Leisure Visits Survey, 2005	Number of visitors from outside the sub-region (estimated)	Need to net off deadweight, displacement, and leakage of spend outside Merseyside.
Health and Well-being	Health and Well-being - Exercise	GVA; Social cost saving	Sport England (2002); DoH (2004) Regeneris Consulting (2005)	Number of local users who have become active as a result of the site	-
	Health and Well-being - Air pollution absorption	Social cost saving	McPherson (1992)	Area of new planting	n/a
Land and Biodiversity	Biodiversity	Other well-being	Hanley, Willis, Powe and Anderson (2002)	Area of habitat managed/improved	n/a
Land and Property Values	Landscape/amenity value, Recreation	-	-	-	-
Economic Growth and Investment	Not able to quantify				
Labour Productivity	Health and Well-being – Exercise (motivational effects not quantified)	-	-	-	-
Products from the land	Products from the land	GVA	Annual Business Inquiry	Woodland area managed	n/a

Potential Limitations to the Modelling

4.81 Whilst the model is rooted as far as possible in the available evidence and the inputs are as far as possible based on actual data, the model employs a number of simplifying assumptions and has a number of limitations. The main ones are as follows:

- Willingness to Pay (WTP) techniques: the model relies in several instances on established studies that have used WTP techniques. These approaches have their own imperfections, including possible bias in survey responses (people may feel the need to make out that they value nature more than they actually do) and the hypothetical nature of the market (clearly these approaches require respondents to imagine that a market exists – there is no way of verifying whether they would actually pay what they say they would pay, should such a market actually exist).

- Benefit transfer approach – this approach works by applying an unadjusted average Willingness to Pay and assumes that this average WTP is applicable both at the study site and the policy site. In reality, there may be a number of factors which may mean that this is not the case. Factors which may be different in the study site and the policy site include: the socio-economic characteristics of the populations, the physical characteristics of the sites and the valuation context (i.e. the proposed changes in the quality and/or quantity of the policy and study good/services that are valued).[62] Also, using an average Willingness to Pay ignores the extent of variation around this mean average, which could be high.

- Visitor numbers – given the lack of data on usage of the sites, the model uses an estimate, derived from a GIS analysis of the local population and data from a survey of the Merseyside/North Cheshire population on a small number of Mersey Forest sites. More detail on the methodology is provided in appendix B.

- Additionality of Usage – As well as estimating the level of usage, an important consideration is the extent to which this usage is additional, rather than displacement of usage of other sites. To assess this we have conducted an analysis of the existing greenspace around the sites before the sites were created. Whilst based on sound logic, this assessment is not based on primary research on the additionality of visits.

- Non-use value – calculating a non-use value for biodiversity is inherently challenging, since individuals find it difficult to 'put a price' on such values as they are rarely asked to do so.[63] In relation to the biodiversity benefit a further question arises as to how to scale up the benefits: if an intervention is pursued which protects habitats in Merseyside, who values it? One could make a case that given that it is a non-use value, all UK households may value this. We have used the conservative assumption that it is just Merseyside residents who benefit from this.

4.82 Whilst some of these issues would be remedied to some extent by primary research at The Mersey Forest sites (e.g. visitor surveys, monitoring of visitor numbers) this has not been feasible given resource constraints.

[62] DEFRA (2007) *Introductory Guide to Valuing Ecosystem Services*, p38

[63] Ibid, p31.

5. Results of the Modelling

5.83 In this section we set out the results of the modelling work. This covers a sample of 77 site interventions by The Mersey Forest as part of its Objective One Programme.[64] The section covers the gross and net additional benefits of the Programme, analysed by the source of benefit and type of economic value. It should be noted that benefits are assumed to apply at the point of maturity of a site. The section also includes three case study sites to illustrate how the different types of benefit vary according to the specific attributes of the site and of the nature of the intervention. Appendix A contains the results of the modelling by site.

Total Monetised Value

5.84 To understand the relative scale of the benefits we have aggregated them together for all of the sites, to give an overall monetised benefit. The Mersey Forest's Objective One Programme of investments is estimated to generate, on an annual basis, a gross monetised benefit of **£5.5 million** (in 2009/10 prices). Of course, in judging the overall impact of the Programme, the important thing to consider is the extent to which the investments have generated *net additional* economic benefits overall, rather than displacing benefits from elsewhere in Merseyside. We judge that the investments deliver a net additional monetised benefit of **£2.0 million**, once these additionality effects are taken into account. On a net present value basis this equates to **£71 million**. Table 5-1 shows how this breaks down by type of benefit.

Table 5-1: Total Monetised Benefit of The Mersey Forest's Objective One Funded Investments, by Source of Benefit (£000s)

	Gross		Net Additional	
Source of Benefit	**Annual**	**NPV**	**Annual**	**NPV**
Carbon Sequestration	£16	£1,388	£16	£1,388
Energy Saving - direct cost saved	£0	£10	£0	£10
Energy Saving - carbon cost saved	£0	£5	£0	£5
Biodiversity	£38	£1,375	£38	£1,375
Products from the land	£164	£5,964	£164	£5,964
Quality of Place - landscape (from home)	£412	£15,001	£412	£15,001
Quality of Place - landscape (while travelling)	£527	£19,193	£527	£19,193
Recreation	£1,547	£56,361	£405	£14,754
Tourism	£2,552	£92,974	£253	£9,199
Health and Well-being: exercise (GVA)	£74	£2,686	£20	£722
Health and Well-being: exercise (cost saving)	£48	£1,763	£13	£474
Health: Air Pollution absorption	£116	£2,717	£116	£2,717
Total Monetised Benefit	**£5,495**	**£199,436**	**£1,963**	**£70,800**

Source: Regeneris Consulting calculations
Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

[64] This covers all of the Objective One interventions, apart from those which are enterprise assistance projects, and those for which there are no outputs. Enterprise assistance project have been separately evaluated.

5.85 As the table shows, the relative scale of the benefits varies considerably. The largest benefits are:

- Quality of Place: Overall the benefits created from increases in woodland views (both from home and while travelling) account for the greatest share of the total net additional benefit, amounting to £940,000 in annual net additional terms. This is 47% of the total net additional benefit from the sites. This is because the literature ascribes a large benefit to a woodland view for households in proximity to the sites (£312 per household, in 2009/10 prices) and for households travelling regularly past the sites (£264 per household, 2009/10 prices). Across all of the investments, a total of 1,320 households are judged to have a view of woodland from their home that they did not have before the sites were created. A total of 13,100 households in Merseyside are judged to have an enhanced regular view of woodland while travelling.[65] Closer analysis shows that two sites account for the majority of the views from home: Blackbrook Estate (£213,000) and Rose Farm (£113,600). Griffin Wood and the A570 Rainford Bypass support the greatest amount of value from passing traffic: £288,000 and £120,000, respectively.

- Recreation and Tourism: in gross terms these effects amount to £1.5 million (28% of the total benefit) and £2.6 million (47% of all benefits) respectively, or 75% in total. This is due to the relatively large WTP values ascribed to recreational visits in the literature (an average of £1.95 per visit in today's prices), and the average spend per tourist trip to woodland taken from the Day Visitor Survey (£31 in today's prices). Notably, once additionality effects are taken into account, the overall share of these two benefits falls. On a net additional basis, recreational benefits amount to £405,000 and tourism benefits £252,000 (21% and 13% of the total benefit, respectively, or 34% in total). This is because the additionality of these benefits is highly sensitive to the availability of alternative recreational opportunities (i.e. the stock of existing accessible greenspace in the locality of the sites). For several of the sites, although there is a large gross benefit, the additionality is judged to be zero, meaning that the creation of the site has not led to any increase in access to recreational opportunities for the local population.

- Health and Well-being (air pollution): at £116,000, these account for 2% of the gross benefits and 6% of the net additional benefits.

- Health and well-being (exercise): The exercise benefits generated by the sites are potentially considerable, at £122,000 in total, in gross terms. The GVA benefits (from reduced absenteeism and reduction in the incidence of premature death) account for £74,000 or 60% of this, with the remainder accounted for cost savings to the NHS. Again, the important thing to consider is the net additional impact – the extent to which the sites are likely to be generating new physical activity, which, in the absence of the intervention at the site, would not otherwise have taken place. Taking account of the existing stock of accessible greenspace, we judge that there is a net additional benefit of £33,000, consisting of £20,000 in GVA benefits and

[65] As discussed in the methodology section, we have apportioned the total Willingness to Pay, according to the extent to which households already had a view of woodland while travelling. To put this figure into context, the original study by Garrod (2002) concluded that 329,444 households in England as a whole had views of woodland on regular journeys.

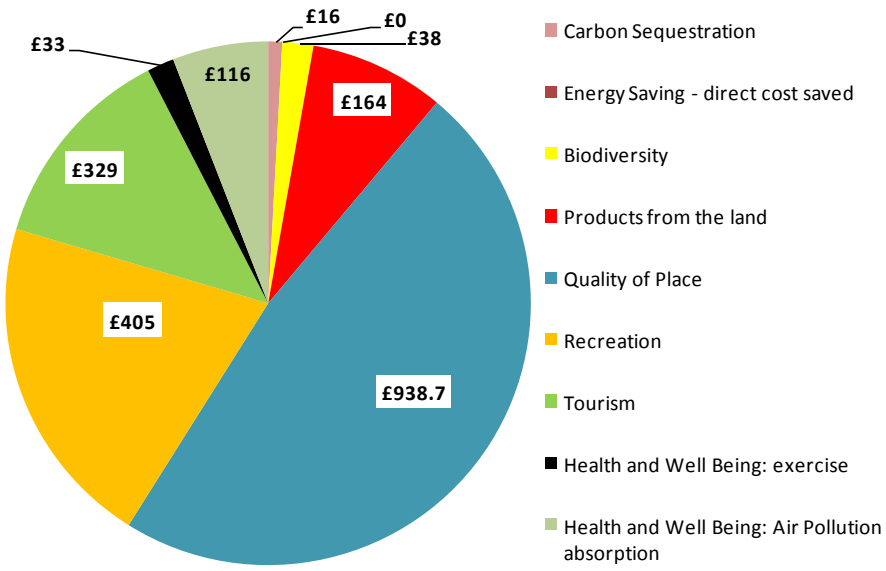
£13,000 in cost savings.

5.86 In contrast, the model produces small values for some of the benefits:

- Annual carbon sequestration benefits are relatively small, at £17,000 (just 0.3% of the gross total and 0.8% of the net additional total). This is largely a function of the social cost of carbon (£27 per tonne in 2009/10 prices).[66]
- Energy saving benefits: This impact is very sensitive to the proximity of the sites to houses and the positioning of the trees. Only one of the sites was judged to have this impact, amounting to £400 in gross and net additional terms.

5.87 The size of the benefits in net additional terms is set out in the pie chart below. This illustrates the dominance of the quality of place, recreational and tourism benefits (which together account for more than three quarters of the total benefit).

Figure 5-1: Annual Net Additional Benefit by Type of Benefit, £000s (2009/10 prices)



Source: Regeneris Consulting calculations

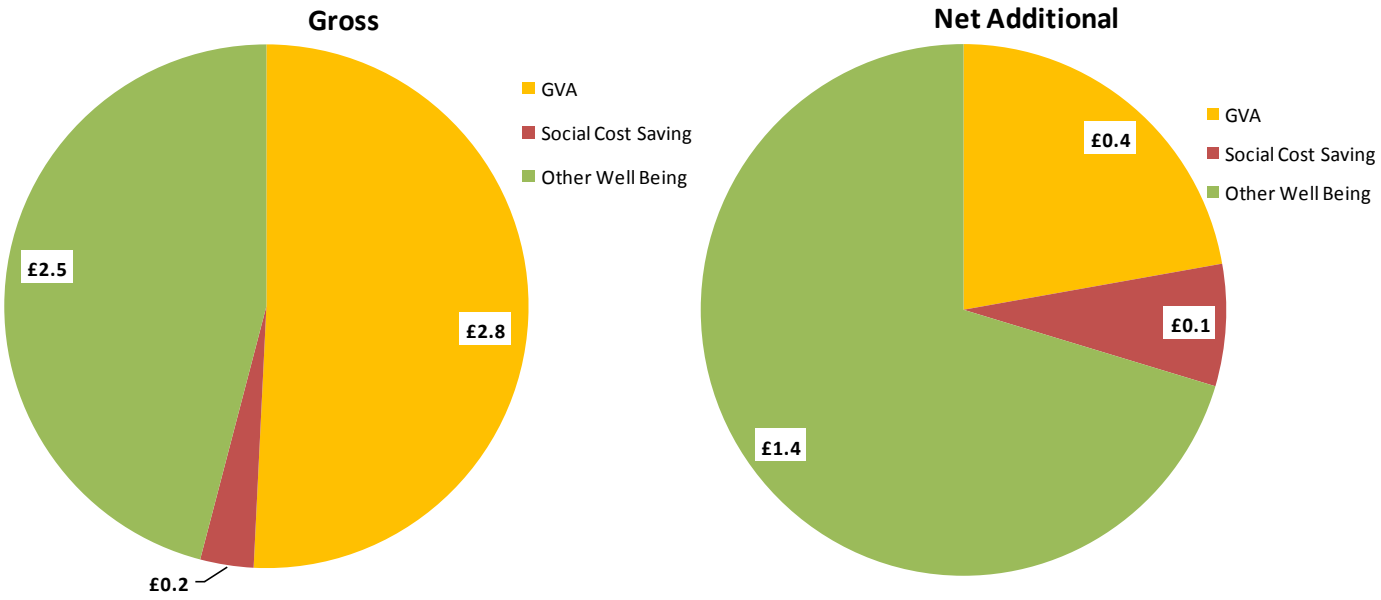
Note: Benefits are assumed to apply at the point of maturity of the site.

The Different Types of Economic Value

5.88 As discussed in sections 3 and 4, there are several different measures of the economic value of green infrastructure, and our model captures direct GVA benefits, social cost savings (some of which are indirect GVA benefits) and other well-being benefits. The chart below shows how the total gross and net additional monetised benefits break down into these categories of economic value.

[66] Of course, if a higher cost of carbon were used this would increase the carbon sequestration value of the woodland proportionally.

Figure 5-2: Total Annual Monetised Benefit by Type of Economic Value (£ million, 2009/10 prices), Gross and Net Additional



Source: Regeneris Consulting calculations

Note: Benefits are assumed to apply at the point of maturity of the site.

Gross Benefits

- **GVA: The majority of the benefits are GVA benefits: £2.8 million**. This is composed of GVA from tourism spend, from direct jobs (Products from the Land), and from improvements in health. The largest of these is the tourism impact, accounting for 90% of the GVA benefit.

- **Other Well-being benefits amount to £2.5 million**. These are composed of the non-market benefits derived from recreation, quality of place and biodiversity. By far the largest element in this, in gross terms, is the recreation benefit (61% of the total well-being benefit), followed by quality of place (37% of the total well-being benefit). Biodiversity benefits amount to £38,000 (1.5% of the total well-being benefit).

- **Social cost savings amount to £181,000** (3% of the total monetised benefit). Of these, the air pollution absorption component is the largest, at £116,000.

Net Additional Benefits

5.89 As the chart above shows, the picture is somewhat different when we look at the net additional benefits. On this basis, **other well-being benefits dominate, at £1.4 million** (70% of the total), followed by **GVA (£436,000)** and **social cost saving (£146,000).** The reason for this shift is that the displacement effect is relatively high for the GVA benefits: 85% of the gross benefit is displacement, arising from the proximity of alternative tourist forest sites to some of those created by the Objective 1 Programme. The health-related GVA impact follows a similar pattern. By comparison, 46% of the well-being benefit is displacement (of

the recreation benefit) and only 16% of the cost savings are displaced (this is the cost saving element of the exercise benefit).

Selected Sites

5.90 These aggregate figures presented above mask a significant amount of variation in the relative scale of the benefits between the sites. This is due to a range of factors. These include the nature of the intervention (woodland management interventions that do not have any new planting do not generate any carbon sequestration benefits, air pollution benefits or any quality of place value, for example), the location of the site (sites close to areas of population tend to have a larger recreational and health benefit, and if very close to housing also have a large quality of place value), and the proximity of the site to existing greenspace (new sites created in areas where there is already a large amount of accessible greenspace have a lower recreational and health impact in net additional terms).

5.91 The full results by site are set out in Appendix A, but we have chosen three case studies to illustrate how the benefits vary between different types of sites.

Blackbrook Estate

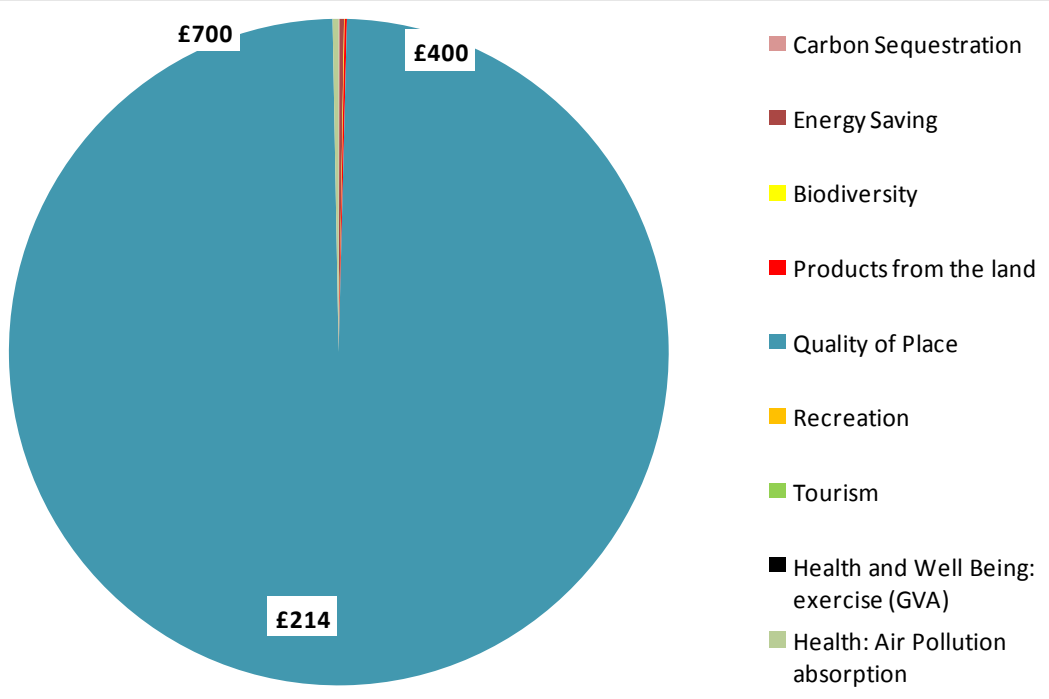
The Blackbrook Estate is located in St. Helens. In 2003, Groundwork St. Helens delivered a programme of street tree planting in the area, planting a total of 1.14 hectares at a cost of £39,000. The results of the modelling are set out below (in £, 2009/10 prices).

	Gross		Net Additional	
	Annual	**NPV**	**Annual**	**NPV**
Carbon Sequestration	£100	£7,900	£100	£7,900
Energy Saving - direct cost saved	£400	£9,600	£400	£9,600
Energy Saving - carbon cost saved	£60	£5,100	£60	£5,100
Biodiversity	£80	£2,900	£80	£2,900
Products from the land	£200	£8,300	£200	£8,300
Quality of Place	£213,000	£7,762,000	£213,000	£7,762,000
Recreation	£17,700	£644,900	£0	£0
Tourism	£0	£0	£0	£0
Health and Well-being: exercise (GVA)	£750	£26,700	£0	£0
Health and Well-being: exercise (cost saving)	£500	£17,500	£0	£0
Health: Air Pollution absorption	£700	£15,400	£700	£15,400
Total Monetised Benefit	**£234,000**	**£8,500,000**	**£214,600**	**£7,811,000**

Source: Regeneris Consulting calculations

Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is

As this shows, the relative scale of the benefits at the Blackbrook Estate is quite different from the Programme of sites taken as a whole. The majority of the benefit is from improved quality of place from landscape amenity, due to the proximity of houses to the trees, which consequently benefit from a view of the trees. The quality of place benefit is £213,000, over 90% of the total benefit. Recreation benefits are relatively low, at £18,000 in gross terms, and there are no tourist benefits. Indeed, due to the range of other greenspace in proximity to the estate, the net additional recreation benefit is judged to be zero. The same therefore follows for the health and well-being (exercise) benefits. Again due to the proximity of the trees to housing, there is judged to be a small energy saving benefit for some local dwellings. Given the relatively small volume of new planting, benefits from carbon sequestration and air pollution absorption are fairly small. The chart below summarises this graphically.



Given the nature of the benefits generated, it follows that almost all of the benefits are in the category of "other well-being."

Bidston Moss

Bidston Moss is located in Wirral, west of the M53 motorway, and forms an important gateway into the Liverpool City Region. The site is one of those developed under the Newlands Programme, a region-wide scheme to regenerate Brownfield land for socio-economic benefits (http://www.forestry.gov.uk/newlands). A range of interventions have taken place on the site, in partnership between the Mersey Forest, NWDA, the Forestry Commission, Groundwork Wirral, Merseyside Waste Disposal Authority, and Wirral Council. There were two phases to the Objective 1 investment, which amounted to £741,000 in total:

- Phase 1: creating access to the site: 2,215 metres of new footpaths were installed

- Phase 2: Further access creation (6,283m of footpaths), new planting (7.2 hectares), 36.8 hectares of habitat managed/improved and 26 hectares of woodland managed.

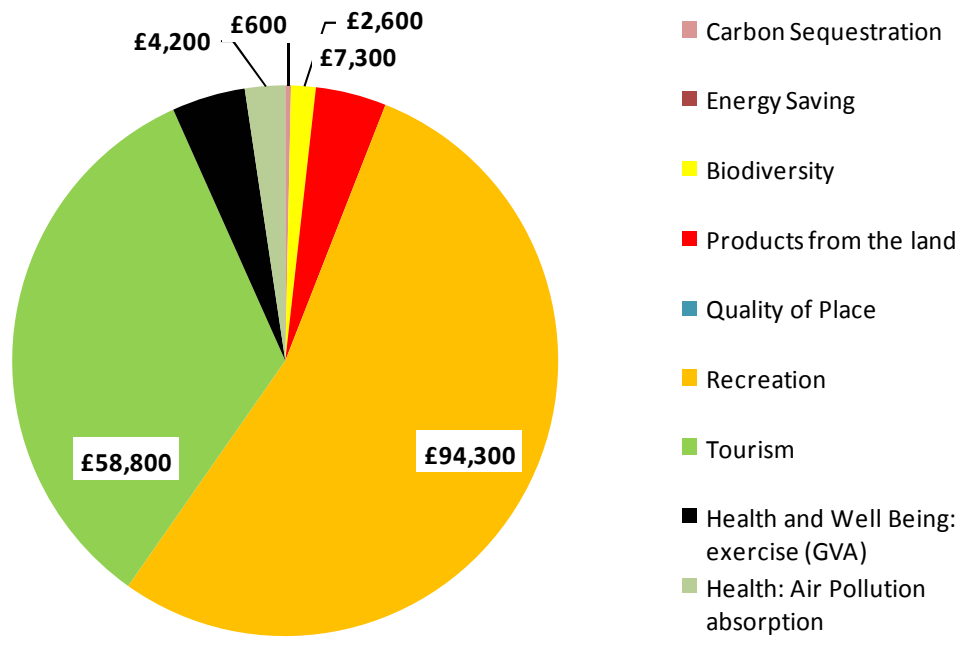
	Gross		Net Additional	
	Annual	**NPV**	**Annual**	**NPV**
Carbon Sequestration	£600	£49,700	£600	£49,700
Energy Saving - direct cost saved	£0	£0	£0	£0
Energy Saving - carbon cost saved	£0	£0	£0	£0
Biodiversity	£2,600	£94,000	£2,600	£94,000
Products from the land	£7,300	£268,000	£7,300	£268,000
Quality of Place	£0	£0	£0	£0
Recreation	£306,700	£11,172,000	£94,300	£3,434,000
Tourism	£579,400	£21,105,000	£58,800	£2,140,900
Health and Well-being: exercise (GVA)	£15,000	£546,500	£4,600	£168,000
Health and Well-being: exercise (cost saving)	£9,800	£358,700	£3,000	£110,300
Health: Air Pollution absorption	£4,200	£97,400	£4,200	£97,400
Total Monetised Benefit	**£925,600**	**£33,690,600**	**£175,400**	**£6,361,900**

Source: Regeneris Consulting calculations

Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated

The total gross benefit from the site is £925,000, and the net additional benefit is £175,000. Recreation and tourism benefits dominate both the gross and net additional impact, with a large population in proximity to the site. The exercise-related benefits are fairly significant. There is a significant difference between the gross and net additional benefits, because 70% of the local population within the sphere of influence of the site already had good access to greenspace for recreational purposes.

The partnership has also been working to encourage new investment and regenerate the local economy. For the reasons discussed in section 2 we have been unable to quantify this benefit, but economic research on land and property values around the site is currently being carried out.



Sefton Meadows

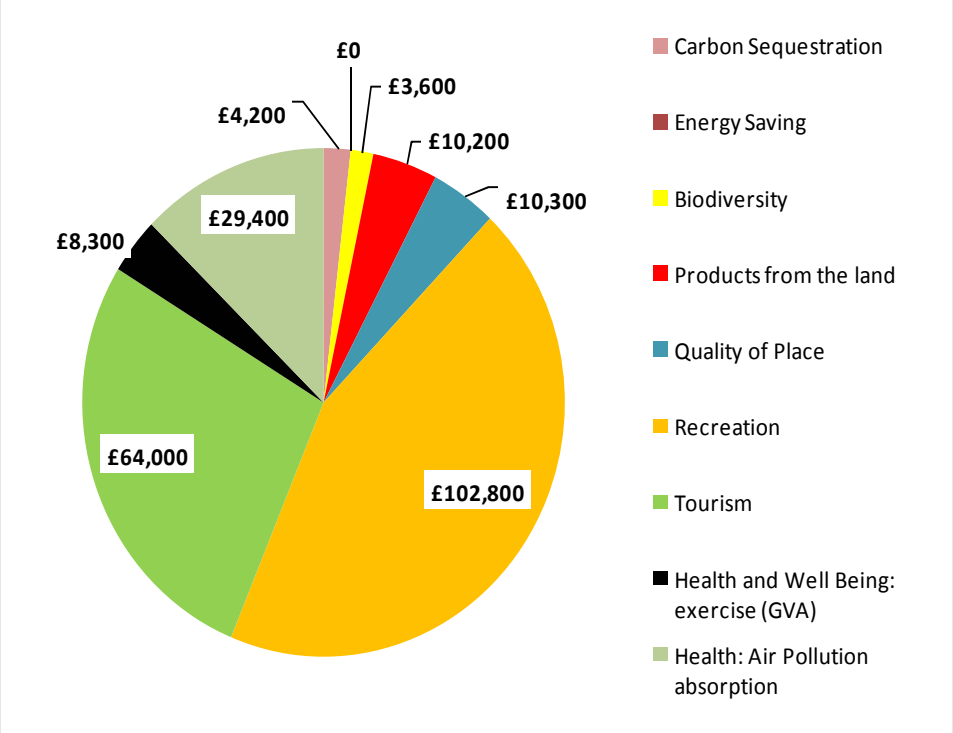
Sefton Meadows is a former landfill site, owned by Forestry Commission. Intervention at the site has been funded by Treasury Capital Modernisation Fund, NWDA and Objective One. In 2003, there began a £488,000 programme of new planting, consisting of 51 hectares of new planting and 5,200 metres of access creation. The results of the modelling are shown in the table below (in £, 2009/10 prices).

	Gross		Net Additional	
	Annual	**NPV**	**Annual**	**NPV**
Carbon Sequestration	£4,200	£352,400	£4,200	£352,400
Energy Saving - direct cost saved	£0	£0	£0	£0
Energy Saving - carbon cost saved	£0	£0	£0	£0
Biodiversity	£3,600	£130,200	£3,600	£130,200
Products from the land	£10,200	£370,800	£10,200	£370,800
Quality of Place	£10,300	£375,000	£10,300	£375,000
Recreation	£162,900	£5,933,300	£102,800	£3,743,900
Tourism	£307,700	£11,209,400	£64,000	£2,334,100
Health and Well-being: exercise (GVA)	£8,000	£290,300	£5,000	£183,200
Health and Well-being: exercise (cost saving)	£5,200	£190,500	£3,300	£120,200
Health: Air Pollution absorption	£29,400	£689,700	£29,400	£689,700
Total Monetised Benefit	**£541,500**	**£19,541,600**	**£232,800**	**£8,299,500**

Source: Regeneris Consulting calculations

Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

The total annual gross benefit from the site is £541,000 and the net additional benefit is £233,000. Given the size of the site and the proximity to local population, recreational and tourism benefits are relatively large. Around 40% of the gross benefit is judged to be displacement of visits from other local greenspace. Given the volume of new planting, air pollution absorption benefits are also fairly large.

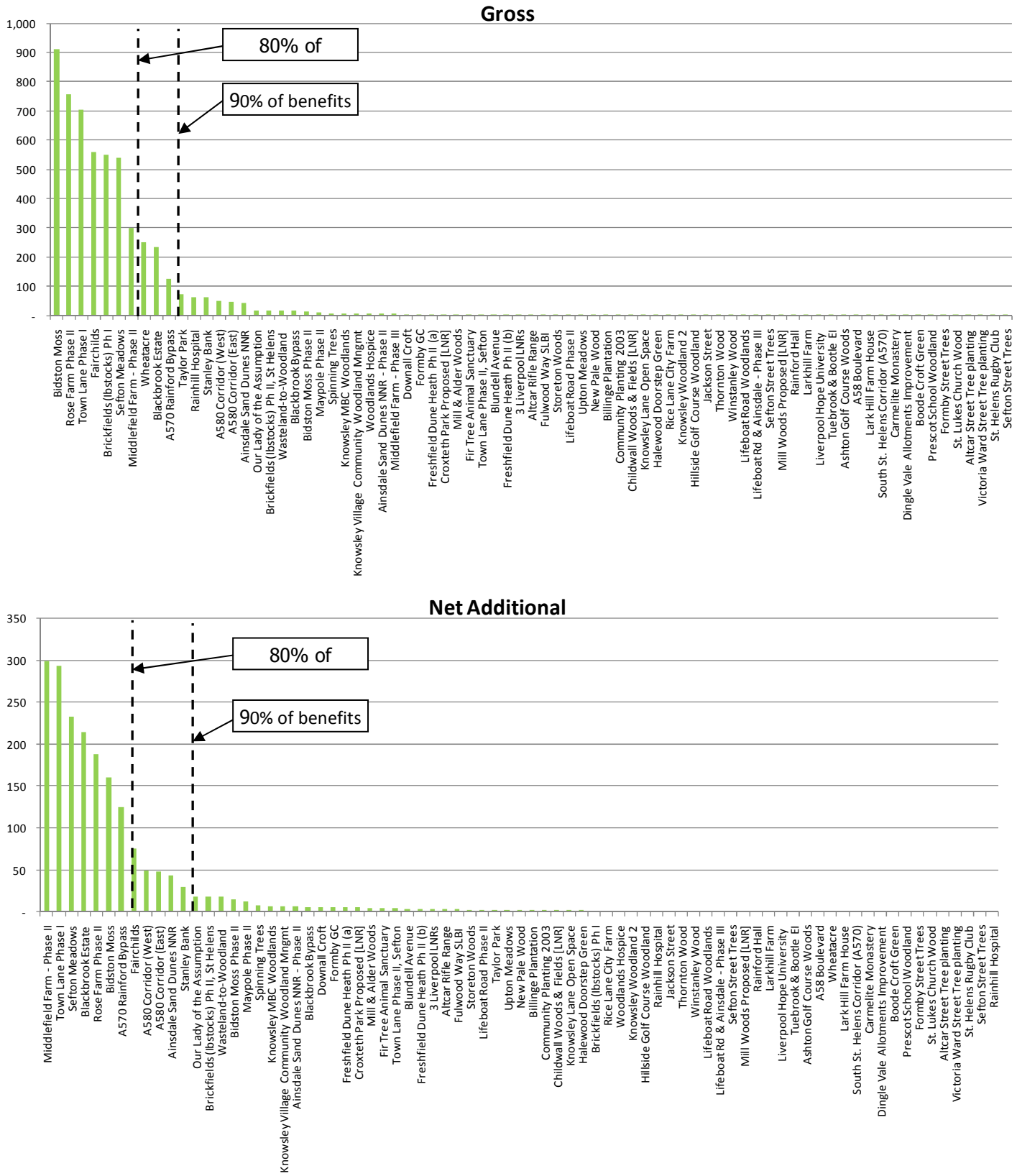


Distribution of benefits by site

5.92 The case studies above give a flavour of how the relative scale of the benefits varies depending on the nature and location of the sites. As Figure 5-3 and Figure 5-4 show, the distribution of benefits across the sites is uneven, with a long tail of sites with a relatively small benefit associated with them. These are the sites for which there is either no recreational/tourism (and therefore no exercise-related benefit) and no quality of place/landscape amenity benefit attributable to the Objective One investments. These sites generate benefit through carbon sequestration and air pollution reduction (if new planting is involved) and through biodiversity conservation and woodland management, and these benefits tend to be smaller in relative terms – see Figure 5-3 (annual benefits). It should be noted that many of these sites do support these types of benefit; however, since it was not the Objective One investment which created the sites, we cannot ascribe these benefits to the Programme.

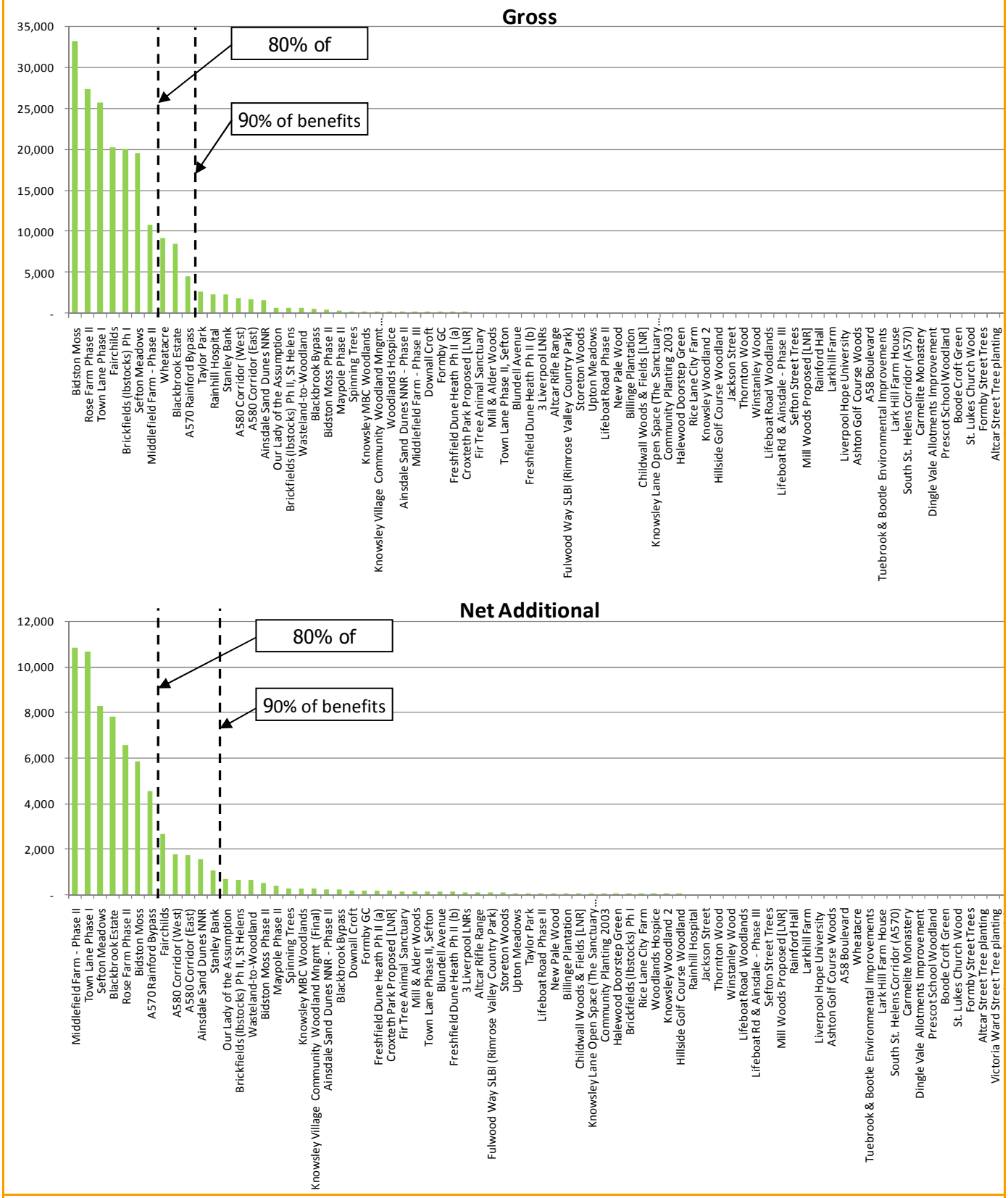
5.93 Figure 5-4 shows the benefits in Net Present Value terms. Although the sites with the largest benefit remain the same as for the annual benefits, those with the smaller benefits account for a slightly larger proportion of the total, since the carbon sequestration benefits are undiscounted.

Figure 5-3: Total Annual Benefits by Site, Gross and Net Additional (£000s, 2009/10 prices)



Source: Regeneris Consulting calculations. Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

Figure 5-4: Total NPV Benefits by Site, Gross and Net Additional (£000s, 2009/10 prices)



Source: Regeneris Consulting calculations. Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

Sensitivity Analysis

5.94 As discussed, one of the limitations of the model is that, given the lack of available data on usage of the sites, the recreational and tourism benefits are based on analysis of the local population in proximity to the sites and assumptions on the likely level of usage. Given that the model is sensitive to the assumptions made we have deliberately erred on the side of caution in our assumptions on the penetration rates of the local population by the sites. It is nonetheless useful to carry out a sensitivity analysis of the results, in order to understand how the total benefit varies with different assumptions.

5.95 We have therefore explored the impact of varying the assumption on the penetration rate (i.e. the percentage of the local population who are assumed to use the site, regardless of frequency). Our baseline scenario used in the model takes a penetration rate of 56%, which is taken from data from the latest Public Opinion of Forestry Survey[67]. We have added two further scenarios: a low scenario (taking a penetration rate of 33%) and a high scenario (taking a rate of 79%). The results of the sensitivity analysis are shown below, on an annual basis:

Table 5-2: Total Annual Benefits with different Penetration Rates (£000s, 2009/10 prices)

	Low Scenario (33%)		Baseline Scenario (56%)		High scenario (79%)	
	Gross	Net Additional	Gross	Net Additional	Gross	Net Additional
Carbon Sequestration	£16.4	£16.4	£16.4	£16.4	£16.4	£16.4
Energy Saving - direct cost saved	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4
Energy Saving - carbon cost saved	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
Biodiversity	£37.7	£37.7	£37.7	£37.7	£37.7	£37.7
Products from the land	£163.7	£163.7	£163.7	£163.7	£163.7	£163.7
Quality of place - landscape (views from home)	£412	£412	£412	£412	£412	£412
Quality of place - landscape (views while travelling)	£527	£527	£527	£527	£527	£527
Recreation	£911.8	£238.7	£1,547.3	£405.1	£2,182.8	£571.4
Tourism	£1,504.2	£148.8	£2,552.5	£252.5	£3,600.8	£356.3
Health and Well-being: exercise (GVA)	£43.5	£11.7	£73.7	£19.8	£104.0	£28.0
Health and Well-being: exercise (cost saving)	£28.5	£7.7	£48.4	£13.0	£68.3	£18.3
Health: Air Pollution absorption	£115.8	£115.8	£115.8	£115.8	£115.8	£115.8
Total Monetised Benefit	**£3,761**	**£1,680**	**£5,495**	**£1,963**	**£7,229**	**£2,247**

Source: Regeneris Consulting calculations

Note: Benefits are assumed to apply at the point of maturity of the site.

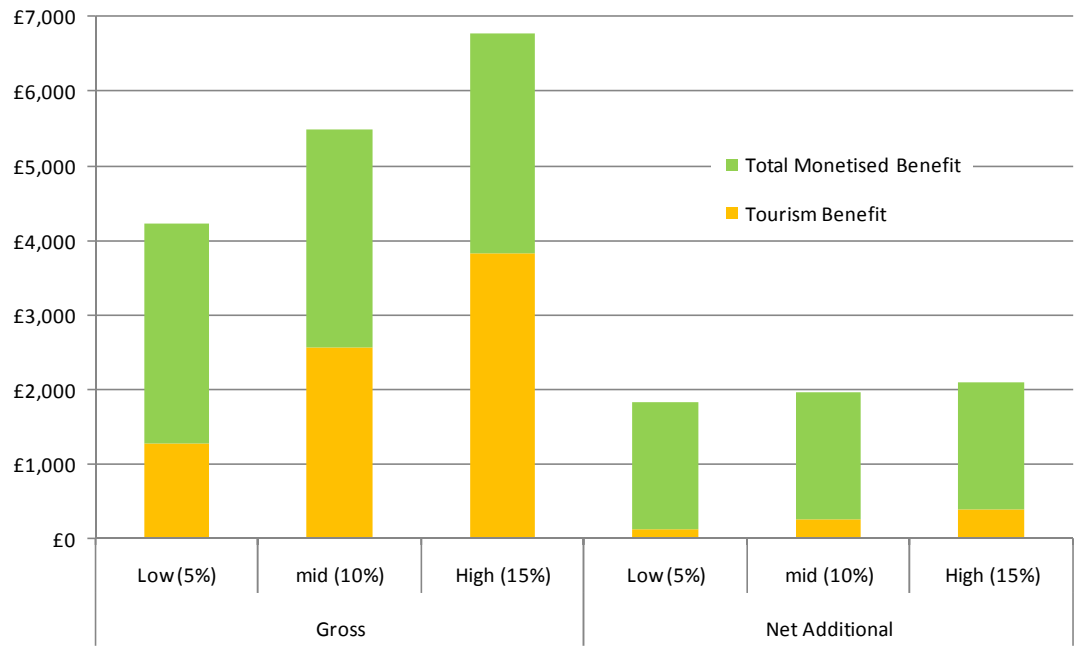
5.96 This shows that the model is sensitive to this assumption: lowering the penetration rate of the sites to 33% reduces the gross benefit to £3.8 million (that is, by 32% compared to the mid scenario) and the net additional benefit by £1.7 million (by 15%). On the other hand, if

[67] UK and GB Public Opinion of Forestry Surveys, 2003 to 2007, Forestry Commission.

usage rates were as high as 80%, the gross benefit would be £7.2 million and the net additional benefits £2.2 million. As can be seen from the table, this assumption impacts on the scale of the recreational, tourism and health and well-being (exercise) benefits.

5.97 A further area of sensitivity in the model is related to the assumption on the proportion of visitors to the sites who are tourists. The baseline assumes that 10% of visitors are tourists. The chart below shows how changing this assumption impacts on the overall results. We have used a low scenario (5% of all visitors are tourists) and high scenario (15% of visitors).

Figure 5-5: Tourism benefits and Total Benefits with different shares of tourist visitors as a % of all visitors



Source: Regeneris Consulting Calculations
Note: The baseline penetration rate (56%) is used in all scenarios
Note: Benefits are assumed to apply at the point of maturity of the site.

5.98 Again, the chart shows that this is an important area of sensitivity. In the low scenario, total benefits fall to £4.1 million in gross terms and £1.8 million in net additional terms (falls of 23% and 6% respectively, compared to the baseline scenario). In the high scenario, the total benefits rise to £6.7 million in gross terms and £2 million in net additional terms. Clearly, given the additionality effects that apply to the tourism benefit, the total net additional benefits are much less sensitive to this assumption than the gross benefits.

Value for Money Assessment

5.99 To put the overall benefit of the Objective One Programme into context, it is useful to compare it to the overall cost of the interventions. The total cost of The Mersey Forest's Objective One Programme of interventions is £6.9 million.[68] Table 5-3 sets out the various benefits generated for every £1 invested in the interventions. As this shows, there is a

[68] Note that this excludes the value of the enterprise assistance projects.

positive return on investment in terms of net additional GVA created, and when the other benefits are added into the mix, the return on investment improves. When all benefits are considered, **every £1 invested in the Programme will generate £10 in net additional NPV terms**. This, in our view, represents excellent value for money.

Table 5-3: Benefits generated per £1 of investment, (2009/10 prices)

	Gross		Net additional	
	Annual	**NPV**	**Annual**	**NPV**
GVA	0.40	14.7	0.06	2.3
GVA plus social cost saving	0.43	15.5	0.08	3.0
Total benefit (GVA plus social cost saving plus other well-being)	0.8	28.8	0.3	10.2

Source: Regeneris Consulting calculations
Note: Benefits are assumed to apply at the point of maturity of the site. Net Present Value is calculated over 50 years.

6. Concluding Observations

6.100 This study has sought to quantify the range of benefits associated with The Mersey Forest's Objective One Programme, by developing an economic model which is able to capture these benefits in monetary terms (GVA, social cost saving and other well-being). This model was based on a review of the existing literature on the social, economic and environmental benefits of greenspace, and no primary research was carried out.

6.101 It should be noted that the model does not cover all of the possible benefits associated with the interventions. As noted in Section 3, there is a lack of quantitative evidence on the link between green infrastructure interventions and inward investment (through improvements in image and quality of life). Also, the model does not capture the value of any flood risk alleviation impacts from the interventions.

The Results

6.102 Our modelling work has shown that it is possible to quantify the benefits created by investments in green infrastructure of the type considered here. Our study suggests that the benefits from The Mersey Forest's Objective One Programme are significant, with nearly £2 million in net additional benefits generated, of which the majority are non-market well-being benefits, over a fifth are GVA, and the remainder social cost saving. In net present value terms this represents are very good return on investment, given the cost of securing these benefits: for every £1 invested in the Programme, £10 in net additional economic benefit is generated.

The Importance of Location

6.103 What the results of this study reinforce is the importance of location in the benefits of green infrastructure. The dominant benefits are from quality of place and from recreation and tourism. The former are maximised when the new planting is located in close proximity to housing, and/or on road routes which don't already have good access to views of woodland. The latter are maximised by creating sites that are both close to and easily accessed by the local population, and located in areas where there is a lack of existing greenspace.

Areas for Further Research

6.104 Given the importance of the recreational and tourism benefits that green infrastructure brings, a key imperative for the Community Forest network should be to improve intelligence on the level of usage of the sites and of the profile of visitors in terms of their origin, purpose and frequency of visit and so on. Visitor surveys should also be used to better understand the health related benefits from the sites.

6.105 In addition, the potential benefits related to flood risk alleviation and image enhancement for inward investors and skilled workers are areas which we have been unable to quantify in this study. Further research into these effects would be beneficial.

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The Economic Contribution of the Mersey Forest's Objective One Funded Investments - APPENDICES

A Final Report by
Regeneris Consulting

The Mersey Forest

The Economic Contribution of the Mersey Forest's Objective One Funded Investments - APPENDICES

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Contents

Appendix A: Modelling Results by Site Intervention

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	Energy saving - financial cost saved	Energy saving - social cost saved	Biodiversity	Products from the land	Landscape	Tourism	Recreation	Health (exercise): GVA	Health (exercise): Cost Saving	Health (air pollution)
Sefton Meadows	£4,166	£0	£0	£3,576	£10,179	£10,296	£434,134	£229,794	£11,242	£7,378	£29,405
Wheatacre	£0	£0	£0	£0	£0	£0	£225,958	£119,603	£5,851	£3,840	£0
Fairchilds	£1,797	£0	£0	£1,542	£4,391	£4,992	£478,366	£253,207	£12,388	£8,130	£12,685
Maypole Phase II	£1,062	£0	£0	£911	£2,595	£0	£0		£0	£0	£7,495
Rose Farm Phase II	£5,637	£0	£0	£4,838	£13,772	£113,568	£520,185	£275,342	£13,471	£8,840	£39,784
Mill & Alder Woods	£245	£0	£0	£210	£2,395	£0	£0	£0	£0	£0	£1,730
St. Lukes Church Wood	£0	£0	£0	£0	£90	£0	£0	£0	£0	£0	£0
Jackson Street	£0	£0	£0	£0	£870	£0	£0	£0	£0	£0	£0
Knowsley Lane Open Space (The Sanctuary Community Wood)	£0	£0	£0	£0	£1,677	£0	£0	£0	£0	£0	£0
Carmelite Monastery	£0	£0	£0	£0	£180	£0	£0	£0	£0	£0	£0
Winstanley Wood	£0	£0	£0	£0	£798	£0	£0	£0	£0	£0	£0
Community Planting 2003	£163	£0	£0	£140	£399	£0	£0	£0	£0	£0	£1,153
Woodlands Hospice	£16	£0	£0	£14	£0	£1,248	£0	£6,765	£280	£184	£115
Ainsdale Sand Dunes NNR	£0	£0	£0	£11,274	£32,094	£0	£0	£0	£0	£0	£0

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	Energy saving - financial cost saved	Energy saving - social cost saved	Biodiversity	Products from the land	Landscape	Tourism	Recreation	Health (exercise): GVA	Health (exercise): Cost Saving	Health (air pollution)
Blackbrook Estate	£93	£383	£61	£80	£228	£213,096	£0	£24,976	£1,034	£678	£657
Rainford Hall	£0	£0	£0	£14	£439	£0	£0	£0	£0	£0	£0
Lifeboat Road Woodlands	£0	£0	£0	£0	£699	£0	£0	£0	£0	£0	£0
Fir Tree Animal Sanctuary	£45	£0	£0	£39	£110	£4,056	£0	£0	£0	£0	£317
Billinge Plantation	£0	£0	£0	£0	£1,864	£0	£0	£0	£0	£0	£0
Rainhill Hospital	£0	£0	£0	£756	£403	£0	£0	£84,336	£3,246	£2,130	£0
Storeton Woods	£0	£0	£0	£0	£2,537	£0	£0	£0	£0	£0	£0
Upton Meadows	£0	£0	£0	£35	£2,170	£0	£0	£0	£0	£0	£0
Upton Meadows	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Our Lady of the Assumption	£51	£0	£0	£43	£124	£18,096	£0	£0	£0	£0	£357
Sefton Street Trees	£0	£0	£0	£6	£0	£0	£0	£0	£0	£0	£0
Sefton Street Trees	£0	£0	£0	£154	£439	£0	£0	£0	£0	£0	£0
Brickfields (Ibstocks) Ph I	£0	£0	£0	£0	£768	£0	£492,782	£260,838	£12,761	£8,374	£0
Bidston Moss	£0	£0	£0	£0	£0	£0	£817,398	£432,662	£21,167	£13,891	£0
Town Lane Phase I	£0	£0	£0	£0	£0	£0	£632,021	£334,539	£16,367	£10,741	£0
Thornton Wood	£0	£0	£0	£0	£838	£0	£0	£0	£0	£0	£0
Ashton Golf Course Woods	£0	£0	£0	£0	£299	£0	£0	£0	£0	£0	£0
Lark Hill Farm	£0	£0	£0	£0	£245	£0	£0	£0	£0	£0	£0

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	Energy saving - financial cost saved	Energy saving - social cost saved	Biodiversity	Products from the land	Landscape	Tourism	Recreation	Health (exercise): GVA	Health (exercise): Cost Saving	Health (air pollution)
House											
Downall Croft	£46	£0	£0	£39	£112	£4,992	£0	£0	£0	£0	£323
Rice Lane City Farm	£0	£0	£0	£14	£1,447	£0	£0	£0	£0	£0	£0
Hillside Golf Course Woodland	£0	£0	£0	£0	£1,182	£0	£0	£0	£0	£0	£0
Altcar Rifle Range	£110	£0	£0	£95	£269	£2,184	£0	£0	£0	£0	£778
Dingle Vale Allotments Improvement	£0	£0	£0	£7	£160	£0	£0	£0	£0	£0	£0
A58 Boulevard	£0	£0	£0	£77	£220	£0	£0	£0	£0	£0	£0
Knowsley MBC Woodlands	£0	£0	£0	£95	£6,902	£0	£0	£0	£0	£0	£0
Halewood Doorstep Green	£82	£0	£0	£140	£808	£0	£0	£0	£0	£0	£577
Wasteland-to-Woodland	£0	£0	£0	£1,596	£16,466	£0	£0	£0	£0	£0	£0
Knowsley Woodland 2	£0	£0	£0	£35	£1,297	£0	£0	£0	£0	£0	£0
Lifeboat Road Phase II	£181	£0	£0	£0	£916	£0	£0	£0	£0	£0	£1,280
Prescot School Woodland	£0	£0	£0	£0	£110	£0	£0	£0	£0	£0	£0
Freshfield Dune Heath Ph II (a)	£0	£0	£0	£1,353	£3,852	£0	£0	£0	£0	£0	£0
Boode Croft Green	£10	£0	£0	£12	£23	£0	£0	£0	£0	£0	£69

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	Energy saving - financial cost saved	Energy saving - social cost saved	Biodiversity	Products from the land	Landscape	Tourism	Recreation	Health (exercise): GVA	Health (exercise): Cost Saving	Health (air pollution)
Blundell Avenue	£49	£0	£0	£42	£3,253	£0	£0	£0	£0	£0	£346
Altcar Street Tree planting	£8	£0	£0	£0	£0	£0	£0	£0	£0	£0	£58
Victoria Ward Street Tree planting	£7	£0	£0	£0	£0	£0	£0	£0	£0	£0	£52
Formby Street Trees	£13	£0	£0	£0	£0	£0	£0	£0	£0	£0	£92
Larkhill Farm	£12	£0	£0	£0	£295	£0	£0	£0	£0	£0	£86
Liverpool Hope University	£20	£0	£0	£42	£120	£0	£0	£0	£0	£0	£144
Fulwood Way SLBI (Rimrose Valley Country Park)	£0	£0	£0	£771	£2,195	£0	£0	£0	£0	£0	£0
Tuebrook & Bootle Environmental Improvements	£38	£0	£0	£7	£0	£0	£0	£0	£0	£0	£265
New Pale Wood	£0	£0	£0	£0	£1,942	£0	£0	£0	£0	£0	£0
Bidston Moss Phase II	£588	£0	£0	£2,580	£7,345	£0	£0	£0	£0	£0	£4,151
St. Helens Rugby Club	£0	£0	£0	£7	£0	£0	£0	£0	£0	£0	£0
South St. Helens Corridor (A570)	£0	£0	£0	£21	£196	£0	£0	£0	£0	£0	£0
Freshfield Dune	£49	£0	£0	£841	£2,395	£0	£0	£0	£0	£0	£346

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	Energy saving - financial cost saved	Energy saving - social cost saved	Biodiversity	Products from the land	Landscape	Tourism	Recreation	Health (exercise): GVA	Health (exercise): Cost Saving	Health (air pollution)
Heath Ph II (b)											
Childwall Woods & Fields [LNR]	£0	£0	£0	£436	£1,275	£0	£0	£0	£0	£0	£0
Mill Woods Proposed [LNR]	£0	£0	£0	£122	£346	£0	£0	£0	£0	£0	£0
Croxteth Park Proposed [LNR]	£0	£0	£0	£555	£4,571	£0	£0	£0	£0	£0	£0
A580 Corridor (West)	£7	£0	£0	£140	£399	£48,741	£0	£0	£0	£0	£52
A580 Corridor (East)	£194	£0	£0	£55	£156	£46,343	£0	£0	£0	£0	£1,372
Knowsley Village Community Woodland Mngmt (Final)	£0	£0	£0	£52	£6,942	£0	£0	£0	£0	£0	£0
Blackbrook Bypass	£118	£0	£0	£419	£1,194	£3,432	£0	£13,114	£543	£356	£836
Taylor Park	£91	£0	£0	£421	£1,138	£0	£0	£94,890	£3,652	£2,397	£646
Middlefield Farm - Phase II	£822	£0	£0	£705	£283	£290,789	£0	£0	£0	£0	£5,800
Stanley Bank	£319	£0	£0	£273	£778	£26,549	£0	£44,823	£1,725	£1,132	£2,249
Formby GC	£65	£0	£0	£55	£158	£4,680	£0	£0	£0	£0	£455
Lifeboat Rd & Ainsdale - Phase III	£0	£0	£0	£0	£609	£0	£0	£0	£0	£0	£0
Middlefield Farm - Phase III	£0	£0	£0	£0	£0	£0	£0	£7,948	£306	£201	£0

Gross Benefits by Site Intervention, by Type of Benefit											
	Carbon Sequestration	**Energy saving - financial cost saved**	**Energy saving - social cost saved**	**Biodiversity**	**Products from the land**	**Landscape**	**Tourism**	**Recreation**	**Health (exercise): GVA**	**Health (exercise): Cost Saving**	**Health (air pollution)**
A570 Rainford Bypass	£32	£0	£0	£233	£663	£124,159	£0	£0	£0	£0	£225
3 Liverpool LNRs	£0	£0	£0	£897	£2,575	£0	£0	£0	£0	£0	£0
Sefton Coast and Countryside Service	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Spinning Trees	£2	£0	£0	£0	£0	£7,488	£0	£0	£0	£0	£12
Brickfields (Ibstocks) Ph II, St Helens	£41	£0	£0	£1,262	£3,593	£13,104	£0	£0	£0	£0	£288
Town Lane Phase II, Sefton	£229	£0	£0	£701	£599	£936	£0	£0	£0	£0	£1,614
Grand Total	£16,409	£383	£61	£37,736	£163,744	£938,749	£3,600,844	£2,182,836	£104,033	£68,272	£115,817

Appendix B: Methodology

This section summarises the methodology used to arrive at the impact estimates for each type of benefit. Each benefit has been calculated on an annual basis and then its present value has been calculated over a period of 50 years, a standard appraisal period for this type of investment. In line with the guidance the social cost of carbon has been assumed to rise in real terms by 2% p.a. and has not been discounted. The other benefits have been discounted at 3.5% p.a. (the standard government social discount rate) but assumed to increase in real terms by 2%, in line with the UK trend growth in real income.

Climate Change mitigation and Adaptation

Carbon Sequestration (cost saving)

1. This has been calculated by taking the average carbon sequestration rate in tonnes per hectare over a full rotation from planting to harvesting. The Forestry Commission estimates this at 3 tonne per hectare. We have applied this to the area of new planting at the sites. To value this, we have used the social cost of carbon stated in Government guidance from Defra and HM Treasury. The shadow price of carbon was £25 per tonne in 2007/8. Guidance states that the social cost of carbon increases in real terms (i.e. after inflation) by 2% per annum. Uprating the 2007 cost to 2009/10 prices using GDP deflators for inflation and applying a 2% real increase p.a., the social cost of carbon is £27.23.

2. Guidance states that in calculating present values of carbon emissions, values should not be discounted.

Energy Saving – direct (cost saving)

3. Trees, when planted in a suitable way, can have the effect of reducing energy costs in nearby buildings. This works through shelterbelt effects (by reducing wind speed and thus reducing the need to heat buildings) and through shading effects (by reducing solar exposure and hence the need for air conditioning).

4. There has been a fair amount of research done in the US on the air conditioning effect, but we have not identified any research on this effect in the UK. Given the climatic differences with the US the results of these studies cannot be easily transferred to the UK. However, the shelterbelt effect has been studied in the UK. Guidance from what was the Department for the Environment, Transport and the Regions stated that energy savings by planting shelter belts typically range between 3 and 9%.

5. To calculate the scale of the shelterbelt effect has involved several steps:

    1) Estimating the number of households and businesses in the area of the site whose energy bills could have been reduced through the shelterbelt effect. This has been done using GIS to identify the SOAs in proximity to the site, along with ONS data on the number of households and businesses in those SOAs (Census 2001 and Annual Business Inquiry). We have assumed that houses/businesses that are within 10 metres can potentially be affected in this way.

    2) Estimating the baseline gas consumption of these households and businesses. We have done this using BERR data on gas consumption by SOA. This sets out the total

level of consumption and average consumption (in Kwh) per meter for domestic and industrial/commercial uses.

3) Calculating the energy consumption reduction from the shelterbelt (in Kwh) by applying a 9% reduction.

4) Finally, valuing this reduction using current UK gas prices.

6. Again it is important to note that in the absence of OS map files we do not know the exact location of houses and businesses in relation to the sites, so have only been able to use buffer zones to estimate this.

Energy saving – cost of carbon saved (cost saving)

7. In addition to the direct financial cost savings to households and businesses from the above effect, there is a social cost saving from the carbon emissions foregone as a result of the decrease in energy consumption. The level of carbon emissions foregone is calculated using data from the Carbon Trust on the tonnes of carbon produced per kwh of gas consumed. This has then been valued using the social cost of carbon (see carbon sequestration above).

Biodiversity (well-being value)

8. Research by the Forestry Commission found that households were willing to pay £0.84 per year for a 12,000 ha increase in lowland new broadleaved native forest. We have assumed that this value is proportional to the scale of increase, so that households are willing on average to pay £0.000081 for a 1 hectare increase. To calculate the value placed on biodiversity in the site, we have applied this to the area of new planting (or in the case of Bidston Moss, the area of habitat managed/improved), and scaled up based on the number of households in Merseyside and North Cheshire (from Census 2001). It should be noted that it could also be argued that these benefits should be applied to all households in UK.

Products from the Land (GVA)

9. To calculate the scale of this impact we have used industry average figures on the number of direct jobs in forestry (SIC 02) per hectare of forestry cover in England (0.004 Full Time Equivalent jobs per hectare), applied to the area of new planting/area of woodland managed. This has then been converted into Gross Value Added (GVA) using average GVA per FTE forestry job in England (£46,600 per FTE job).

Landscape/quality of place (well-being value)

10. Research for the Forestry Commission found that households with a woodland view were willing to pay £269 per annum per household on average for that woodland view. The same research found that the value of a woodland view for households passing it on regular journeys was £226. We have uprated these figures to 2009/10 prices using Treasury GDP deflators.

11. To calculate the scale of this benefit for views from home the Mersey Forest team has conducted a Viewshed analysis to estimate the number of households in proximity to the site which have a woodland view as a result of the site creation (and which did not have any view of woodland before). This was the methodology recommended by Garrod (2002) in the

original study. The original study was not able to use this method due to resource constraints (the study was attempting to aggregate across the whole of England).

12. The benefits for traffic passing the sites only apply to a small number (five) of the sites. To assess the number of households benefiting from this view we have collected data on peak hour traffic data (cars only) from the Highways Agency Traffic Information System (HATRIS) database for the relevant roads (M62, A580 East, A580 West, and A570) at the observation points as close to the sites as the data allow. To convert this data on the number of cars regularly passing the sites into unique households we have used Census 2001 data for Merseyside, on the number of cars per household and applied this to the traffic figures. Additionality effects are important here. Therefore, we have assumed that households passing the sites would be willing to pay a portion of the £226 that was found in Garrod (2002), and that this portion varies depending on the amount of woodland they would have passed before the creation of the Objective 1 sites. The steps are as follows:

    1) Calculate using GIS what proportion of the entire Merseyside major roads network was close to woodland 'prior' to the Obj 1 programme, and assume that each person's route had that same proportion of woodland close to it.

    2) Estimate the average length of people's journeys to work using census data. This tells us what length of woodland people on average saw on their journey prior to the O1 programme (L_A). According to the 2001 census, the average journey to work beginning or ending in Merseyside is 8.48km long. Therefore L_A = 8.48km x 45.4% = 3.85km.

    3) Using GIS, for each site in question, measure the length of the site that is parallel to the roads (L_S)

    4) The additional economic value (E) of the sites is then given by:

E = WTP for view (£264, 2009/10 prices) x (L_S / (L_A + L_S)) x No. of households passing regularly each year

Recreation (well-being value)

13. Stage 1 of our research cited Forestry Commission research which found that people value forestry visits, and that this value varied according to the distance travelled and the frequency of visit.

14. There is no data available on the number of visits to the sites per year. Therefore, we have estimated the visitor numbers to the sites based on their size and the proximity to the local population. The sites were split into three categories, and for each category The Mersey Forest team has assumed a different sphere of influence, as below:[1]

- Small (less than 3 hectares) – 300 metre buffer
- Medium (3 hectares to 20 hectares) – 1km buffer
- Large (20 hectares or greater) – 2km buffer

[1] These are based around Natural England's ANGSt targets.

15. The Mersey Forest's GIS team were then able to accurately pick out how many households were within the buffer zone for each site. This was converted into an estimate of the number of adults using Census data on the average number of adults per household. We then applied the usage rates to the adult populations in the buffer zone, using data from the Forestry Commission's Public Opinion of Forestry Survey to estimate the number of residents who visit the site. Using sensible and conservative assumptions, we then estimated how frequently these visitors used the site, based on the principle that the closer you live the more likely you are to use a site more regularly. Applying these assumptions on frequency of visit to the number of visitors gives us the number of visits, for each frequency band. We have then estimated the value of these visits, using the willingness to pay figures in the literature.

16. In order to convert these gross figures into net additional figures, we looked at the extent to which the sites was creating additional access to greenspace. The Mersey Forest team used GIS to construct a baseline of existing greenspace before the sites were created, using

- The Woodland Trust's Woods For People dataset
- Registered Common Land
- English Heritage Parks & Gardens
- Countryside Right of Way Act open access land
- Dedicated Land

17. Based on this data and the date when the sites were created The Mersey Forest team were then able to estimate the proportion of the households which had access to greenspace before the sites were created. To convert the figures to net additional figures, we netted off these households from the totals within the buffers.

18. As discussed in the report the total recreation values generated by the model are highly sensitive to the assumptions made on the level of usage.

Tourism (GVA)

19. We define tourism impacts as those arising from the spending of any visitors who come to visit a site from outside Merseyside. This impact therefore depends on whether the site is of sufficient scale or quality to attract visits from outside Merseyside, given the nature of other competing sites outside Merseyside. Given that there is no visitor data for the sites, we have looked at data from other Country Parks. A review of visitor surveys for various Country Parks around the country reveals that those of a sufficient scale tend to attract between 10 and 30% of visitors from outside their respective sub-regions. The average across these country parks is 17% - see the table below.

Proportion of Visitors who visit Country Parks from outside the sub-region in which the park is located	
	% from outside Sub-region
Vicar Water Survey (Nottinghamshire)	19%
Brereton Heath Local Nature Reserve and the Sandstone Trail Survey (Cheshire)	10%
Pooley Country Park and Ryton Pools Country Park Survey (Warwickshire)	26%
Weaver Parkway Survey (Cheshire)	13%
Average	**17%**
Source: Various visitor surveys	

20. In our baseline scenario we have applied the conservative assumption that 10% of the visitors to the sites are tourist visitors, as was taken from the Brereton survey. We have then assumed that these visitors spend an average of £32 per head (source: England Leisure Visits 2005 Survey) in the local economy. We have then assumed that 33% of this spend is leakage, that is, it does not take place in Merseyside itself. To convert this into GVA we have applied the ratio of GVA to turnover in the Hotels and Restaurants sector (source: Annual Business Inquiry), a best fit for the tourism sector at the 2 digit SIC level.

Health and Well-being – exercise (GVA and cost saving)

21. Research by Sport England found that a 10% points increase in adult activity (i.e. a reduction in the proportion of those aged 16+ who are sedentary from 37% to 27%) could generate savings of at least £500m a year. Research by Regeneris Consulting (2004) found that improvements in public rights of way in the North East caused a 4% points increase in adult activity. To calculate the potential economic impact of the sites from increasing activity we have assumed that the provision/improvement of the sites will have led to an increase of 4% points in adult activity among the local population. The calculation has the following steps:

- Calculate the potential saving per head in Merseyside and North Cheshire of a 10% points increase in activity. To do this we have apportioned the £500m England benefit to Merseyside and North Cheshire based on its population share, and then increased this to reflect the fact that the incidence of respiratory disease is higher in the region than the national average.

- Factor this down to reflect the assumption that the sites will generate a 4% points increase in activity, in line with the findings of Regeneris Consulting (2004). This gives a potential benefit of £4.60 per head in Merseyside and North Cheshire.

- Calculate potential benefit at the site level. This involves assuming that the local users (i.e. those who use the site regularly) will have increased their activity by 4% points. The benefit per head has been applied to the number of local regular users (at least once a week), which was calculated in the recreation benefit above.

1.1 In moving to net additional impacts, the calculation uses the number of additional local users, based on the analysis of existing greenspace performed as part of the assessment of

the recreation benefit.

Health and Well-being - pollution absorption (cost saving)

22. Phase 1 of our research identified work for the Forestry Commission which valued the impact of woodland on air quality, through improvements to health. The conclusion drawn is that this impact is de minimis in economic terms.

23. We have, however, identified research from the US, which looks at the impact in a different way, in terms of cost savings on pollution control. This suggests that the impact is more significant. A case study of Lincoln Park looked at the value of urban greenspace in reducing air pollution. This estimated the absorption rate of particulates, nitrogen dioxide, sulphur dioxide and carbon monoxide by trees in the park and valued these using data on the costs of pollution control. We have used the data from this study on the average annual value per hectare of air pollution absorption (£577 per hectare, in 2009/10 prices), and applied this to the area of new planting at the sites.

24. The study applies the caveat that information on the pollution interception and absorption capacity of trees is hard to come by and that therefore the figures in the study should be considered preliminary estimates. Note that this excludes absorption of carbon dioxide; therefore there is no double counting with the value of carbon sequestration.

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