Green Infrastructure Valuation Toolkit

Tom Butlin
The Mersey Forest

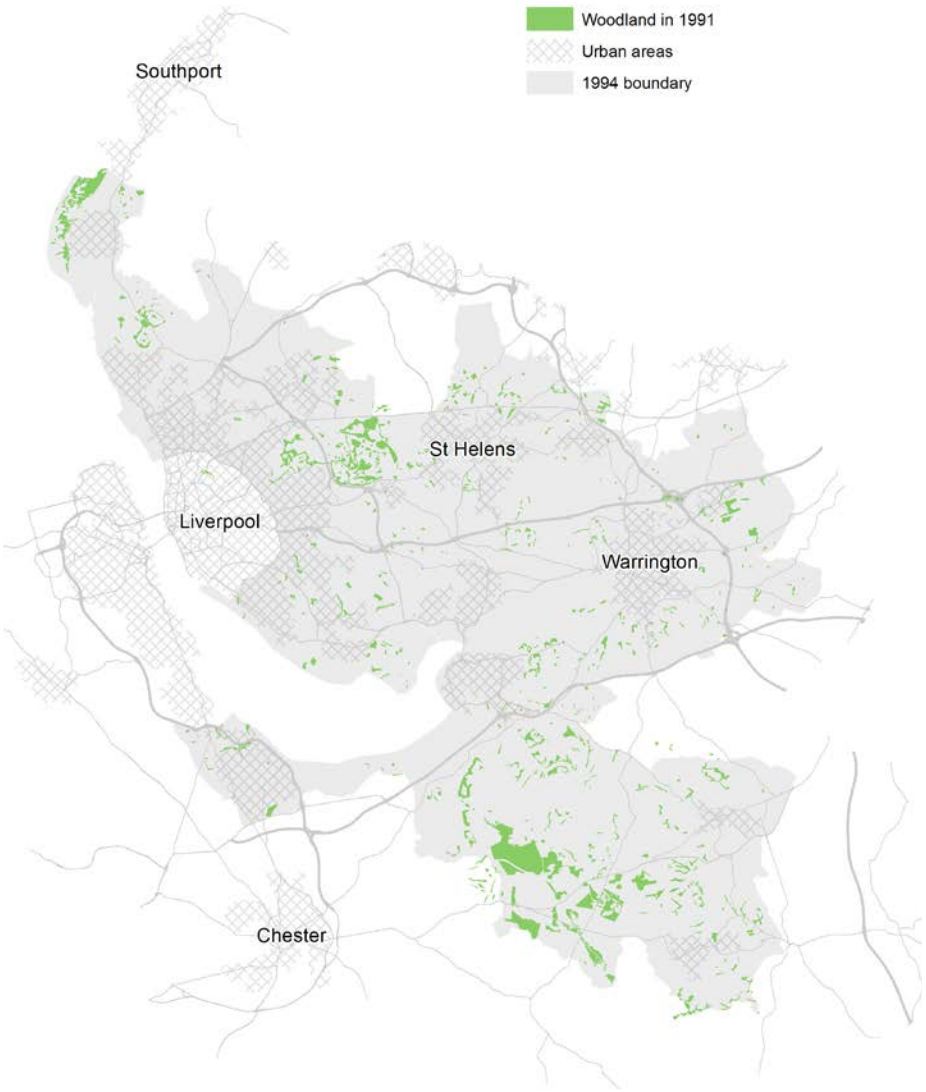
GIFT-T!
Green Infrastructure For Tomorrow - Together!

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

THE MERSEY FOREST
more from trees

Woodland cover 1991

(only mapped within 1994 boundary)



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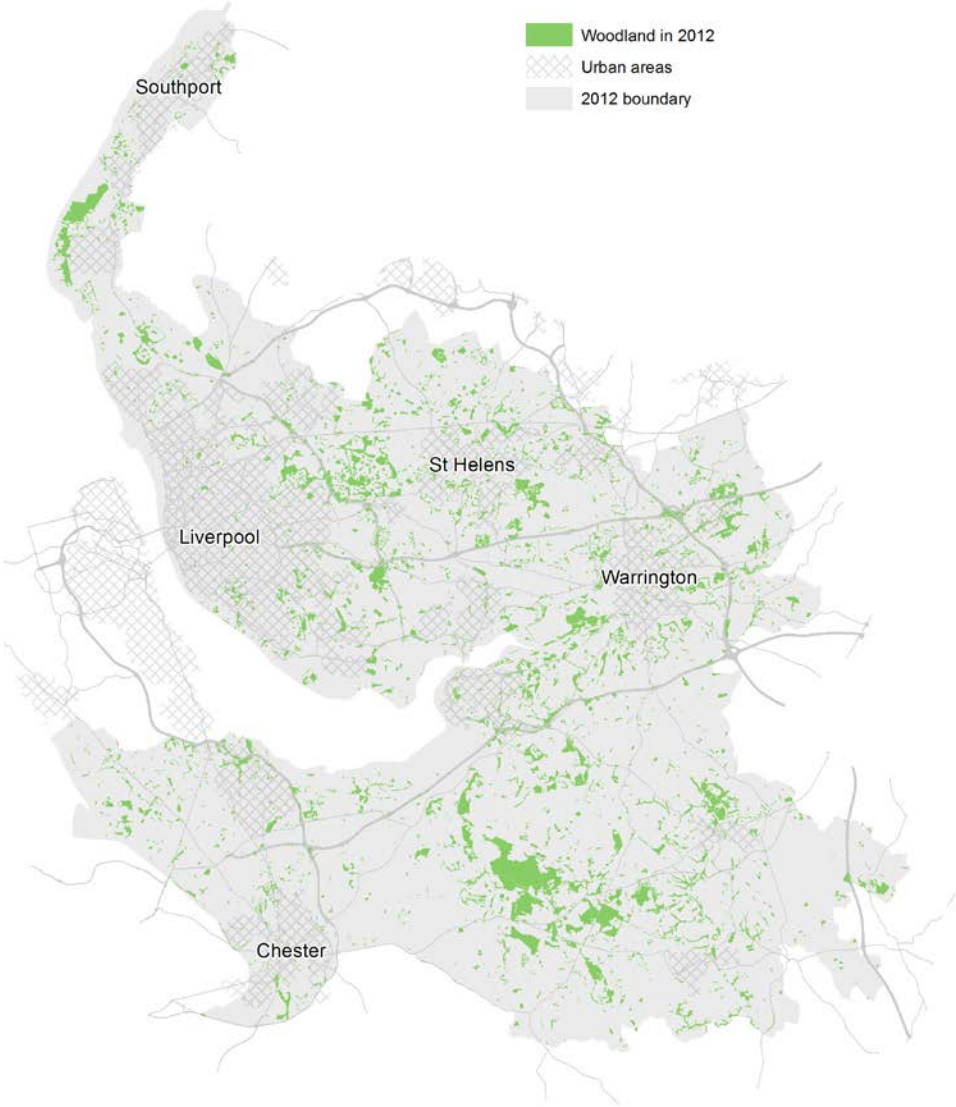
Woodland cover 2012



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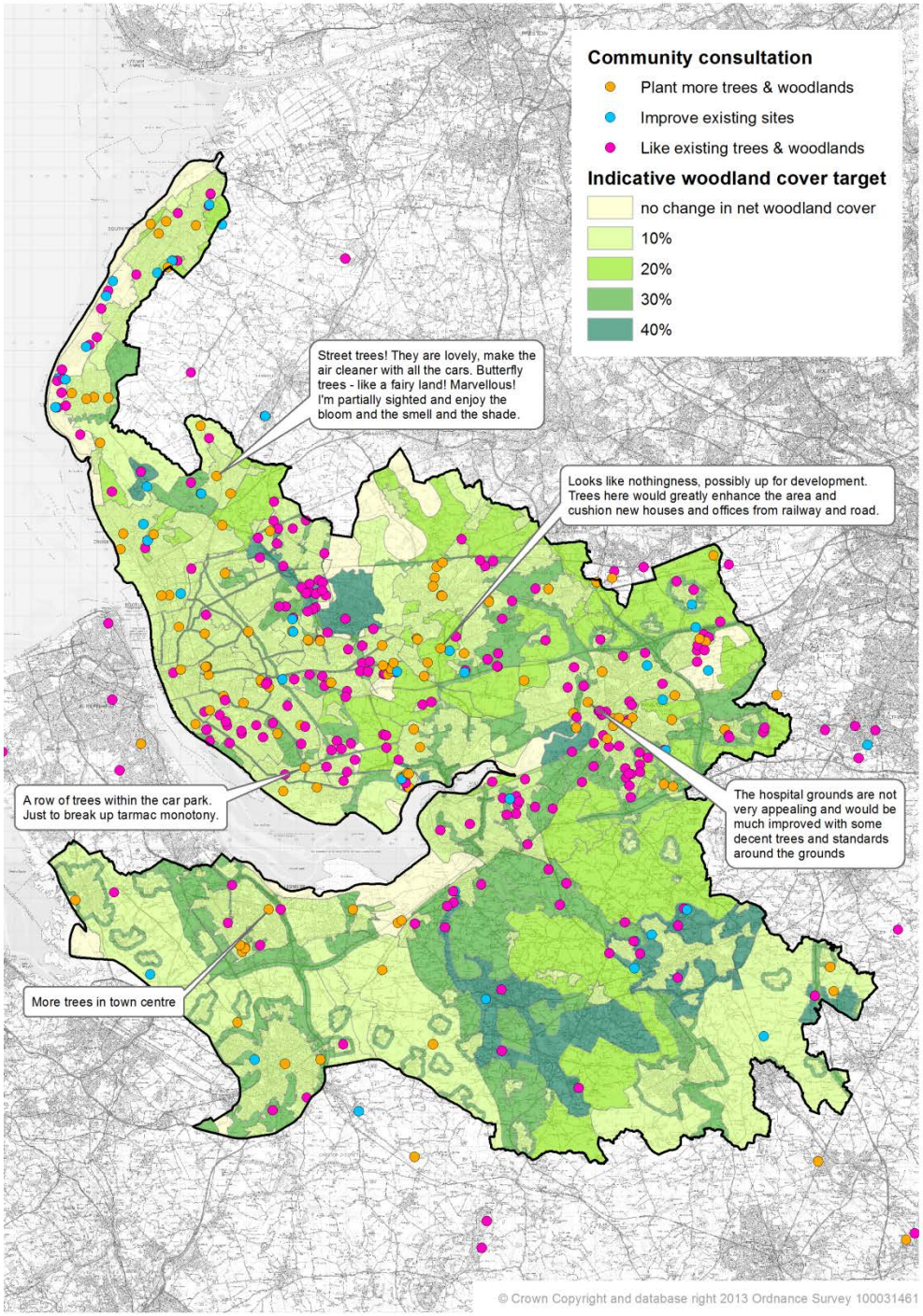
More from trees

The Mersey Forest Plan


Community consultation
Plant more trees & woodlands
Improve existing sites
Like existing trees & woodlands
Indicative woodland cover target
no change in net woodland cover
10%
20%
30%
40%
Street trees! They are lovely, make the air cleaner with all the cars. Butterfly trees - like a fairy land! Marvellous! I'm partially sighted and enjoy the bloom and the smell and the shade.
Looks like nothingness, possibly up for development. Trees here would greatly enhance the area and cushion new houses and offices from railway and road.
A row of trees within the car park. Just to break up tarmac monotony.
The hospital grounds are not very appealing and would be much improved with some decent trees and standards around the grounds
More trees in town centre
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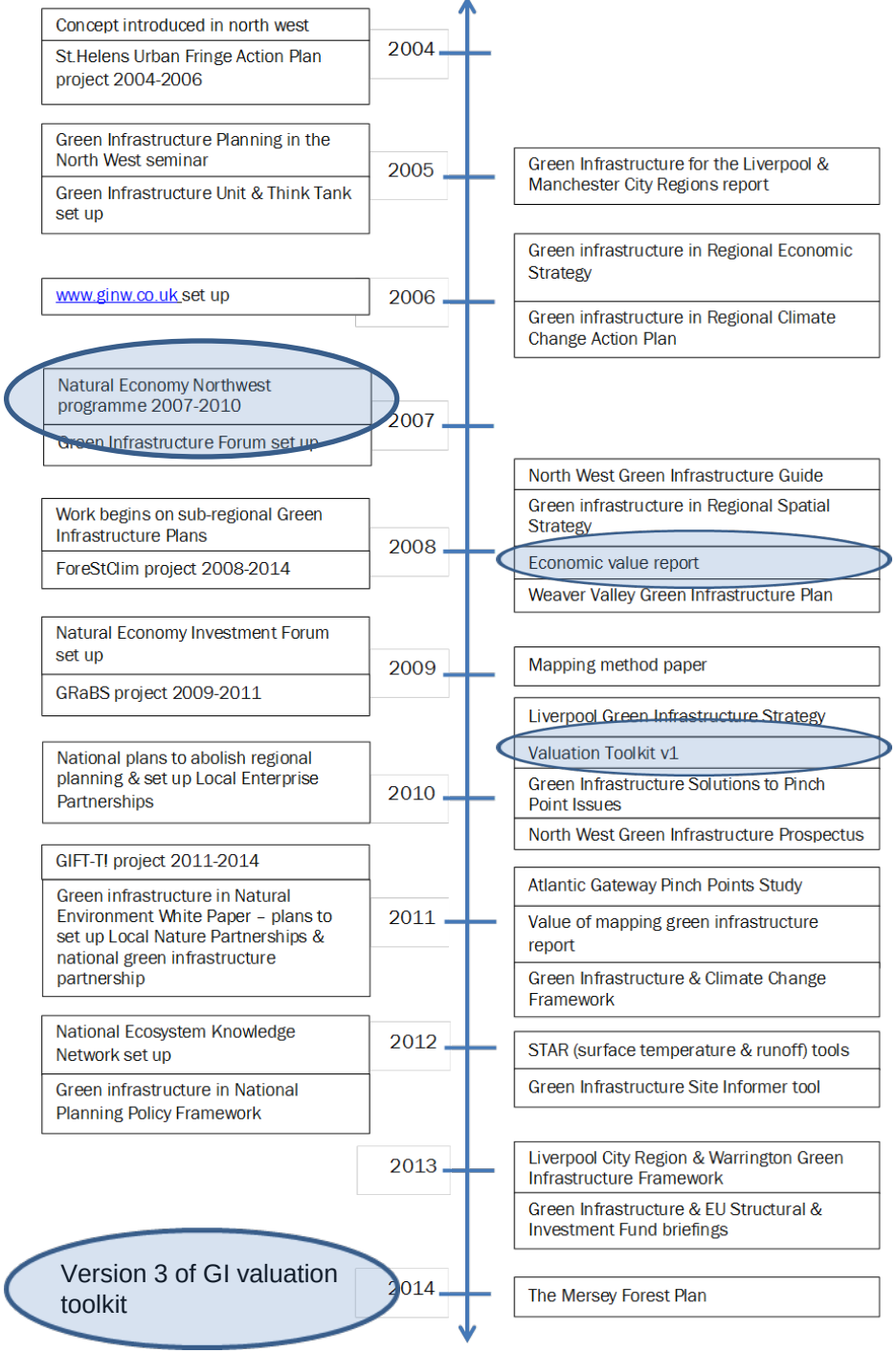
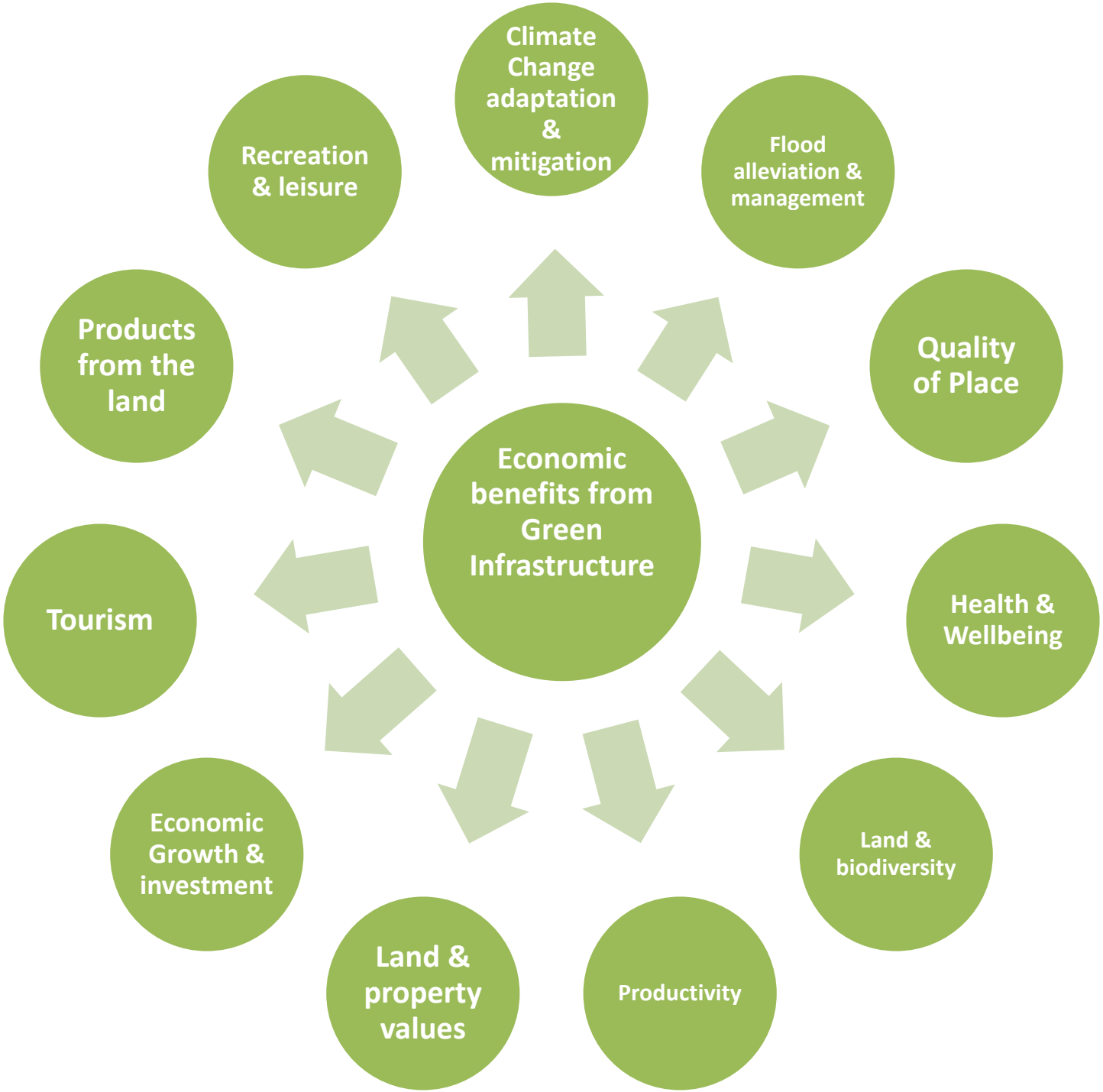
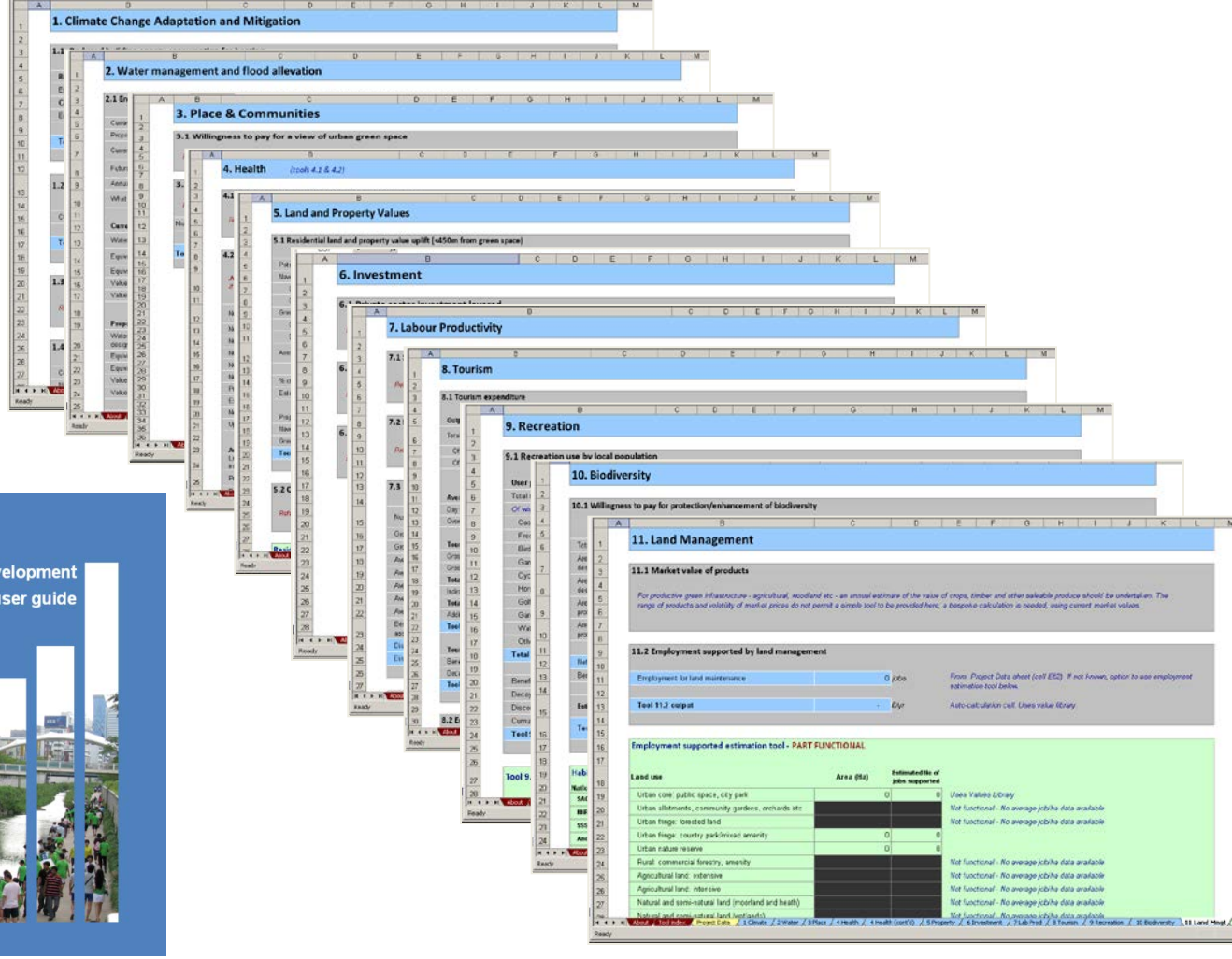
Our green infrastructure journey to date



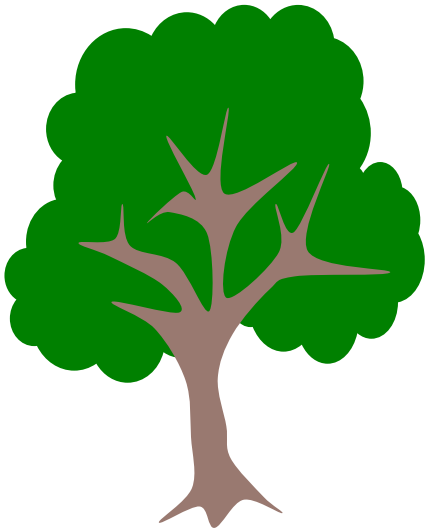
type → functions → benefit → value


Economic benefits from Green Infrastructure
Climate Change adaptation & mitigation
Flood alleviation & management
Quality of Place
Health & Wellbeing
Land & biodiversity
Productivity
Land & property values
Economic Growth & investment
Tourism
Products from the land
Recreation & leisure



User Guide + Spreadsheet-based **Calculator**

The Toolkit - http://bit.ly/givaluationtoolkit

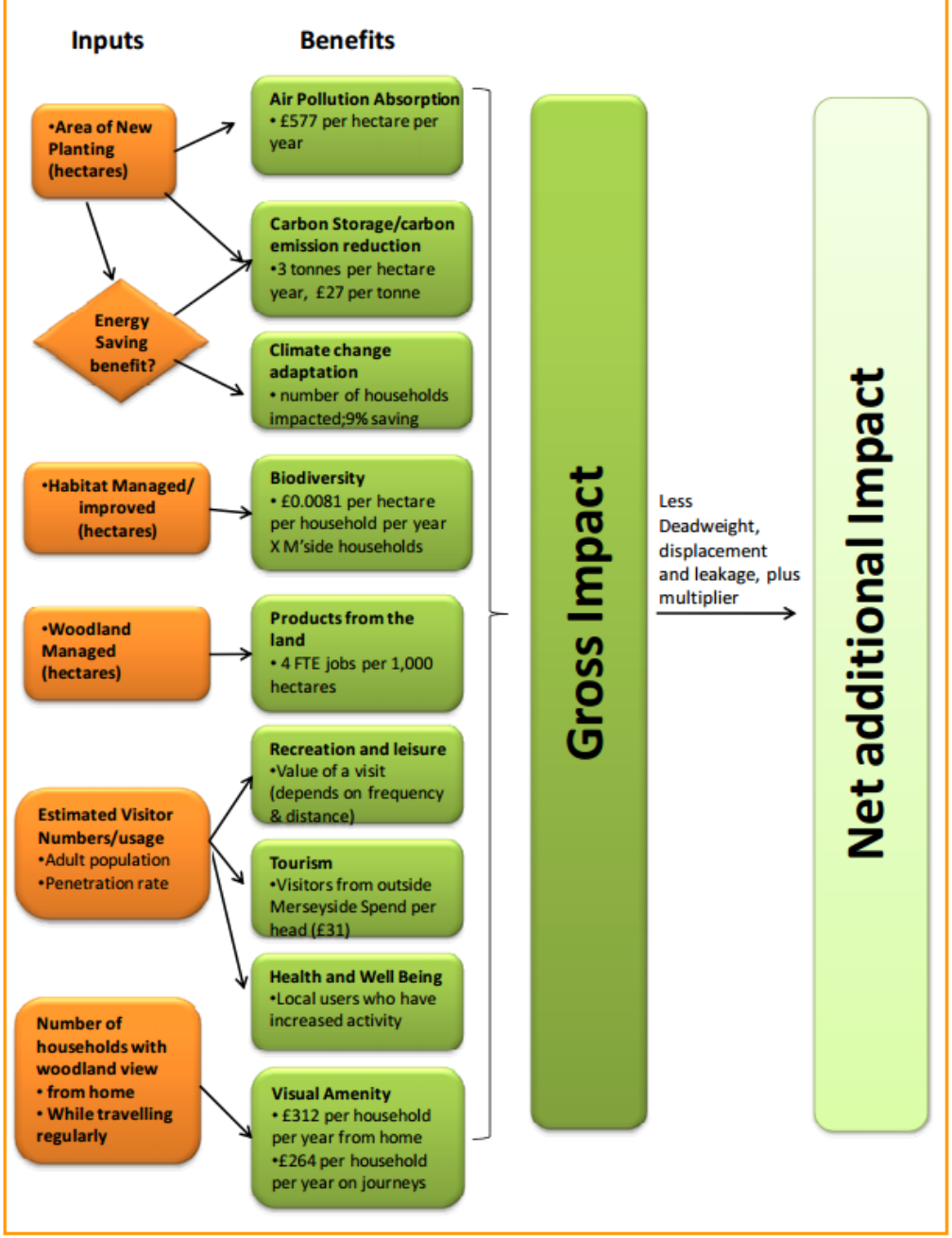
GREEN INFRASTRUCTURE ASSET / INTERVENTION	FUNCTION	BENEFIT	VALUE	
	SHELTER FROM WIND		£ REDUCED BUILDING HEATING	M
			£ AVOIDED CO_2	M
	EVAPO-TRANSPIRATION	CLIMATE CHANGE ADAPTATION & MITIGATION	°C REDUCED TEMPERATURES	Qt
	CARBON SEQUESTRATION		£ MARKET VALUE OF CO_2 STORED	M
	PARTICULATE FILTERING	HEALTH & WELL BEING	£ REDUCED POLUTION CONTROL	M
			REDUCTION PULMONARY DISEASES	Ql

In **monetary** terms M

In **quantitative** terms Qt

In **qualitative** terms Ql

Figure 4-1: Structure of the model



Why was it created?

- Show monetary value of Green infrastructure
- Help to make the case for investment
- To support project managers
- To show what could be done!

Elements of the Toolkit

- Tool Index
- Double Counting
- Project data
- The tools
- Value Library
- Assessments

http://bit.ly/givaluationtoolkit

Tool Index

Tool index

Benefit groups	Functions	Tools	Tool Outputs: Monetary	Quantitative	Qualitative		Recommended timeframe for value assessment
1. CLIMATE CHANGE ADAPTATION & MITIGATION	Shelter from wind	1.1 Reduced building energy consumption for heating	□	□	■	*Monetisation and quantification functional for residential properties only*	10 years
		1.2 Avoided carbon emissions from building energy saving for heating	□	□	■	*Monetisation and quantification functional for residential properties only*	10 years
		1.3 Avoided damage from wind and storms	X	X	■	*Monetisation and quantification require further research*	t.b.d.
	Reduction of urban heat island effect	1.4 Reduction of peak summer surface temperatures	X	■	■	*Monetisation requires further reserch*	t.b.d.
	Cooling through shading and evapo- transpiration	1.5 Reduced energy consumtion for cooling	■	■	■		10 years
		1.6 Avoided carbon emissions from building energy saving for cooling	□	□	■	*Monetisation and quantification functional for green roofs only*	10 years
	Carbon storage and sequestration	1.7 Carbon stored and sequestered in woodland and forests	□	□	■	*Monetisation and quantification functional for broadleaf woodland only*	50 years, benefit accrual period 20-25 years with new tree planting
		1.8 Carbon stored and sequestered in non-woodland based landscapes	X	X	■	*Monetisation and quantification require further research*	t.b.d.
2. WATER MANAGEMENT & FLOOD ALLEVIATION	Interception, storage and infiltration of rainwater	2.1 Energy and carbon emissions savings from reduced stormwater volume entering combined sewers	■	■	■		30 years
		2.2 Reduced wastewater treatment costs for domestic and commercial water customers	■	■	■		30 years
		2.3 Avoided costs of traditional water drainage infrastructure	X	X	■	*Monetisation and quatification requires access to average contruction costs data*	30 years

Double counting

Potential for double counting

Tools that produce monetary outputs	1.1	1.2	1.5	1.6	1.7	2.1	2.2	4.2	4.6	5.1	7.3	8.1	8.2	9.1	10.1	11.2	Within tool
1.1 Reduced building energy consumption for heating																	
1.2 Avoided carbon emissions from building energy saving for heating																	
1.5 Reduced energy consumption for cooling																	
1.6 Avoided carbon emissions from building energy saving for cooling																	
1.7 Carbon stored and sequestered in woodland and forests																	
2.1 Energy and carbon emissions savings from reduced stormwater volume entering combined sewers																	
2.2 Reduced wastewater treatment costs for domestic and commercial water customers																	
4.2 Reduced mortality from increased walking and cycling																	
4.6 Avoided costs for air pollution control measures																	
5.1 Residential land and property values uplift																	
7.3 Savings from reduced absenteeism from work																	
8.1 Tourism expenditure																	
8.2 Employment supported by tourism																	
9.1 Recreational use by the local population																	
10.1 Willingness to pay for protection or enhancement of biodiversity																	
11.2 Employment suported by land management																	

Potential for double counting probably exists - use of both tools is not advised

Potential for double counting probably does not exist

What data does the toolkit need?

- The increase in Green Infrastructure
  - Taking additionally and displacement into account
  - May just be trees
- Numbers of people
- Numbers of businesses
- Access created
- Average house prices
- Capital and revenue costs of proposed GI
- Additional local data - IF AVAILABLE

Project Data

Project data

	Before	After		
Project area	n.a.	0	ha	*Linked to tool 1.4*
Total area of greenspace	0	0	ha	*Linked to tools 1.4, 2.1, 4.7 and 10.1*
New green space created by the project	n.a.	0	ha	*Linked to tools 2.1, 4.7, 5.1*
Pre-existing area of greenspace enhanced by the project	n.a.	0	ha	*Linked to tool 5.1*

	Before	After		
Tree cover	0	0	ha	*Linked to tools 1.7*
Area of new woodland created	n.a.	0	ha	*Linked to tool 1.7*
Total area of green roofs	0	0	sq.m	*Linked to tool 1.5*
including: area of intensive green roofs	0	0	sq.m	*Tool 2.1*
area of semi-intensive green roofs	0	0	sq.m	*Tool 2.1*
area of extensive green roofs	0	0	sq.m	*Tool 2.1*
Current land use				*Context only*
Project context eg inner city, urban or rural area (or a mix of all)?				*Context only*
Land ownership?				*Context only*
What is the level of deprivation in the area? Refer to IMD data				*Context. Can contribute to business case.*
Is there currently a lack of green space in the area? Refer to local open space audit results and associated open space standards. Refer to national benchmarks such as ANGsT standards. How will this project help?				*Context. Can contribute to business case.*
Does the site have heritage value? What features are being enhanced/protected/ promoted through the project?				*Context. Can contribute to business case.*

	Before	After		
Cycle routes	0	0	km	*Linked to tool 4.2b*
Current cycle routes upgraded	n.a.	0	km	*Linked to tool 4.2b*
Footpaths	0	0	km	*Linked to tool 4.2a*
Footpaths upgraded	n.a.	0	km	*Linked to tool 4.2a*
Is the land publicly accessible?				*Context only*
Is the site currently well connected or remote?				*Context only*
Will the project improve green travel options?				*Context. Can contribute to business case.*
Assessment of transport impact conducted?				*Context. Can contribute to business case.*

1. Climate Change Adaptation and Mitigation

1.1 Reduced building energy consumption for heating

Residential buildings with large trees < 10	0	*Insert number of properties qualifying*	*Requires manual input*
Energy saving for residential properties	0	*kWh (gas)*	*Uses data feeds from Values Library.*
Commercial buildings			*Requires further work*
Energy saving for commercial properties			*Requires further work*
Tool 1.1 output	0	*£/yr*	*Auto-calculation cell. Only accounts for residential properties*

1.2 Avoided carbon

CO2 saving

Tool 1.2 output

1.3 Avoided damag

Refer to the User Guic

4. Health *(tools 4.1 & 4.2)*

4.1 Health costs savings from increase in physical activity

Refer to the User Guide for qualitative evidence.

Requires further work for developing a monetisation tool

4.2a Reduced mortality from increased walking

This tool is in two parts. Scroll down to find 4.2b

***Judgment needed before proceeding**: Will the new / enhanced green infrastructure asset be capable of encouraging at least 3 hours of exercise per week for users? If not, this tool does not apply.*

	Before	*After*	
Number of households <300m	0	0	*From Project Data sheet (cell D32 and D36)*
Number of households <1200m	0	0	*From Project Data sheet (cell E34 and E38)*
Number of local residents <300m	0	0	*From Project Data sheet (cell D34 and D38)*
Number of local residents within 301-1200m	0	0	*From Project Data sheet (cell E34-D34 and E38-D38)*
Number of local residents beyond 1200m	0	0	*Input required*
Existing pedestrian routes			
New pedestrian routes			
Upgraded pedestrian routes			

5. Land and Property Values

5.1 Residential land and property value uplift (<450m from green space)

Potential number of properties benefiting	-		*From Project Data sheet (cell F36)*
New green space created	0	*Ha*	*From Project Data sheet (cell E6)*
Of which high quality 'city park'	0	*Ha*	*Requires input*
Of which quality 'local park'	0	*Ha*	*Requires input*
Green space enhanced	0	*Ha*	*From Project Data sheet (cell E7)*
Of which high quality 'city park'	0	*Ha*	*Requires input*
Of which quality 'local park'	0	*Ha*	*Requires input*
Average property price	0	*£*	*From Project Data sheet (cell D67). For reference, average residentia*

Values library

1. CLIMATE CHANGE ADAPTATION AND MITIGATION	Value			Units	Date	Source
	Low	Mid/average	High			
Max surface temperature and evaporative fraction		T=22.3(1/(EF+0.53))+2.2*EF+0.9			2006/2010	curve fitted to data from Dr Susannah Gill
Average UK household energy consumption (electricity)		4,800.00		*kWh*	2007	www.carbonindependent.org, BERR Energy Trends December 2007 www.berr.gov.uk/files/file43304.pdf
Average UK household energy consumption (gas)		16,000.00		*kWh*	2007	www.carbonindependent.org, BERR Energy Trends December 2007 www.berr.gov.uk/files/file43304.pdf
CO2 emission factor of grid electricity		0.537		*kg/kWh*	2010	Defra/Carbon Trust
CO2 emission factor of natural gas		0.203		*kg/kWh*	2010	Defra
Domestic electricity price		15.5		*p/kWh*	2013	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/26
Domestic gas price		4.7		*p/kWh*	2013	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/26
Commercial electricity price		7.3		*p/kWh*	2012	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/26
Commercial gas price		2.3		*p/kWh*	2012	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/26
Average energy savings (heating) domestic		0.03		%	2010	Combined average from sources
Average energy savings (heating and cooling) commercial		0.08		%	2010	Combined average from sources
Average efficiency, air conditioning		33%		%	2006	Evaluating Green Roof Energy Performance - Jeffrey Sonne, Ashrae Journal 2006
Green roof, heat dissipation		150		*w/m2*	2010	University of Manchester workshop, April 2010
Social value of carbon		6.0		*£/tonne*	2013	Mid value: was based on Stern £27/t, raising at 2% per annum. As recommanded by DECC, Carbon Valuation in UK Policy Appraisal, 2009 (use as default in calculation). Now based upon http://www.forestry.gov.uk/fr/INFD-7WTDJU. High value: £53/t, recommended by DEFRA 2012

2. WATER MANAGEMENT AND FLOOD ALLEVIATION	Value			Units	Date	Source
	Low	Mid/average	High			
Water industry energy use for wastewater treatment		645		*kWh/Megalitre*	2010	Water UK
CO2 emission factor of grid electricity		0.537		*kgCO2/kWh*	2010	Carbon Trust
Commercial electricity price	4		12	*p/kWh*	2010	Estimate
Social value of carbon		53		*£/tonne*		Defra (raising at 2% per annum)
Surface water drainage site area charges (United Utilities)	*See data table 2.2 in Water sheet*			£	2009/2010	United Utilities, www.unitedutilities.com/siteareacharges.htm
Surface water rebate to domestic customers (Welsh Waters)		45		*£/yr*	2011/12	Welsh Water

Assessments

SUMMARY OF ECONOMIC VALUE

BENEFITS	BENEFIT MONETISATION		
Benefits groups	GVA value	Land and property value	Other economic value
1 Climate Change Adaptation & Mitigation	£0	n.a.	£0
2 Water management & Flood Alleviation	£0	n.a.	n.a.
3 Place & communities	n.a.	n.a.	n.a.
4 Health & Well-being	£0	n.a.	£0
5 Land & Property Values	n.a.	£0	n.a.
6 Investment	n.a.	n.a.	n.a.
7 Labour Productivity	£0	n.a.	n.a.
8 Tourism	£0	n.a.	n.a.
9 Recreation & leisure	n.a.	n.a.	£0
10 Biodiversity	n.a.	n.a.	£0
11 Land management	£0	n.a.	n.a.
TOTAL ECONOMIC VALUE OF BENEFITS	£0	£0	£0
	These three figures should not be added together, as they represent different kinds of value		

SUMMARY OF QUANTITIES

BENEFITS			BENEFIT QUANTIFICATION
Benefits groups	Functions	Tools	
1 Climate Change Adaptation & Mitigation	Shelter from wind	1.1 Reduced building energy consumption for heating	0 kWh/yr energy saved
		1.2 Avoided carbon emissions from building energy saving for heating	0 $kgCO_2$/yr not emitted
	Reduction of urban heat island effect	1.4 Reduced peak summer surface temperatures	0 °C in surf. temperature reduction
	Cooling through shading and evapo-transpiration	1.5 Reduced building energy consumption for for cooling	0 kWh/yr energy saved
		1.6 Avoided carbon emissions from building energy saving for cooling	0 $kgCO_2$ not emitted
	Carbon storage and sequestration	1.7 Carbon stored and sequestered in woodland and forests	0 $kgCO_2$ sequestered
2 Water management & Flood Alleviation	Interception, storage and infiltration of rainwater	2.1 Energy and carbon emissions savings from reduced stormwater volume entering combined sewers	0 L/yr water diverted from sewers
3 Place & communities	Catalyst for community cohesion and pride	3.2 Increase in volunteering	0 new volunteers
4 Health & Well-being	Provision of attractive opportunities for exercise	4.2 Reduced mortality from increased walking and cycling	0.00 lives saved per yr
	Air pollution removal	4.6 Avoided costs for air pollution control measures	0.00 t/yr of carbon monoxide removed 0.00 t/yr of sulfur dioxide removed 0.00 t/yr of nitrogen dioxide removed 0.00 t/yr of PM10 removed 0.00 t/yr of ozone removed

Values for GVA, Property and non market values

The Toolkit is not

- Perfect!
- A replacement for a full Cost Benefit analysis
  - But may indicate the value of spending a lot of money on CBA
- Simplistic
- A “black box”
  - Knowledge of the economics, models, assumptions and limitations important in being able to justify the valuation

It is…

- Straight forward to use
- Based on peer reviewed models and published values
- Wide ranging in scope
  - All green infrastructure
  - 11 economic benefits
- Quick
- Sensible
- Used in practice
- In its third revision
- Continuing to be developed

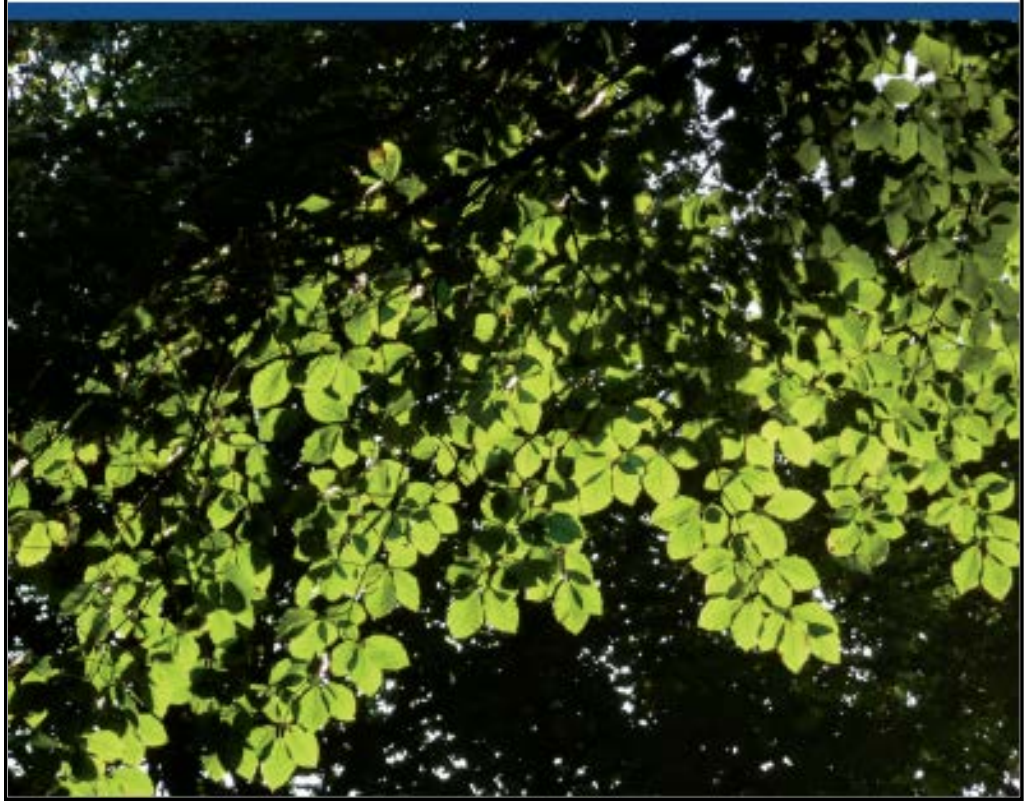
Some examples

Wirral Waters

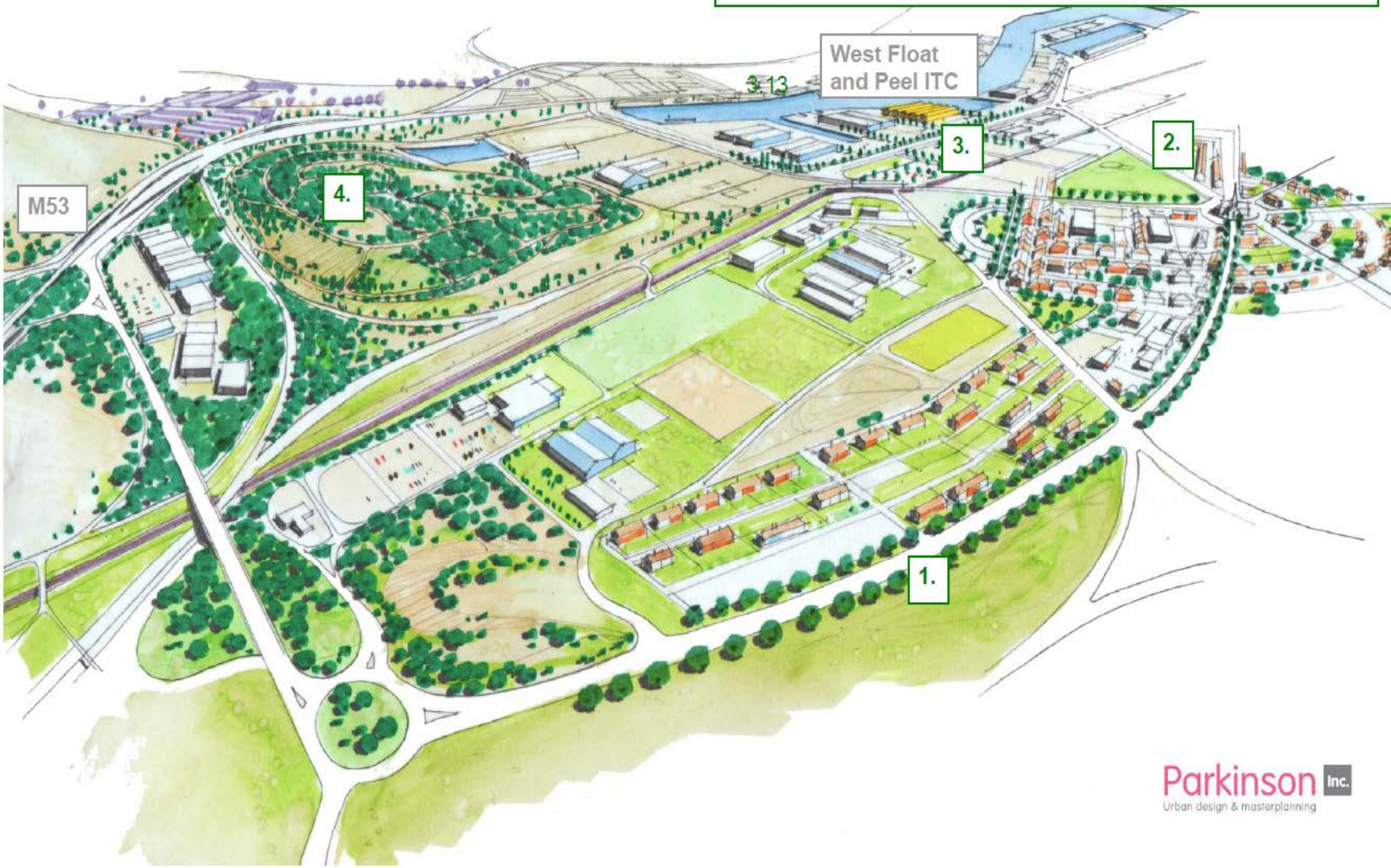
Indicative Economic Assessment

A quantification and valuation of the economic benefits of a proposed programme of improvements to the green infrastructure in the areas around the development at Wirral Waters

August 2011

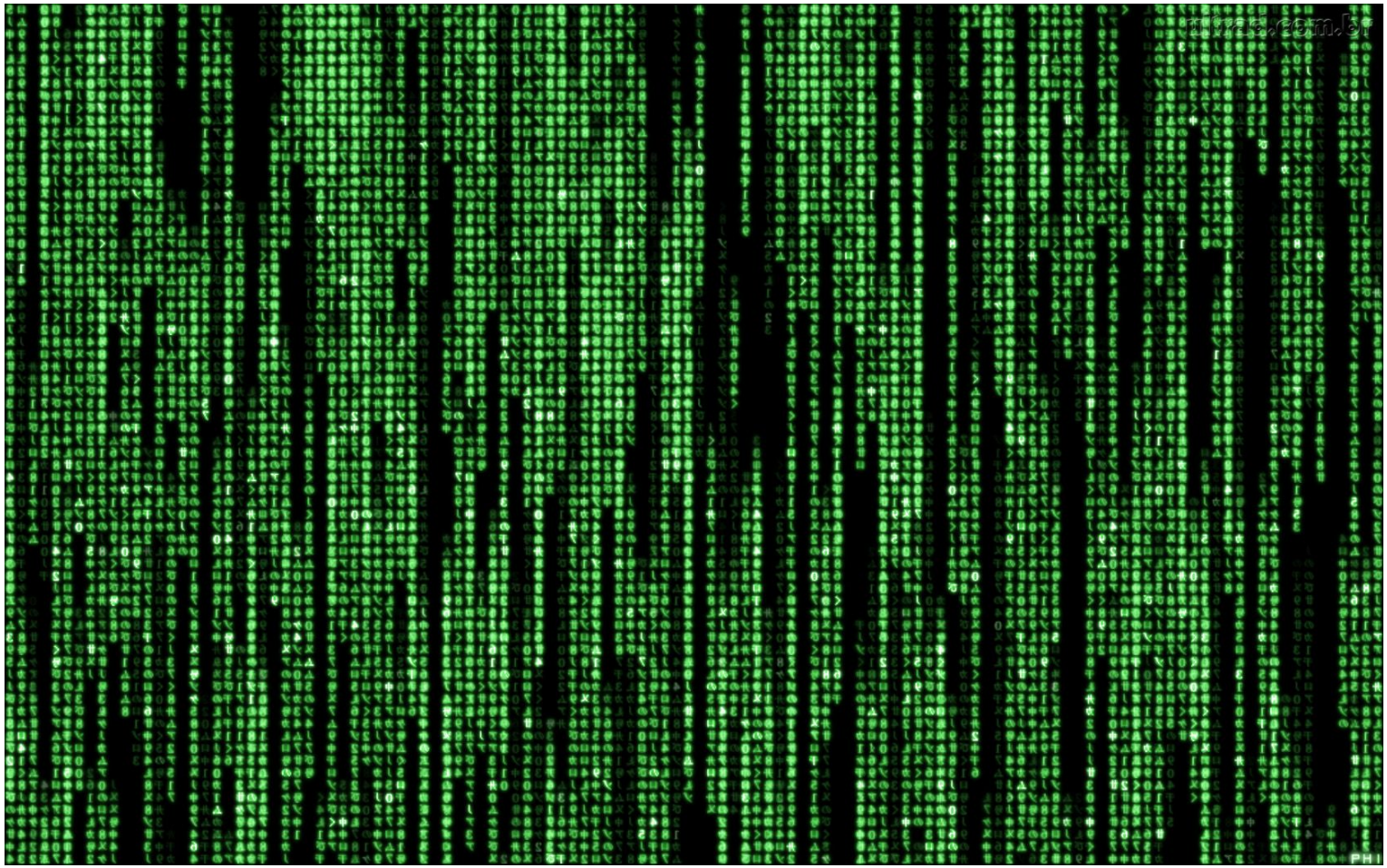


Western Approaches – tree planting connecting pedestrian, cycleway, rail and road approaches from the west to West Float and East Float. Bidston and Birkenhead North Stations, and the M53 are key approaches and arrival points into Wirral Waters, Wallasey and North Birkenhead



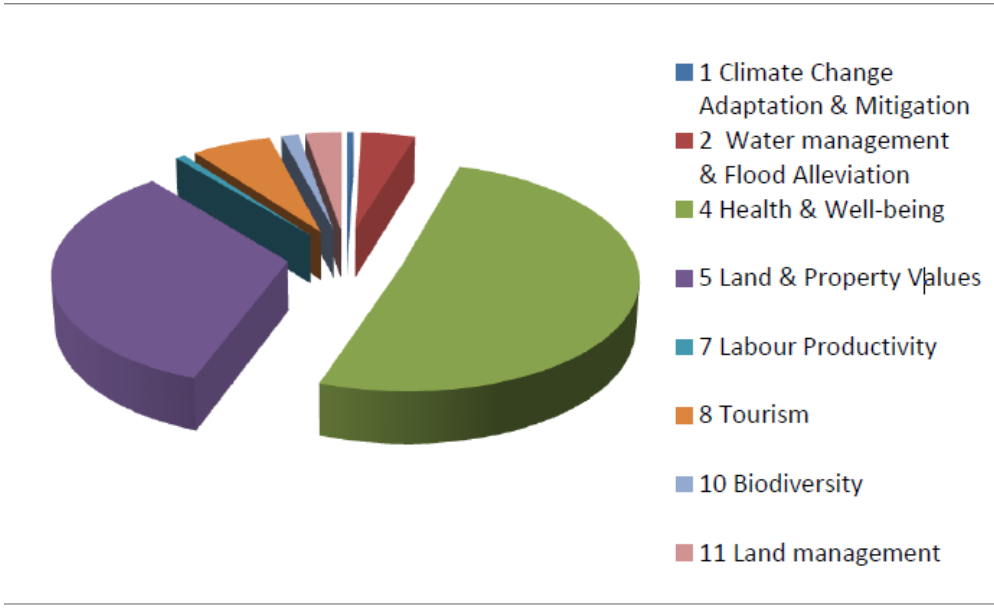
Parkinson Inc.
Urban design & masterplanning

Run the data



Result for Green Streets Wirral Waters

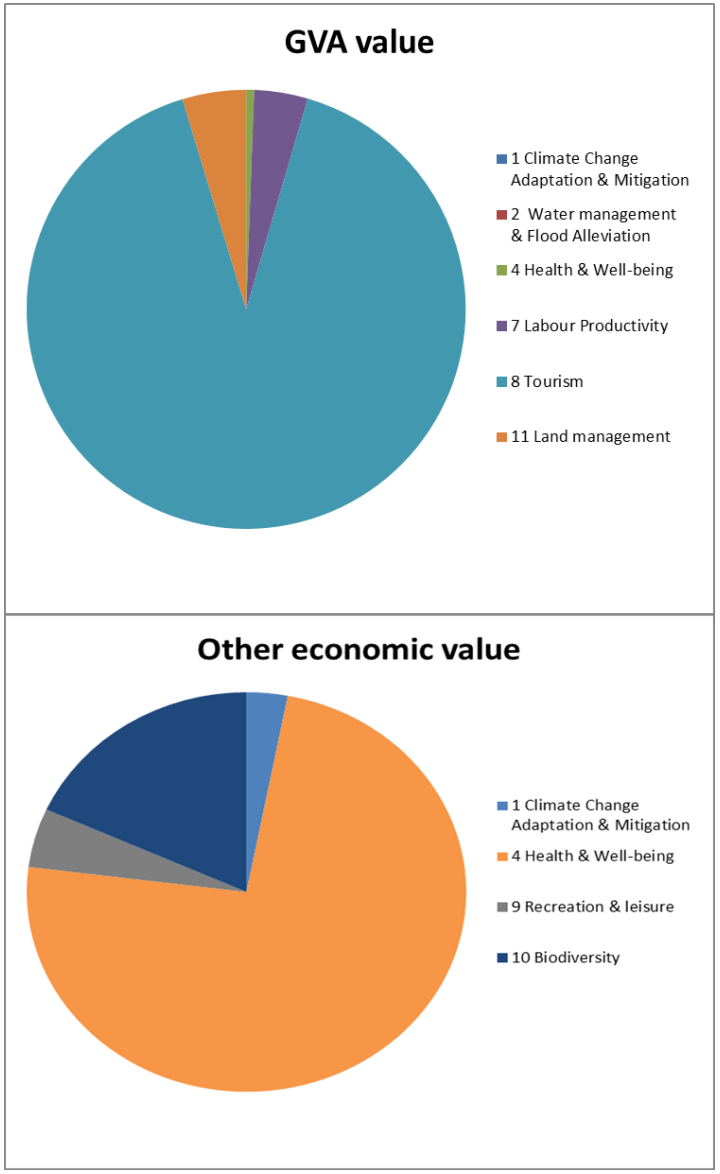
- Investment €2m
- Contribution to **GVA -** for Wirral Waters the toolkit identified value of **€15m**
- **Wider economic benefit** - For Wirral Waters the toolkit identified value of **€20m**



BENEFIT QUANTIFICATION

Benefits groups	Functions	Tools		
Climate Change Adaptation & Mitigation	Shelter from wind	1.1 Reduced building energy consumption for heating	480000	kWh/yr energy saved
		1.2 Avoided carbon emissions from building energy saving for heating	97440	kgCO2/yr not emitted
	Reduction of urban heat island effect	1.4 Reduced peak summer surface temperatures	25.30	Co in surf. temperature reduction
	Cooling through shading and evapo-transpiration	1.5 Reduced building energy consumption for cooling	0	kWh/yr energy saved
		1.6 Avoided carbon emissions from building energy saving for cooling	0	kgCO2 not emitted
	Carbon storage and sequestration	1.7 Carbon stored and sequestered in woodland and forests	9.36	kgCO2 sequestered
Water management & Flood Alleviation	Interception, storage and infiltration of rainwater	2.1 Energy and carbon emissions savings from reduced storm water volume entering combined sewers	168000000	L/yr water diverted from sewers
Places and communities		3.2 Increase in volunteering	400	new volunteers
Health and Wellbeing		4.2 Reduced mortality from increased walking and cycling	0.717025216	lives saved per yr

€2 million investment in GI
€15 million GVA
€35 million of total economic value



300ha community woodland

Contribution to GVA –€14m
Impact on property value –€11m
Other economic benefit - €36m

Getting more from trees

THE MERSEY FOREST
more from trees

This year we planted over 20,000 trees in The Mersey Forest area.
But what does this mean in real terms for people, wildlife and the economy?

In 2013/14 our activities led to...

20,531

trees planted in Merseyside and North Cheshire

including...

543 **hedgerow trees**

+

1471 **street trees**

521 **events held by The Mersey Forest Team**

leading to

12471 **people engaged in our activities across the area**

But what does this all mean?

*Planting 20531 trees has wide-ranging and long term benefits....**

370,000

litres of water diverted from the sewers each year, helping to avoid flooding

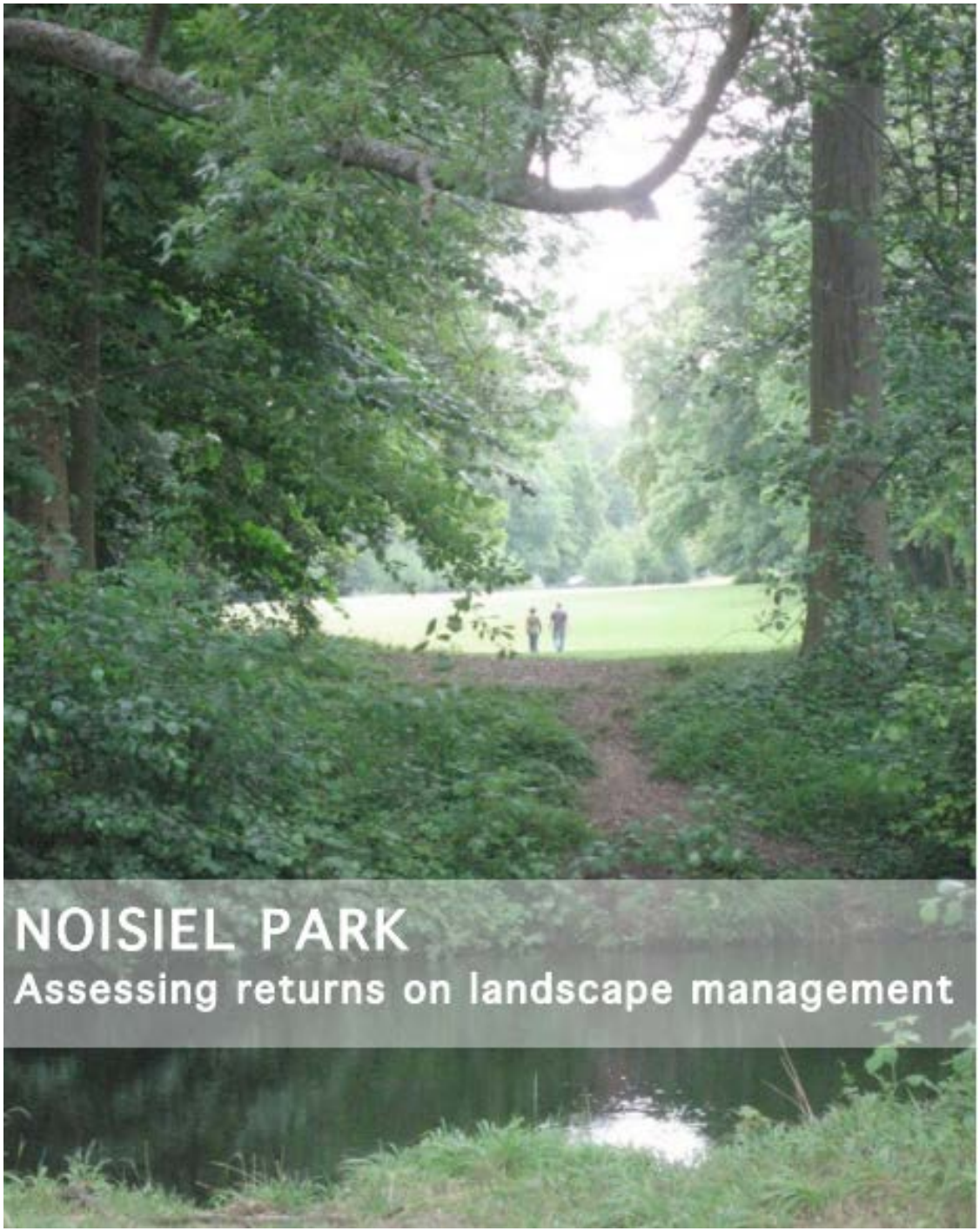
45 **tonnes**

of CO_2 sequestered per year, mitigating climate change

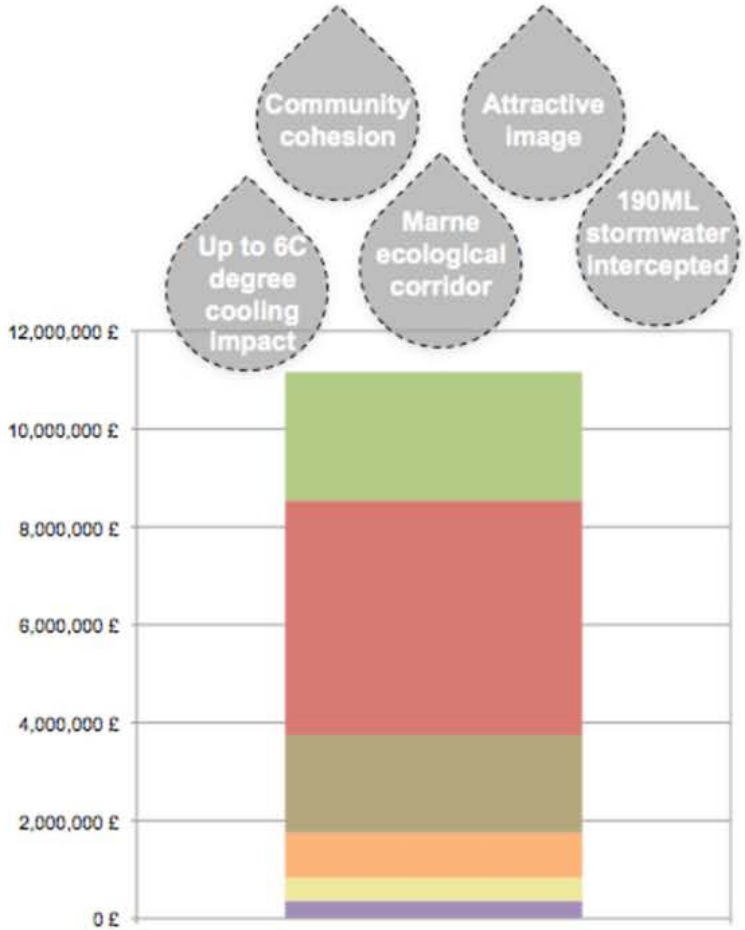
gases removed from the air each year, improving air quality

... among other benefits, including habitat for wildlife, setting the scene for investment and providing places for recreation.

*The data provided in this infographic is based on calculations made using the Green Infrastructure Valuation Toolkit. which can be found at bitly/givaluationtoolkit



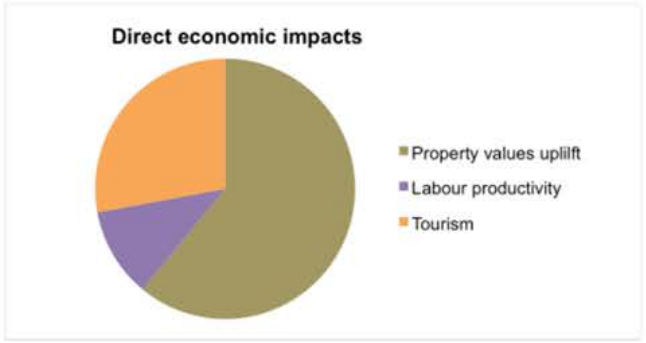
Courtesy of
Anne Jaluzot

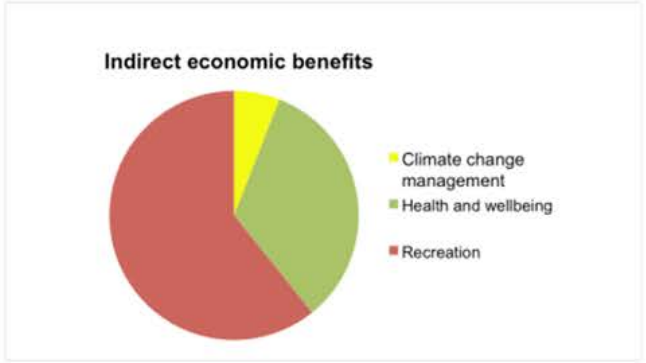


Benefits that could be monetised:

- Health and wellbeing
- Recreation
- Property values
- Tourism
- Climate change management
- Labour productivity

Benefits that could only be quantified or qualified:





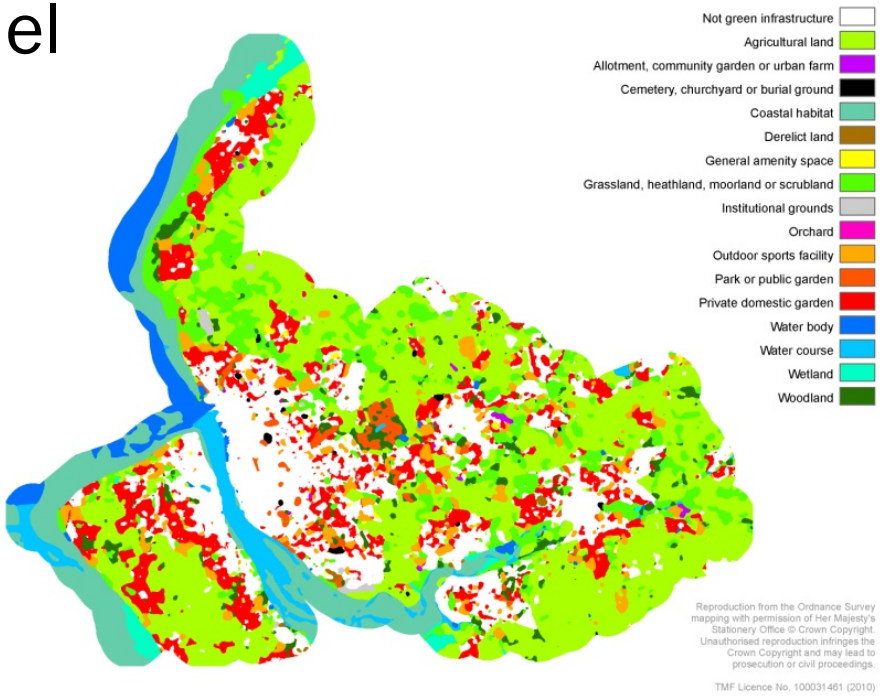
Good bits

- First toolkit of its type – aimed at projects at landscape and local levels and attempts to assess a wide range of benefits.
- Talks the language of economic development and regeneration.
- Shows Net Present Value
- Recognised models
- Capable of producing useful information to help get a better picture of the broad value of a project.
- Quick to use
- Latest version tackles many early criticisms
- Seems to be acceptable even with caveats

- Extensive use of benefit transfer – but problems with evidence transferability.
- Problems with evidence robustness for some tools
- Not all benefits have tools available – evidence gap
- Does need some understanding of the underlying economics
- Needs to be sense checked – is this value likely?
- Range and sensitivity gaps.

What next?

- PhD underway that will
  - Look to update the model
  - Link to Geographic Information System
    - Potential for scenario modelling
    - Potential for Dynamic Interactive Cost Benefit assessments
- Continue to update based on latest research/models



Beyond Valuation - Our next adventure!! Or the next door.

- **GI increasing Land value** - encourages investment generally and allows sites to more easily be brought forward for development.

$$IRR = r_1 + \frac{(NPV_1) \times (r_2 - r_1)}{(NPV_1 - NPV_2)}$$

- **Reducing the time to development /reducing voids**– bringing forward the date at which income is received.

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}.$$

Thank You

The Toolkit - http://bit.ly/givaluationtoolkit

The Mersey Forest - www.merseyforest.org.uk

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GIFT-T!
Green Infrastructure For Tomorrow - Together!

Investing in Opportunities
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