BeST (Benefits of SuDS Tool)

W045c BeST - Technical Guidance

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BeST (Benefits of SuDS Tool) Technical Guidance

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Assessing the benefits of SuDS and other drainage enables conversations with interested stakeholders and helps identify other potential funding routes. Understanding the wider value of different drainage options provides greater information to support decision makers faced with difficult choices.	**AVAILABILITY**	Unrestricted
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BeST: BENEFITS OF SuDS TOOL

Drainage systems consistently provide core fundamental benefits ranging from public health to minimising the chance of flooding. However some drainage systems can provide far wider and larger benefits. Sustainable drainage systems (SuDS) are such systems, providing the benefits expected from a conventional, piped approach as well as many others. This is possible because SuDS enhance the urban area and contribute to economic development and environmental quality.

Stakeholders are increasingly collaborating to design and build drainage systems within urban improvements. Questions are often asked about the benefits different SuDS solutions may bring, their size and their value. Understanding these benefits can support conversations between different stakeholders and support funding applications.

CIRIA has developed a user tool and guidance, W045 BeST (Benefits of SuDS Tool) to support practitioners estimate the impacts that drainage schemes can create. Evaluating the type and size of these benefits can otherwise be difficult, often requiring specialist economic inputs.

The 4 components of W045 BeST

W045a BeST: Evaluation Tool *supporting practitioners evaluate benefits for a drainage proposal*

W045b BeST Options Comparison Tool: *Tool to compare more than one drainage proposal*

W045c BeST Technical Guidance: *Provides technical information behind the tool*

W045d BeST User manual: *Provides an overview of how to use the tools*

BeST provides a structured approach to evaluating a wide range of benefits (in the table right), often based upon the drainage system performance overall. It follows a simple structure, commencing with a screening and qualitative assessment to identify the benefits to evaluate further. Where possible, it provides support to help quantify and monetise the benefit. For some benefits, it provides a structured approach to qualify the impact they may have.

The tool creates summary tables presented under both an Ecosystem Services (ESS) and Triple Bottom Line (TBL) framework. It automatically generates a series of graphs for use in reports. An Option Comparison Tool enables data from more than one ‘simulation’ of BeST to be copied and compared with the overall net present cost, benefit and value.

Figure A shows how the guidance links with the other components of BeST.

Benefit category	Monetised
Amenity	✓
Biodiversity and ecology	✓
Building temperature	✓
Carbon reduction and sequestration	✓
Crime	×
Economic growth	×
Education	✓
Enabling development	✓ / ×
Flexible infra./climate change adaptation	To be developed
Flooding	✓
Groundwater recharge	✓
Health	✓
Pumping wastewater	✓
Rainwater harvesting	✓
Recreation	✓
Tourism	×
Traffic calming	×
Treating wastewater	✓
Water quality	✓

Technical guidance content	What	Evaluation Tool	Option comparison Tool	User manual page	Suggested audience
1. Introduction	About evaluating benefits	✗	✗	5-7	Decision makers, clients, practitioners
2. When an assessment is required	Start using the tool	✓	✗	8-9	Clients, practitioners
3. Screening and qualitative assessment	Screen the impacts	✓	✗	10-12	Practitioners
4. Evaluating benefits	Evaluate the benefits	✓	✗	13-17	Practitioners
5. Summarising and presenting results	Present the results	✓	✓	18-20,22	Practitioners
6. Considering uncertainty and applying sensitivity	Consider sensitivity	✓	✗	21	Practitioners
7. Using the results	Using and comparing the results	✗	✗	n/a	Decision makers, clients, practitioners

Figure A How the guidance relates to the other components of BeST

CONTENTS

PURPOSE OF THE TECHNICAL GUIDANCE

Sustainable drainage systems (SuDS) provide a wide range of benefits to society and the environment. Considering these benefits, and valuing them often shows that they outweigh the costs, or provide greater overall value than a conventional solution. A key challenge in the UK is that the benefits are not well understood or explained. Benefits typically accrue because of the overall scheme rather than just individual components. The Benefits of SuDS Tool (BeST) is the first UK tool to help estimate the benefits of SuDS by helping to calculate a monetary value.

There are four parts to BeST:

- **W045a BeST –** Evaluation Tool (referred in the technical guidance as 'the tool' or BeST). *A structured spreadsheet tool that estimates a wide range of benefits linked with SuDS based upon the values and decisions made by the user;*
- **W045b BeST –** Option Comparison Tool. *A summary spreadsheet that creates graphs and compares options where more than one option is 'run' through the Evaluation tool.*
- **W045c BeST –** Technical Guidance (this document). *Provides background to the tool, data, and how to complete an assessment.*
- **W045d BeST –** User manual for the Evaluation and Options Comparison Tools. *Provides guidance of how to use the tool and quickly become familiar with its structure and functionality.*

This guidance document accompanies the tool. It is a key output of CIRIA Research Project RP993 'Demonstrating the Multiple Benefits of SuDS', the aim of which is to:

"*Develop an appropriate framework, methodology and accompanying guidance and tools that enables the wider benefits of SuDS to be determined*."

Any decision means considering the pros and cons associated with different courses of action. Decision makers must use the best evidence available to them, recognising that information will never be complete or perfect, and that we live in a world of uncertainty. Many decisions, including those around drainage infrastructure, have impacts for which there are no readily observable markets or price information. This results in overlooking these (typically social and environmental) impacts and implicitly assigning a zero value. Therefore the impacts of interventions on these areas (positive or negative) are subsequently excluded from the decision making process.

The purpose of this guidance is to support clients, decision makers and practitioners in using and interpreting the evaluation tool to help capture and consider a wide range of benefits related to SuDS (financial, social and environmental) in decision making around drainage infrastructure investments. Of course, decisions should, and will also take into account other relevant factors, such as equity and political considerations. This document provides detailed guidance to refer to when using the tool, including information needed to complete a benefit assessment, select values and avoid double counting. It is important to note that BeST does not provide design guidance. For SuDS design support, refer to C753 The SuDS Manual (Woods-Ballard et al, 2015).

The tool provide users with a practical means of assessing and, where feasible, valuing multiple benefits. It can therefore support broader decision making tools such as cost-benefit analysis (CBA) and is aimed at all those involved in planning, appraising, designing, funding and implementing SuDS in the UK. This includes water and sewerage companies, local authorities, regulators and developers.

When using BeST, read and refer to this guidance before and whilst assessing the benefits of SuDS.

1 AN INTRODUCTION TO ASSESSING THE BENEFITS OF SuDS

1.1 Background to the guidance

Sustainable drainage systems (SuDS), described in Box 1-1 provide various types of benefits. They can attenuate and treat surface water, reducing the risks of flooding and pollution downstream. They can provide an attractive environment that people value, support the economy and directly benefit wildlife. Additionally, they provide a flexible infrastructure which is better suited to adaptation at lower overall cost to future uncertainties (such as climate change) than conventional systems. SuDS have the ability to deliver these multiple benefits and others.

Box 1-1 Sustainable drainage systems

Sustainable drainage is a progression from the practice of draining sites using subsurface pipe and storage systems only conveying runoff below ground up to a fixed design capacity and controlling the rates of runoff discharged into receiving waterbodies. The SuDS philosophy has developed out of recognition that these conventional approaches have not protected waterbodies from degradation and also that runoff can itself provide society with a vital supply of water.

The SuDS approach uses natural hydrology as the baseline against which system performance is evaluated. SuDS aim to manage rainfall close to where it falls (at source); slow and attenuate runoff before it enters receiving waterbodies; allow water to soak into the ground and replenish soil moisture and groundwater levels; promote evapotranspiration; and filter and cleanse runoff of contaminants washed from the land surface. In many cases implementing drainage components that are on the surface (i.e. above ground), and will often incorporate vegetation and surrounding planting, as well as proprietary products will facilitate the delivery of SuDS.

Despite these benefits, the provision of SuDS in new development and retrofit situations remains limited and piecemeal. A key reason for this is an apparent or perceived lack of robust evidence to support a business case for implementation and supporting tools to help complete an initial evaluation of the benefits efficiently.

A project steering group including a range of water related stakeholders and disciplines (such as landscape architects, ecologists, drainage engineers) supported this project and helped to develop and test the guidance and tool.

1.2 Aim of BeST and supporting guidance

This guidance document and accompanying tool will help users to:

1. Undertake a more robust economic appraisal for different drainage options, supporting decision making for different stakeholders;
2. Adopt a robust, standard approach to assessing the benefits of SuDS that is open to scrutiny, increasing support from partner organisations;
3. Share information and improve engagement with other stakeholders;
4. Enhance transparency of benefits associated with SuDS, increasing potential for partnership working and shared funding opportunities; and
5. Improve understanding of who benefits and hence who may implement, manage, maintain and pay for drainage improvements.

1.3 How to use the guidance

This technical guidance provides knowledge and information to support the user complete an evaluation using BeST following a four-stage methodology. Figure 1-1 shows these four-stages and Section 1.6 describes them in detail.

Section 1 of this guidance provides an overview of the tool and its development. Sections 2 and 3 provide technical guidance for completing the first stages of the tool before detailed consideration of selected benefits. It is important to be familiar with these first three sections. Section 4 provides technical support behind each benefit in the tool. Use these as a resource as and when completing the applicable benefit sheet in BeST. Sections 5 to 7 provide supporting information for use after completing the assessment of individual benefits.

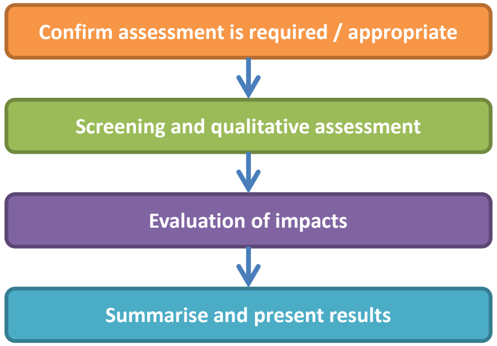


Figure 1-1 Summary of the tool's four stage methodology

This guidance document directly supports BeST. A short 'User Guide' is provided to accompany the tool, included at the end of this document. However, there are some important points to consider before using the tool to assess the benefits of SuDS.

1. A degree of **site specific information is required (section 1.9)** to complete the tool. The outputs are obviously dependent on the inputs provided, so the more data gathering, monitoring and modelling that has been done, the more robust will be the results.

2. Apply the tool **as early in the decision making process as possible**. This is most likely to be during the options appraisal stage, whilst opportunities to incorporate SuDS still exist and before decisions on whether SuDS, conventional drainage, or some combination is preferred. It may be that information and data needed to complete the assessment is not available or very limited at the options appraisal stage. In this case, the best approach may be to undertake a high-level assessment using the tool early on (with assumptions), and a fuller, more detailed assessment later on.

3. Apply the tool at the **largest possible spatial level**. Although it is possible to apply the tool at a scheme level (e.g. an individual development or a single street), many of the benefits (e.g. water quality, carbon) will only be realised as scale becomes more significant. Therefore, groups of SuDS components or schemes are likely to deliver proportionately greater benefits than individual SuDS components. When the scheme is small, consider the impact relative to the scale of investment.

4. Consider the **baseline situation and the proposed option(s) to assess**. In any economic assessment, it is crucial to understand what the situation would be in the absence of an intervention (SuDS or other), since it is the benefit of the intervention *over and above this situation* that needs to be assessed. In a retrofit situation, this is about comparing the option with the existing location. In new development, this is about comparing the performance (in its widest sense) of a SuDS option typically with a conventional drainage option. In a retrofit situation, this is about comparing the performance of a proposed option with what happens currently (the baseline). Where there are multiple options, run the tool more than once to compare them (e.g. SuDS or pipes only). Section 2.3 provides further guidance on identifying and specifying the baseline and the option(s) to assess.

5. **Be transparent**. The tool is not a 'black box' and we have provided information to support assumptions made and added references where appropriate. Transparency is therefore an important aspect of the tool in order to provide an audit trail and to build trust with stakeholders in understanding the results. The tool encourages recording any assumptions made and the confidence in both the information provided and the outputs.

6. Whilst the tool can, with appropriate input information, provide indicative values of the benefits of SuDS, it also allows the use of **site-specific, locally derived values to be used,** for example, from visitor surveys, local charges or water company willingness to pay (WTP) surveys. It is possible to add in these values in the 'values library' in the tool. In general, locally derived and site-specific quantities and values will provide a more accurate and robust assessment.

1.4 Structure of the guidance

Section 1: **Introduction** - This provides context and introduces the guidance and tool. It includes guidance on when to apply the tool, an overview of the methodology, how we have taken account of uncertainty, some guidance on double counting, an overview of how to use the guidance and sets out information requirements.

Section 2: **When is an assessment required** - relates to the decision making process and encourages a review of the context of the SuDS scheme proposed to ensure that an assessment using BeST is needed and appropriate.

Section 3: **Screening and qualitative assessment of benefits -** helps to screen the benefit categories to ensure a focused assessment on those areas where significant benefits are likely to occur. This helps to complete a qualitative assessment.

Section 4: **Evaluating the benefits –** is a key part of the guidance since it helps to quantify and value those benefits of most significance. It provides background to the sources of information, how to assess the impact and choosing appropriate confidence scores.

Section 5: **Summarising and presenting the results –** provides guidance on summarising and presenting the results.

Section 6: **Considering uncertainty and applying sensitivity analysis -** helps to identify key areas of uncertainty in the assessment and undertake appropriate sensitivity analysis.

Section 7: **Using the results -** provides guidance on using the results to inform and support decision-making.

1.5 Guidance on when to apply and use the tool

There may be many reasons for wanting to demonstrate the benefits of SuDS. However, the tool does not necessarily need to be applied if SuDS are a mandatory requirement or if they are cheaper (lower cost) compared to the alternative (e.g. conventional solution). The tool is designed to assess and capture additional benefits (i.e. those over and above the current situation, what would have happened anyway or the alternative).

The tool considers the outcomes resulting from the overall design, rather than the performance of, individual measures, in particular those related to flooding and water quality. Here the performance of the overall drainage design is important due to the interactions between different components (whether SuDS or conventional). C753 The SuDS Manual (Woods-Ballard et al, 2015) provides support to help design SuDS.

1.6 When and where to apply the tool?

BeST can be applied at differing stages of the SuDS design and planning process, from strategic assessment to optioneering and implementation. However, its usefulness and effectiveness will be greater the earlier in the decision making process it is applied. The reason for this is that, once strategic planning or design decisions have been made, the type of option (decision alternatives) to assess and compare becomes more limited (see Box1-2).

When applying the tool, it is likely that larger schemes (either geographically or those with the most SuDS components) will lead to the

> **Box 1-2 Options and schemes**
>
> An option is defined here as an alternative for meeting a set requirement. A scheme is a confirmed way of meeting the requirement and may consist of one or several options.

greatest benefits. Smaller schemes (e.g. street level) will generally deliver limited benefits (although it is still appropriate to assess such schemes as they may be beneficial if the costs of the scheme are also small). However, whilst the benefits from small schemes may be small, they may contribute to a larger set of benefits in the longer term as other schemes take place. In such situations, it may still be worth quantifying and valuing relevant benefits. In general, the level of effort used to complete the tool should be proportionate to the size and expected outcome of the scheme.

BeST can only provide an *indication* of the likely benefits associated with SuDS (or other drainage scheme). Where planning significant investment, or where a decision may be contentious, consider completing locally specific, bespoke analysis and surveys. Sections 5 and 7 provide further guidance on interpreting and using the results.

When using the tool, the number of assumptions to make will depend upon when applying it in the design process, the availability of information and the confidence in this information. If the hydraulic performance of the design is unknown and there is little knowledge of the site, then the assumptions made and the values obtained from the tool will be of limited value (although this can be accounted for through the use of confidence scores). Completing hydraulic designs along with character and aesthetic assessments will enable a more robust estimation of the benefits.

Recognise that our understanding of, and evidence relating to, the value of SuDS is constantly evolving. Therefore, the BeST tool and accompanying guidance will need to be periodically updated (e.g. as new valuation evidence emerges). See www.susdrain.org/resources/best for the latest versions.

1.7 Who should use the tool?

Users who complete the assessment may include those undertaking the design (for example drainage designers or landscape architects) or those wishing to make decisions based on an understanding of the economics of SuDS compared with a conventional approach (for example local authorities or other organisations looking to approve SuDS). This primarily includes those who are involved with or leading the drainage design and is likely to form part of a multi-disciplinary process involving:

- Drainage engineers
- SuDS designers / practitioners
- Master planners
- Flood risk managers
- Landscape architects
- Ecologists
- Engineers
- Economists
- Planners

Practitioners using the tool do not need to be experts in each benefit area. This technical guidance and the user manual provides support to complete an initial assessment. However, where assessed benefits are significant, further evidence may be required. This may require support from practitioners working within specific disciplines related to SuDS design and resultant benefits.

1.8 What the tool can and cannot do?

The output from the tool will give an initial evaluation of the wider benefits of SuDS over a specified period and area. Where a more detailed understanding of certain benefits is important, the tool can indicate which categories may require more detailed assessment, using local surveyed data and more specific information.

The tool enables the comparison of different options whether using SuDS, conventional drainage or any base case. Apply the tool in the context of a new development or retrofit where:

- New development enables a conventional drainage design to be compared with a SuDS design of similar scope and purpose (see Box 1-3).
- Redevelopment / retrofit enables a base case (existing) to be compared with the benefits that may arise from a SuDS design or strategy.

Box 1-3 Selecting benefits

Carefully consider the benefits to assess, as some conventionally drained sites may still have other above ground non-drainage components and design (e.g. trees, parks), that may provide similar benefits to SuDS but were not designed to intercept and manage water in the same way.

The tool enables one comparison with the "base case" at a time. For example, to assess two different retrofit SuDS strategies, 'run' the tool twice to see the change in potential benefits compared with the existing base case. This clearly, requires a degree of effort to develop or acquire information to inform the base case and support the subsequent assessment. This section discusses in more detail the information requirements.

The tool requires the user to have knowledge of the location and the proposals, and assumes that the SuDS design and performance is appropriate for what is required or stipulated. CIRIA's SuDS Manual (Woods-Ballard et al, 2015) provides guidance to support the design. The tool requires the user to think and consider how to apply their specific design proposals and location within the tool. This along with understanding

Table 1-1 At-a-glance summary of what the tool and guidance can and cannot do

Can do	Can't do
✓ **Play a valuable role as a decision support tool - informing decision makers of the potential benefits of different courses of action**	× Account for every individual site-specific nuance or context. It requires the user to think how to enter their site or catchment information into the tool.
✓ **Estimate monetary value of benefits based upon information provided by the user**	× Estimate the benefits without user input to translate the context of the scheme into the framework of the tool
✓ **For new development compare the benefits of a SuDS option with a conventionally drained option**	× Provide great accuracy without local evaluation or similar scoping studies being undertaken
✓ **For retrofit compare an option against the existing baseline**	× Indicate benefits without some form of drainage design and performance assessment
✓ **Provide support to help evaluate some benefits in a simplified manner**	× Be a design tool or decision making tool and say which SuDS to use and how chosen drainage will specifically perform
✓ **Investigate the impact of uncertainty in the values being used and applied**	× Provide a detailed distributional analysis of benefits
✓ **Provide summaries, graphs and comparisons (if more than one option considered)**	× Guarantee that the benefits indicated by the tool will be delivered in practice
✓ **Provide an indication of the kinds of benefits that are likely to occur from a given drainage scheme**	× Guarantee that beneficiaries will want to (or are able to) support funding of SuDS
✓ **Provide an indication of which groups may benefit from a given drainage scheme**	× Determine the costs (capital, operational, whole-life) of the drainage scheme
✓ **Suggest where more detailed analysis or assessment of impacts may be needed**	× Eliminate any potential overlap between different benefits
✓ **Produce simple dataset and graphics to substantiate output information**	× Provide a full life-cycle assessment of all potential drainage solutions

the tool functionality and guidance enables the user to apply it to a wide number of cases. Table 1-1 summarises what the tool and guidance can and cannot do.

1.9 Overview of the methodology supporting the tool

Previous work (Ashley et al, 2013) explores the multiple benefits potentially offered by SuDS. Stakeholder engagement undertook in developing the tool captured their requirements and focused on those benefits likely to be of greatest significance.

As a result of this process, the tool includes two approaches to organise the benefits covered in the tool. The first is broadly in line with the ‘ecosystem services’ framework widely used for systematically understanding and assessing how changes in the environment affect people (see for example European Commission, 2013).

Ecosystem services are the benefits provided by ecosystems that contribute to making human life both possible and worth living (UK NEA, 2011). They are generally split into four categories:

- **Provisioning services** – goods or products that people consume or are used in the production of other goods. Examples include crops, fruits, fibre, timber, fish, natural medicine;
- **Regulating services** – benefits derived as a result of an ecosystem control of natural processes such as air quality maintenance, water quality and flows, pollination, flood protection, climate regulation and erosion control;
- **Cultural services** – non-material benefits such as recreation, spiritual values and aesthetic enjoyment; and
- **Supporting services** – natural processes that maintain the production of all other ecosystem services such as habitat provision, nutrient cycling, soil formation and water cycling.

The second approach to categorising benefits follows the three pillars of sustainability, sometimes described as the ‘Triple Bottom Line’ (TBL). This is essentially an accounting framework with three parts: social, environmental (or ecological) and financial. Together, these encompass the different aspects of the world from which humans derive well-being.

The tool displays the results using both the ecosystem services framework and a triple bottom line framework.

Table 1-2 shows the benefit categories in the tool, what the benefit covers, and if they can be monetised, along with the ecosystem service or triple bottom line category to which they predominantly relate.

SuDS may deliver other benefits that are not included here. Currently, BeST only includes benefit categories where there is a reasonable amount of evidence and data relating them to SuDS. The tool does however allow other benefits to be added in (through the use of ‘user defined’ benefit categories or directly in the values library for impacts included) and additional categories may be included in future versions of BeST if and when sufficient evidence becomes available.

Whilst most impacts of SuDS will be positive (i.e. benefits), some (e.g. noise and disruption caused by construction and maintenance) may be negative (i.e. costs). Such negative benefits can be captured in the tool. They can be considered as ‘non-financial costs’ and are separate from ‘financial costs’, which are discussed in Section 5.3.1 and which should be added to the ‘Project Inputs’ sheet of the tool.

Before assessing and valuing the benefits of SuDS, it is important to understand the links between different SuDS components (or groups of components) and each benefit category. A series of impact pathways developed following government guidance (Defra, 2007a), set out these links to allow users to develop quantitative estimates of benefits in each category of relevance to a SuDS scheme.

Figure 1-2 contains an overview of the impact pathway approach that looks at the links between ecosystems and the provision of services and how these services contribute to human welfare in in the case of SuDS.

Figure 1-2 Overview of impact pathway approach (source: adopted from Defra, 2007a)

The tool uses a tiered approach, ensuring that the effort and resources needed to complete an assessment is proportionate to the nature of the decision required (see Section 2.1) and the scale of expected benefits. In practice, this means screening benefits at an early stage to assess only those likely to generate significant benefits in detail.

Economists have derived different ways of seeking to value the impacts of interventions on human welfare where no readily available market data exists (see for example Defra, 2007a). Monetary valuation of benefits in BeST is based on a range of market and non-market approaches using best available evidence. The main valuation approach adopted is that of adjusted 'value transfer'. This is a widely recognised, cost-effective method for taking values from existing studies (including WTP type studies, see Box 1-4) and applying them, generally adjusted for different circumstances, characteristics, inflation, etc, to a new study site..

Government guidelines set out a number of steps for the use of value transfer in appraisal (eftec, 2009). The guidelines include a number of criteria for selecting appropriate valuation evidence and applying this to a study site. In summary, the original and the study site should be similar in terms of:

i. The good (benefit) or goods being valued (e.g. physical characteristics and the types of value derived);
ii. The change in the provision of the good (e.g. nature, direction, timing, scale);
iii. Location (e.g. proximity to populations and substitutes/complements);
iv. The affected populations (e.g. type of user, socio-economic characteristics);
v. Number and quality of substitutes; and
vi. Market constructs (e.g. property rights, institutional and social context).

Box 1-4 Water company WTP studies

Water companies have recently undertaken WTP studies to inform investment planning for the 2015-2020 price review period. The results could potentially be used for valuing some of the benefits of SuDS and are cited as potential sources of value estimates for several categories. There are some important issues to be aware of when using water company studies though as the resultant valuations are more specific to the circumstances in which they were derived than other values (eftec, 2014). They apply to customers in the water company's region, so take care when applying to different populations. They are generally for water company-specific measures that water companies can only deliver. They typically assess WTP for a general improvement for example, in freshwater environments rather than for a specific improvement in a catchment. Nevertheless, given the important role of water companies in promoting and delivering SuDS, it is important that values derived from company WTP surveys are not excluded from consideration.

Table 1-2 Benefit categories included in the tool

Benefit category	What it covers	Ability* to monetise?	Ecosystem service category	Triple Bottom Line category
Air quality	Impact on health from air pollution	✓	Regulating	Social/ Environmental
Amenity	Attractiveness & desirability of area	✓	Cultural	Social/ Environmental
Biodiversity and ecology	Sites of ecological value	✓	Supporting	Environmental
Building temperature	Cooling (summer) or insulation (winter)	✓	Regulating	Financial/ Social
Carbon reduction and sequestration	Operational (reduced energy use), embodied (reduced water use), sequestration (planting)	✓	Regulating	Environmental
Crime	Crimes against property or people	×	Provisioning/ Cultural	Financial/ Social
Economic growth	Business, jobs, productivity	×	Provisioning	Financial
Education	Enhanced educational opportunities	✓	Cultural	Social
Enabling development	Headroom for housing/other growth	✓ / ×	Provisioning	Financial/ Social
Flexible infrastructure/ climate change adaptation	Improved ability to make incremental changes to systems (no regrets)	×	Provisioning	Financial
Flooding	Damage to property/ people	✓	Regulating/ Cultural	Financial/ Social
Groundwater recharge	Improved water availability or quality	✓	Provisioning/ Regulating	Financial/ Environmental
Health	Physical, emotional, mental health benefits from recreation and aesthetics	✓	Cultural	Social
Pumping wastewater	Reduced flows to works	✓	Provisioning	Financial/ Social
Rainwater harvesting	Reduced flows, pollution or mains consumption	✓	Provisioning	Financial
Recreation	Involvement in specific recreational activities	✓	Cultural	Social
Tourism	Attractiveness of tourist sites	×	Provisioning	Financial
Traffic calming	Risk of road accidents or street-based recreation opportunities	×	Cultural	Social
Treating wastewater	Reduced volume to treat from combined systems	✓	Provisioning	Financial/ Social
Water quality	Surface water quality improvements to aesthetics, health, biodiversity, etc	✓	Regulating/ Cultural	Environmental

* Note that BeST enables the user to enter a lump sum or present value if information becomes available or a detailed study is undertaken for the benefits marked with a cross in this column.

The guidelines recognize that these criteria will rarely be fully satisfied and information on many of the criteria (e.g. substitutes) may not be available in an original study. They therefore propose that many differences between the original site and the proposed study site can be accounted for through the use of the adjusted transfer approach adopted here

A review assessed over 500 values from more than 100 existing valuation studies of potential relevance to SuDS in the UK, screening against the criteria described above. The literature review completed as part of this project (Ashley et al, 2013) provides further detail on sources of values (e.g. www.evri.ca). Accompanying this is a separate spreadsheet that includes details of the monetary evidence reviewed (www.susdrain.org/resources/best). Whilst many of these are not appropriate for inclusion in the tool (e.g. because of age of the study, location or context), the process produced a dataset of relevant and transferable values covering each benefit category and a variety of different contexts.

The 'Values Library' in the tool contains values assessed as appropriate to use. Most benefits can also add a 'user-defined' value in this worksheet. Wherever possible, the values contain a low, central and high estimate, although where this information was not available, it is highlighted as *not defined*. Section 4 of this guidance includes details of the values recommended and how they should be used. In each category, select only one value (low and high values from the same source can be used in more detailed sensitivity analysis (see Section 6.3) where available).

In short, the approach to valuation adopted in the tool is line with good practice, as well as with government appraisal guidance (HM Treasury, 2013) and consistent with other approaches in the water sector (Environment Agency, 2013b).

'Value' is defined in economic assessments as the amount of benefit that is derived from a change (improvement or reduction) in a given good or service, aggregated over the relevant beneficiary population. It is generally calculated by determining the maximum amount of money an individual is willing and able to pay for the good or service. It is not necessarily the same as market price, which is the price that is actually paid, although price is often used as an indicator of value for market goods.

Measuring economic value (see Box 1-5) is difficult and requires information on the demand for a good or service. In addition, economic value should exclude transfer payments (e.g. subsidies), which are simply transfer money between one group and another. Values should also take account of age, wear and tear, etc, rather than be based simply on current market prices for replacement. We have sought to ensure that, as far as possible, the values we have selected for inclusion in the tool are consistent with these principles of economic valuation.

Box 1-5 Economic or financial benefits?

Economic and financial analyses have similar features, in that both seek to measure the impacts (benefits and costs) of a (drainage or SuDS) scheme. The key difference is that financial analysis include only the costs and benefits to specific organisations (internal impacts), whilst economic analysis considers the costs and benefits to the wider economy or to society as a whole (external impacts). Wherever possible, the benefit categories considered in BeST are based on economic analysis. Even where this is not possible (e.g. pumping wastewater), any external impacts (e.g. carbon) are still explicitly considered and included. This means that BeST is able to provide a societal perspective, incorporating impacts that affect the welfare of all those impacted by SuDS schemes.

Once benefits have been assessed in all categories, they can be aggregated. To ensure consistency in the monetized benefits assessed, those occurring in the future should be discounted. Discounting is based on the principle that more importance is placed on benefits that occur now than those that arise in the future, although be aware that benefits from SuDS may arise over time (Box 1-6). Note that inflation related to future benefits can be ignored, since in economic appraisal the valuation of costs or benefits should be expressed in 'real terms' or 'constant prices' (i.e. at 'today's' price level) (HM Treasury, 2013).

Box 1-6 When benefits accrue

Some benefits from SuDS are likely to be immediate, whilst others may accrue only after a certain amount of time. In addition, benefits may have different 'profiles', i.e. how they increase or decrease over time. These timing aspects, and how they are accounted for in BeST, are discussed further in Section 4.2.

For all public policy related economic appraisals, use the standard discount rate set by the Treasury. Currently, this is 3.5%. For long-term projects (over 30 years), the discount rate actually declines gradually. The user can adapt the tool to allow for this in the 'Present Value Calcs' sheet, as outlined in HM Treasury (2013). The discount rate applicable in the private sector, however, may be different. In the water sector, the 'weighted average cost of capital' (WACC) is set by the financial regulator and water companies will apply this in developing their future investment plans. The WACC is used to calculate the revenue required by companies to provide a return to investors. The level of the WACC has a large effect on customer bills (a 1% change in the WACC would change bills by around £20 a year per customer).

There are some important implications of discounting in the analysis of environmental and social benefits. The higher the discount rate used, the lower the importance placed on future costs and benefits. At any positive discount rate, benefits that accrue more than 50 years into the future will have a very small present value. At a rate of 3.5%, benefits occurring in 25 years will have only 42% of the value of those occurring today. Hence, schemes with benefits occurring well into the future are less likely to be favoured than those with near-term benefits.

The decision rules used in economic appraisal are based on the concept of economic efficiency. A proposed action is deemed cost beneficial or to provide efficient allocation of resources (and is therefore justified) if the discounted benefits of the action are greater than the discounted costs. When comparing costs and benefits, consider including those benefits valued in economic terms and those assessed in qualitative or other quantitative terms. The most commonly used decision criteria in economic analysis are:

- *Net Present Value* (NPV): used at a policy or project level to identify the optimal solution out of a set of mutually exclusive options; and
- the *Benefit-Cost Ratio* (BCR): used at the programme/project level to determine whether or not an option is justified and which can also be used to determine the best allocation of limited funds amongst a set of competing projects.

Table 1-3 describes the four stage methodology adopted in developing BeST and Figure 1-3 shows this diagrammatically.

Table 1-3 The tool's four stage methodology

Purpose	Summary
1. Confirm assessment is required and appropriate	This sets out the reasons for undertaking and key drivers of the assessment. It also provides the baseline (see Section 2.4) and ensures the option(s) to be assessed are suitably understood and specified. *Users should confirm an assessment is required and appropriate before using the tool.*
2. Screening and qualitative assessment*	This establishes the type, size and scale of SuDS to be built and the temporal and spatial scale of the assessment. It identifies what the likely benefits will be and provides an indication of their potential significance.
3. Evaluation of benefits*	This helps to quantify and monetise the most significant benefits of the SuDS, taking account of scale, location, timing, etc. Non-monetised benefits are also recorded.
4. Summarise and present results	Here, the results of the assessment are drawn together across different benefit categories and over time. Sensitivity analysis is also undertaken.

* The tool allows the user to enter benefits and values collected from studies not included in the tool. Therefore, if site specific values and estimates are available to support the assessment, use these during stages 2 and 3.

1.10 Considering uncertainty and applying confidence scores

The tool and guidance provides valuable support for decision making around drainage infrastructure. They will enable users to consistently and systematically identify and assess the multiple benefits of SuDS. However, there will be inherent uncertainties in any assessment of this kind (Box 1-7). Of course, such uncertainty is not limited to SuDS and is likely to apply equally to other forms of drainage infrastructure. The principal sources of uncertainty relate to:

1. **Physical data** – the dimensions and attributes of the SuDS and related impacted systems, such as receiving water bodies.
2. **Construction and decommissioning (temporary impacts)** – e.g. relating to periods of disruption and for which there may be negative benefits (i.e. costs).
3. **Operational performance** – including how well the SuDS manage surface water flows and deliver the expected outcomes.
4. **Valuation of costs and benefits** – including robustness of cost and benefit estimates.
5. **Changes over time** – including those due to climate, growth, future investments in infrastructure and the profile of benefits delivered over time.
6. **Perspectives of users and decision makers** – preconceived or established professional practices can inhibit and introduce bias into their decision making.

Box 1-7 Considering uncertainty

Given the uncertainties involved, it is important to note that the tool provides an *indication* of the benefits associated with SuDS (or other drainage scheme). Where planning significant investment, or where a decision may be contentious, a locally specific, bespoke analysis may be more appropriate.

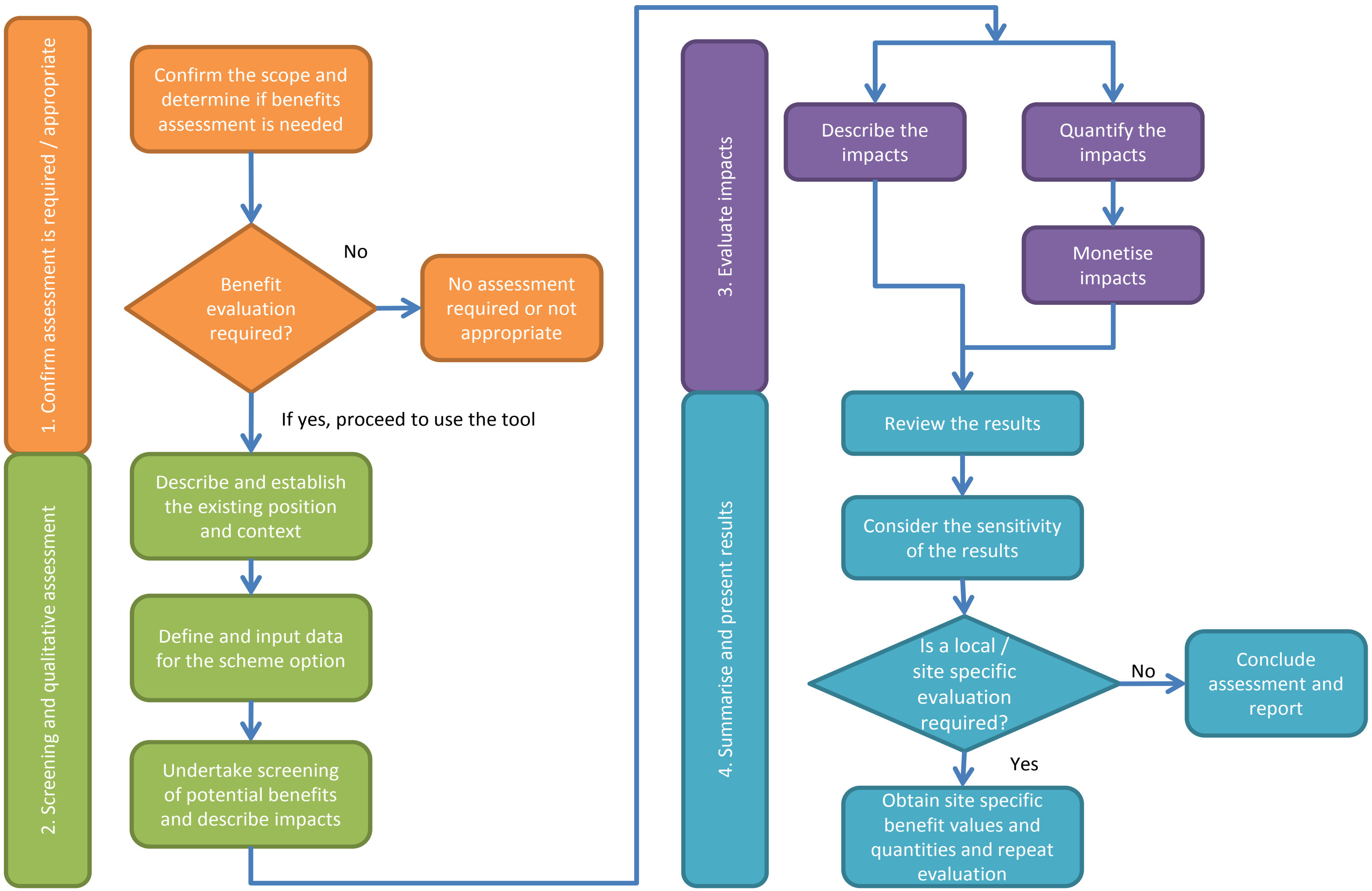


Figure 1-3 Diagrammatic overview of methodology

The tool considers uncertainties through the application of a simple user defined estimate of confidence. This confidence score approach is built into the tool, and follows a number of standard approaches. It considers and accounts for the two key aspects of potential uncertainty in the tool:

- The quantified performance data, i.e. for the outcomes of whatever option is under consideration, e.g. numbers of properties for which flooding has been reduced or avoided; and
- Monetising these outcomes, e.g. how to assign monetary values to reduce flooding.

For each of these, the tool asks the user to apply a confidence score of 25%, 50%, 75% or 100%. Section 4 provides guidance on selecting an appropriate confidence score under each benefit category.

Optimism bias can apply to benefits or costs, i.e. benefits can be overstated and costs understated. In relation to benefits, the potential for optimism bias is minimised in BeST through the use of a robust methodology, the screening process (so only assessing benefits where they are expected to be significant), a conservative approach to quantification and valuation, and using confidence scores. In relation to costs, Section 5.3.1 discusses optimism bias.

Another important aspect to consider in relation to uncertainty is that *valuation is not static*. The benefits of SuDS will change over time for a number of reasons, including:

- the degree of scarcity associated with each benefit category (e.g. the availability of and access to green space in the area);
- seasonality/weather;
- changes in population (the number of beneficiaries); and
- the degree to which SuDS, or the land on which they are cited, is properly maintained and how they subsequently perform.

Values will also vary across space, since SuDS and the benefits they deliver are sensitive to their location (catchment type, vicinity to populated areas, nature of adjacent or surrounding area, socio-demographic characteristics of the population, etc). In particular, there may be regional variations in values.

While attempting to account for these factors within the tool, for example through careful selection of monetary values, guidance on when/where to use different values and profiling of benefits, it is simply not possible to guarantee that an assessment of the benefits of SuDS will remain static over time or is transferable from one location to another. This requires the user to consider and provide reasons when selecting or using values throughout the tool. Further work during 2015/16 will provide further support in this area.

Supporting the approach to uncertainty outlined above is a sensitivity approach that enables the user to alter the confidence scores to determine their influence. Section 6 of this guidance provides greater information to this approach.

1.11 Avoiding double counting of benefits

There are two potential sources of double counting in an economic assessment:

- overlap between benefit categories; and
- using benefits transfer values that include more than just the specific benefit being valued.

The tool considers the first type of double counting in selecting the categories as shown in Figure 1-4 and on the ‘Potential double counting’ sheet in the tool. Although this cannot identify all potential sources of double counting, use this as a guide to indicate where there is a risk of double counting of benefits. Where it highlights a risk of double counting across different impact categories consult the relevant parts of this guidance and take special care to check that this risk is avoided or minimised. Note that whilst this highlights the risk of double counting, it may still be the case that impacts do indeed exist in more than one of the categories highlighted in red and therefore should be assessed. For this reason, we have not blocked the assessment of multiple benefit categories in the tool.

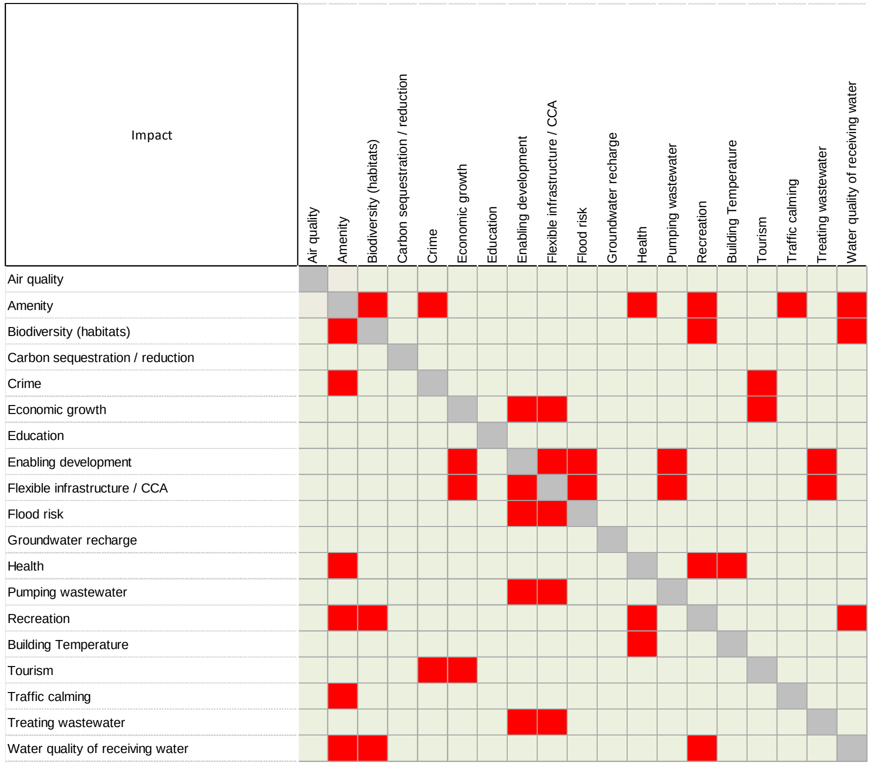


Figure 1-4 Potential for double counting between categories

It is possible to consider the potential overestimation of benefits due to double counting when reviewing the sensitivity of results (see Section 6.3). In addition, be careful not to attribute benefits to SuDS that are wholly or partly driven by non-SuDS measures (e.g. wider green infrastructure interventions). Only those benefits (or that proportion of benefits) that can be confidently attributed to SuDS should be included in the assessment.

This guidance addresses this second type of double counting with warnings and caveats provided for each benefit in Section 4 where there is significant potential to introduce double counting. It is important, therefore, to consider the implications of any assumptions made during the assessment, particularly when selecting the most appropriate monetary value.

1.12 Information requirements and sources

A wide range of data and information may be needed to complete a benefit assessment. This may include for example hydraulic modelling, flood risk assessment, environmental and health impact assessments, population and socio-economic data. This may require the input from a range of professionals, including ecologists, economists, engineers, architects, landscape architects, master planners or flood risk managers in lead local flood authorities designing SuDS for new development or retrofitting. Such a multi-disciplinary approach is likely to enhance the quality of an assessment.

In the first instance, wherever possible, BeST provides guidance and support to undertake an initial evaluation without discipline experts. However, where discipline experts and local assessment information are available, use them to provide data and information. Where the benefit estimation is a significant or important proportion of the overall benefits, consider undertaking a more detailed assessment of the impact and/or monetised value. Table 1-4 shows the minimum and preferred amounts and types of information for each benefit category.

Table 1-4 Example of information requirements for assessing benefits using BeST

Benefit category	Minimum	Preferred
Air quality	Size/type of green components in scheme such as the number of trees and green roofs	Local air quality study
Amenity	Number/type of homes and number of people impacted by scheme	Landscape character assessment or landscape visual impact assessment
Biodiversity and ecology	Change in size/type of green and blue space due to scheme	Biodiversity Action Plan or local habitat surveys
Building temperature	Area of green roof / number of trees	Energy management plan
Carbon sequestration	Number and type of trees	Carbon management plan
Crime	Non-expert qualitative estimation of potential impacts from scheme	Change in crime indices or deprivation levels
Economic growth	Non-expert qualitative estimation of potential impacts from scheme	Value added, job creation, productivity, investment
Education	Non-expert qualitative estimation of potential impacts from scheme	Number of children engaged or educational visits/talks
Enabling development	Avoided infrastructure costs	Local development plan, water cycle study or sewerage management plan
Flexible infrastructure / climate change adaptation	Non-expert qualitative estimation of potential impacts from scheme	Amount and timing of deferred capital investment
Flooding	Number of buildings or people impacted by the scheme	Flood risk assessment
Groundwater recharge	Volume of water infiltrating	Ground water study, water cycle study
Health	Number of homes and number of people impacted by scheme	Health management plan
Pumping wastewater	Change in energy use due to scheme	Pumped flows, pump run times, energy consumption
Rainwater harvesting	Number of properties, average people, consumption rates	Water demand / use study
Recreation	Change in level/type of recreation due to scheme	Open space provision assessments in Local Environmental Action Plans (LEAPs)
Tourism	Non-expert qualitative estimation of potential impacts from scheme	Number of additional visitors
Traffic calming	Non-expert qualitative estimation of potential impacts from scheme	Number of vehicle movements, traffic speed
Treating wastewater	Change in flows	WwTW assessment including chemical and energy usage
Water quality	Current and projected water quality status	UPM (Urban Pollution Management) modelling or similar Reason for Failure (RFF)

2 WHEN IS AN ASSESSMENT REQUIRED?

This section helps to identify whether an assessment using the tool is required and appropriate. By the end of this section, it will be clear whether to proceed or not. When undertaking an assessment, start by completing the 'Project Inputs', and 'Screening questions'. These sheets require important information to help assess the benefits.

2.1 Drivers and need for action

In conjunction with project partners, clients/funders and other key stakeholders, it is important to reflect on, agree and record why an assessment of the benefits of SuDS may be required. Some schemes are likely to be defined and designed to meet specific objectives, so the drivers will impact upon the benefits expected or derived. Table 2-1 sets out the most likely primary and secondary drivers of SuDS schemes, together with some examples. For any given SuDS scheme, more than one of these drivers is likely to be relevant.

Table 2-1 Examples of drivers for SuDS

Primary drivers	Example
Reduced costs	• Minimise/share costs (e.g. construction, infrastructure costs, connection charges) • Obtain financial support from partners/stakeholders • Reduce surface water charges
Flood risk management	• Surface Water Management Plan • Reduce flood risk to properties • Comply with EU Floods Directive
Pollution control	• Reduce combined sewer overflows or diffuse pollution • Comply with EU Water Framework Directive, Urban Wastewater Treatment Directive, revised EU Bathing Water Directive, Shellfish Directive • Comply with EU Groundwater Directive
Drainage capacity	• Increase headroom in sewerage systems • Reduce need to increase size of wastewater treatment works
Biodiversity	• Natura 2000 • Biodiversity Action Plans • SSSIs in favourable condition • National Indicator 197 improved biodiversity sites Support green infrastructure strategy

Secondary drivers	Example
Green growth	• Contribute to green economy • New jobs and skills • Support regeneration
Localism	• Obtain community support for drainage plans • Encourage local participation and education
Water availability	• Restoring sustainable abstraction • Reduce mains water demand • Recharge groundwater • Increase water available for use
Climate change	• Reduction of greenhouse gas emissions • Adaptation to impacts of climate change • Mitigate urban heat island effect

2.2 Deciding whether to complete an assessment

In some circumstances, SuDS either may be a statutory requirement or may be the cheapest option to meet the objectives set (e.g. Defra (2011a) and Committee on Climate Change (2012)). In such cases, a detailed assessment of the benefits is unlikely to be required, although it may help to identify alternative sources of funding or stakeholders to engage and work with. The exception to this may be where there is more than one way of achieving the desired outcome using SuDS. In such cases, an assessment of the benefits may be useful to identify which of these provides the greatest value. Where achieving the desired objective includes SuDS and/or conventional piped solutions, an assessment of the benefits can help inform the decision.

It is likely that the cost of delivering the desired outcome will be an important factor in making a decision, alongside information on the benefits. BeST does not estimate costs. It does enable the entry of whole life costs to allow for example to make cost-benefit calculations or make comparisons between different schemes. BeST includes a separate *'Comparison Tool'* to help compare the benefits of up to four options, which contains a number of automated graphs. See Section 5.3.1 for further information on costs.

2.3 Confirming baseline and proposed options

In any economic assessment, it is the marginal change in the relevant impact that must be estimated. To be able to estimate this, it is crucial to understand what the situation would be in the absence of a (SuDS or other) intervention, since it is the benefit of the intervention over and above this situation that needs to be assessed. In effect, this is a 'do-nothing' or baseline option and should also take account of any known changes to the baseline situation unrelated to the SuDS scheme.

The baseline situation may vary according whether the scheme involves retrofit, redevelopment or new development. Table 2-2 shows the recommended approach to specifying and comparing options, including the costs of options. In a retrofit situation, the baseline is the existing condition and performance of drainage in the area, or this may be a 'do-nothing' option. The 'proposed option' is a proposed drainage scheme that addresses one or more drivers. For new development, the baseline may be a conventional drainage scheme and the option is a SuDS proposal. For redevelopment or regeneration, it is possible to select either comparison approach depending upon what the user wishes to compare. In some situations, it may be appropriate compare present day or future performance, for example including changes to rainfall as a result of climate change. The case study in Box 2-1 shows a retrofit situation comparing a conventional solution with a variety of SuDS-type options.

When considering or comparing more than one option, it is important that the baseline remains the same within the tool. For example, in a retrofit situation, as in the case study in Box 2-1, the baseline is the current drainage performance and the options are alternative approaches to drain the catchment. In such cases, run the evaluation tool more than once to generate the benefits for each option.

Table 2-2 Recommended approach to completing the baseline and proposed case depending upon the scheme type

Scheme Type[a]	Case Type	Recommendation	Present Value (PV) Cost
Retrofit	Baseline	Consider the existing / current situation. This will enable a comparison with the 'proposed' option against the existing situation. For impacts which are not currently relevant to the site(s), leave these values blank.	No value entered.
	Proposed	Consider the drainage intervention proposed and the impacts it will have compared with the existing situation. This may be a conventional or SuDS[b] option[c].	Enter the PV cost for the scheme.
New development (greenfield)	Baseline	Consider the impact of a conventional drainage option here for the new development and record its impact.	Enter the PV cost for the conventional scheme.
	Proposed	Consider the impact of a SuDS drainage option here for the new development and record its impact.	Enter the PV cost for the SuDS scheme.
Redevelopment / regeneration	Baseline	Consider either the existing situation or a conventional drainage option.	Enter no value or the PV cost for the conventional scheme.
	Proposed	Consider the impact of any drainage option.	Enter the PV cost for the scheme.

[a] In a situation where there is a combination of scheme types, consider which is most applicable, or sub-divide the sites and repeat the assessment.
[b] This may be an option with a combination of SuDS and conventional drainage.
[c] This may be a proposed scheme, solution, project or study that describes a drainage intervention.

2.4 Dealing with scale

The design of the four-stage methodology described in Section 1.3 helps to target the level of effort required to undertake an assessment, so being proportionate to the significance of the expected outcome. In addition, the screening element of the tool (see Section 3) will help users to focus only on those areas where the benefits of SuDS are likely to be significant (i.e. material to the decision which needs to be made).

The consequence of this is that some benefits are only likely to be important above a certain scale. Assessments of SuDS schemes using BeST that are focused on small geographical areas, or in places where the impacts are unlikely to be felt by a small number of people, will not deliver large monetary benefits. However, always consider the size of the benefits relative to the size of the investment, so it may still be appropriate to assess the benefits of small schemes.

One issue that may be important in certain schemes is that of tipping points. It may be some schemes will be implemented in phased stages, and that as a result some benefits will only be realised, or become significant, once the scheme reaches a certain point. Take account of this using BeST by adjusting the timescales of the assessment (see Section 4.2 for more detail) - when the benefits start to accrue and when they end.

Box 2-1 Example of baseline and proposed case in BeST: Roundhay Park *(Courtesy of Yorkshire Water)*

At Roundhay Park in Leeds, Yorkshire Water undertook a study to assess a range of potential options that could address a primary driver, water quality issues. These included;

1. Conventional solutions

a) Install underground storage tanks to reduce probability of two combined sewer overflows from discharging to watercourses during rainfall (reducing potential for pollution).

b) Install storage at combined sewer overflows and strategically through the catchment to reduce flood risk to provide a similar level of performance as seen by reducing inflow to the combined system in options 2, 3, and 4.

2. Infiltration through SuDS

Large-scale infiltration, including SuDS in highways and rain gardens in residential properties.

3. Storage/conveyance through SuDS

Convey and store runoff from public space/commercial, through additional SuDS in highways/public open spaces (but no rain gardens in residential properties).

4. Storage/conveyance plus infiltration through SuDS

As above, but with addition of rain gardens in residential properties. This option therefore has the greatest number of SuDS components.

Each proposed option was compared with the baseline situation, i.e. the current drainage performance and the existing urban area.

3 SCREENING AND QUALITATIVE ASSESSMENT OF BENEFITS

Following a decision to proceed with an assessment of benefits, this section helps to identify which benefit categories to consider, using the 'Screening Questions' sheet. This sheet opens benefit assessment sheets based upon the choices made, indicates likely interested stakeholders and organisations, and where necessary, opens a 'SuDS Used' sheet.

3.1 Identifying significant benefit categories

For each of the benefit categories covered by the tool, decide whether there are likely to be significant benefits (or dis-benefits) arising from the scheme. Table 3-1 lists the benefit categories and the key question to answer affirmatively in order to proceed. To support this screening, the tool includes sub-questions. For most benefit categories, significant benefits are unlikely unless all of these can be answered affirmatively.

The tool asks the user to state the likely scale of the benefit. For each category, record whether the benefit is likely to be:

Significant positive	**++**
Minor positive	**+**
Not significant	**0**
Minor negative	**-**
Significant negative (i.e. large non-financial cost)	**--**
Unknown	**?**

When answering the questions in Table 3-1 affirmatively, provide some further description or qualitative response to support the answer. This is important in providing justification for the assessment that follows, and providing an audit trail.

After considering each category, decide whether to assess that benefit by selecting 'YES' in the 'Open impact sheet?' column. Typically this is where a significant (i.e. '++' or '- -') impact is expected. For most benefit categories, significant benefits are unlikely to occur unless the scheme is of a reasonable scale. However, for some categories (e.g. amenity) even a fairly small scheme could lead to significant benefits in the immediate or surrounding areas. Therefore when considering the size of the impact, keep the relative size and cost of the project in mind.

Selecting 'YES' in the 'Open impact sheet?' for each category, and pressing 'enable pages', the tool automatically opens up the relevant benefit category sheets in the tool.

Note that, if after deciding to assess a benefit, and then subsequently reversing this decision (for example due to the potential for double counting), it is important to remove the values in the benefit sheet. If not, the tool still carries these forward into the results.

Table 3-1: Using the screening questions to select benefit categories for assessment

Benefit category	Question	Generic sub questions to consider (not exhaustive)
Monetised benefits		
Air quality	Will the scheme significantly change the level of air pollution?	- Is the site in an air quality management area? - Will the scheme involve green infrastructure (e.g. tree planting, green roofs)? - Is the scheme in a populated area or a transport corridor?
Amenity	Will the scheme change the attractiveness or desirability of the place?	- Does the scheme involve new/improved water bodies, landscaping or greening? - Is the scheme in a populated area, or an area used for recreation, work, commuting, tourism, etc? - Will SuDS components be visible to those living nearby or passing by? - Could the scheme lead to inconvenience/disruption to residents or others (e.g. during construction or loss of car parking)?
Biodiversity and ecology	Will the scheme lead to a change in habitats for plants and animals?	- Will the scheme impact on a designated site (e.g. SSSI, SAC, SPA), Habitats of Principal Importance (BAP priority habitats), a site of local importance for nature, or a non-designated site of local or regional value? - Will the scheme involve SuDS components that may improve these sites, or create new sites?
Building temperature	Will the scheme change the potential for high temperatures in summer and cold temperatures in winter?	- Will the scheme involve green infrastructure (e.g. tree planting, green roofs) or water bodies providing evaporative cooling? - Is the scheme in a built-up area? - Will the planting provide shading and wind protection to properties?
Carbon sequestration	Will the scheme change the amount of carbon in the atmosphere?	- Will the scheme involve planting (including trees) over and above that which would occur without the scheme? - Will the scheme involve new planting (including trees) rather than replacement?
Education	Will the scheme lead to greater awareness of water and surface water management?	- Could the scheme lead to an increase in number of children engaged about SuDS/drainage and their role in the environment, whilst supporting the science curriculum? - Could the scheme lead to improved awareness and more educational visits/talks? - Could the scheme lead to an increase in the number of community events or open days?
Enabling development	Will scheme reduce demands on sewerage systems providing headroom for growth or development?	- Is population growth currently occurring or expected in the future? - Is drainage capacity in sewer system a barrier to this growth or development?

Benefit category	Question	Generic sub questions to consider (not exhaustive)
Monetised benefits		
Flooding	Will the scheme change the impact of flooding?	- Are there properties, buildings, areas or infrastructure (including transport) at risk of surface water flooding or flooding from sewers currently? - Is growth or climate change expected to change the risk of surface water flooding or flooding from sewers in the area? - Is the scheme expected to reduce local flood risk?
Groundwater recharge	Will the drainage / SuDS also increase infiltration into the ground?	- Is the scheme likely to increase the amount of infiltration to groundwater bodies? - Are groundwater bodies currently used for water abstraction, or expected to be used in the future?
Health	Will the drainage / SuDS also contribute to the health and wellbeing of local residents?	- Will the scheme involve green infrastructure (e.g. tree planting, green roofs)? - Could the scheme encourage residents or others to spend more time outdoors or participating in physical activity/exercise? - Could the scheme improve health by reducing the potential for high temperatures in summer and cold temperatures in winter?
Pumping Wastewater	Will scheme change the demands on pumping stations?	- Will the scheme lead to a change in the amount of wastewater pumped? - Do proposed schemes require pumping stations to be added that increase energy use?
Rainwater harvesting	Will the scheme harvest water so that it can be put to other uses?	- Will the scheme include rain water harvesting that reduces water demand?
Recreation	Will the scheme change the available facilities for recreation and leisure?	- Is the site currently used for recreation (e.g. walking, fishing, sports - including water sports)? - Is the scheme expected to improve facilities or opportunities for recreation?
Treating wastewater	Will scheme change the demands on sewage treatment works?	- Will the scheme lead to a change in the amount of water treated? - Is the size of works large and complex enough to make a meaningful impact on treatment costs? - Does the works include pumping stations?
Water quality	Will the scheme change the water quality of rivers, lakes or the sea?	- Are there pollution or water quality issues in the area currently - Is there an associated risk with the type of land use? - Is growth or climate change expected to change risk of pollution or water quality in the area? - Is the scheme expected to reduce pollution or improve water quality?

Benefit category	Question	Generic sub questions to consider (not exhaustive)
Non-monetised benefits		
Crime	Will the scheme change the local environment and thereby contribute to a reduction in crime?	- Could the scheme provide a more pleasant environment that may help to reduce crime?
Economic growth	Will the scheme unlock barriers to economic growth or provide new employment and business opportunities?	- Could the scheme lead to new jobs or training opportunities (e.g. green economy)? - Could the scheme play a part in regeneration programmes, tourism or other types of economic development? - Could the scheme lead to more productive landscapes or food production?
Flexible infrastructure / CCA	Will the scheme enable the area to be more resilient and adaptable to future climate and societal changes?	- Is the scheme expected to defer or delay investment in piped systems or treatment works? - Will it create a more adaptable system resilient to future changes?
Tourism	Will the scheme contribute to increased tourism in the area?	- Could the scheme lead to increase in number of visitors? - Could the scheme lead to increase in quality of visitor experience?
Traffic calming	Will the scheme enable traffic calming measures to be introduced?	- Will the scheme include traffic calming components that could reduce risk of accidents, improve the liveability of the area or increase journey times?

3.2 Identifying beneficiaries and stakeholders

For many of the impact categories (e.g. amenity, recreation, health), it is necessary to estimate the number of beneficiaries associated with an improvement brought about by SuDS. In most cases, this ‘beneficiary population’ will be limited to those who will make use of or directly benefit from the improvement (e.g. those living adjacent to or overlooking the SuDS). In other cases (e.g. river/bathing water quality and biodiversity improvements), the beneficiary population may also include ‘non-users’, i.e. those who do not directly make use of the improvement but still derive some benefit from it.

In all categories, there will be different groups or organisations that are likely to benefit in different ways from SuDS. Some of these beneficiaries may be involved in funding or implementation, but in many cases there may be no apparent or straightforward rationale for linking funding, implementation, responsibility and benefits.

In general, economic analysis focuses on efficiency, and accepts the existing distribution of income and that which would prevail following the implementation of an ‘efficient’ project. Economic theory requires that, for an option to be cost-beneficial, it should result in a situation where those who would gain from an action would theoretically be able to compensate those who would lose, and the gainers would still be better off.

The tool focuses on *what* benefits can accrue as a result of using SuDS (or other drainage) approaches (including the population or number of people who benefit), rather than *the different stakeholder groups* to which the benefits accrue. It is however still important to consider any such distributional issues that arise in decision making.

Nevertheless, it is possible to provide a description of how to distribute benefits over different stakeholder groups. Table 3-2 provides examples of potentially interested stakeholders in the outcomes of building SuDS and potential funders and is built into the tool. BeST does not identify specific beneficiaries. In general, the beneficiaries of SuDS schemes tend to be local, whilst those typically funding the schemes tend to include a larger population (e.g. water company customers or council tax payers). However, specific groups will depend on the particular context and situation, which will vary from scheme to scheme and from place to place. BeST automatically indicates the potential stakeholder types or organisations to engage, based on the completed screening questions.

It is important to note that some of the benefits of SuDS are likely to be private benefits, i.e. they accrue only to specific groups or organisations. Examples of private benefits include household flood risk reduction and health benefits to recreational users. However, there are also likely to be public benefits arising from any SuDS scheme, e.g. mitigation of carbon emissions or reduced burden on the NHS due to health improvements. The exact allocation of public and private benefits will depend on and vary according to the organisations involved, and the tool therefore stops short of a fuller analysis in this area.

Where the distribution of benefits is of specific concern and/or the magnitude of its impact is large, further analysis may be warranted.

3.3 Completing the ‘’SuDS Used’ sheet

The SuDS Used’ sheet enables the user to enter information about certain types of SuDS. The tool uses this information to help estimate the nature and scale of some benefits within the tool. The ‘SuDS Used’ sheet opens automatically ‘following choices made in the *‘Screening questions’* sheet and then pressing the ‘Enable pages’ button.

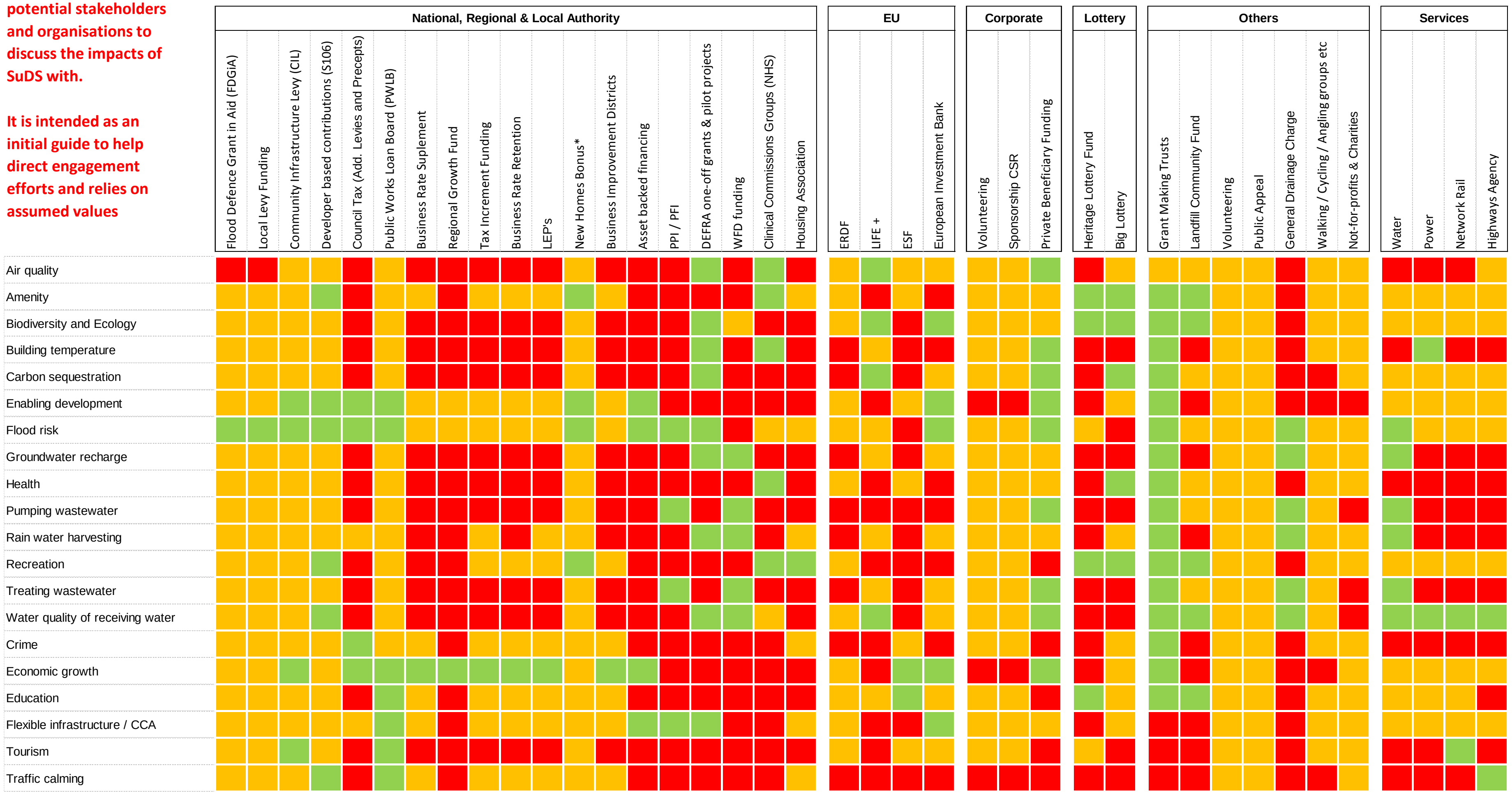
As the tool aims to qualify and quantify the outcome of the drainage scheme as a whole (rather than individual parts), the tool does not require information about all of the SuDS / drainage components. The ‘SuDS Used’ sheet allows the user to define areas or locations for ease of reference. This is to simply provide flexibility in recording SuDS if a design covers different areas with different types of SuDS. Note that when providing information on swales, the tool uses the width and length to calculate the area of swales.

Table 3-2: Potential of interested stakeholders and organisations

Strong potential - Benefit is a priority or qualifying criterion for this stakeholder	YES
Modest potential - Benefit is not a priority but may be linked to another which is	YES
Low potential - Benefit is not a specific priority or criterion	YES

This sheet indicates the potential stakeholders and organisations to discuss the impacts of SuDS with.

It is intended as an initial guide to help direct engagement efforts and relies on assumed values



4 EVALUATING THE BENEFITS

This section sets out, for each benefit category, the key issues and questions to consider for an estimate of benefits. Consider using this section as a reference when completing the applicable benefit sheet in the tool.

For each benefit category, the guidance summarises:

- **The impact pathway** – a simplified representation and example of the relationship between SuDS and outcomes in the benefit category that can be assessed;
- **The method of assessment** – how the tool makes the link between SuDS components and beneficial outcomes that can be assessed;
- **Quantifying benefits** – further details to help the assessor determine quantified estimates of change;
- **Monetary values** – details of the monetary values (see box 4-1) recommended for use in the assessment. In some categories, it is only appropriate to apply one monetary value (unless the values relate to different improvements which are both specifically included in the option);
- **Avoiding double counting** – guidance on the risks of and ways of avoiding double counting; and
  Confidence scores – guidance on selecting confidence scores for the quantitative estimate and the monetary value.

Box 4-1 Allowing for inflation

Note that these have been updated to 2014 prices to take account of inflation, using the government's GDP deflator, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/490867/GDP_Deflators_Qtrly_National_Accounts_December_2015_update.xls.

Application of the tool in future should update values used to the relevant base year in the "Values Library - Yearly Values" tab.

Section 4.1 sets out those benefits that are amenable to quantification and valuation. Section 4.2 outlines those more likely to assess in qualitative terms only.

4.1 Quantifying significant benefits and applying monetary values

4.1.1 Air quality

The impact pathway

A number of SuDS or green infrastructure components (e.g. trees, green roofs, green walls, swales, basins) can have a positive effect on local air quality, particularly in areas where air pollution is an existing problem (i.e. air quality management areas). They can absorb or remove certain pollutants, including nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulates (PM_{10}) and ozone (O_3), providing a number of benefits to people that live, visit or pass through the area, as shown in Figure 4-1.

Figure 4-1 Impact pathway for air quality

It is likely that air quality benefits will only accrue in large retrofit or redevelopment situations, or in schemes implemented incrementally over time (or where it is reasonable to consider this will happen). The extent to which SuDS components impact on air quality will depend on a range of local factors, including their positioning relative to other structures, land form and sources of pollutants, the nature, quantity and size of nearby buildings, and so on. To go into this detail will require a more in depth study completed outside of the tool, however apply the approaches here to give an initial estimate of the impact.

Method of assessment

BeST asks the user to estimate or report existing air quality parameters. Information to support this is available from the National Atmospheric Emissions Inventory (http://naei.defra.gov.uk/data/gis-mapping). This helps to indicate if there is a local air quality issue.

Where a completed air quality study is available, the 'annual pollutant removal estimates' can be input directly into cells in the 'Air quality' sheet (Section AQ1). As part of an air quality study, it may be appropriate to use more detailed analysis to estimate the impact, such as using "i-tree Eco" (Hambridge, 2014). If not, input information related to the SuDS components, e.g. area of green roof or number of trees (along with their expected size at full growth). Complete the remainder of section AQ2 selecting an appropriate 'pollutant removal level' and consider the location of the site (since the benefits of reduction in some air pollutants are greater in more built-up areas or where there is an air quality problem).

The assessment in this category is based on the following formula:

$$\begin{aligned}&\mathit{Reduction\ in\ pollution}\\&\qquad = \mathit{number\ of\ trees\ and\ area\ of\ vegative\ SuDS}\\&\qquad \times \mathit{average\ pollution\ remoavel\ level}\ (40\ \mathit{year\ average})\end{aligned}$$

The tool applies a 40 year average to simplify the calculation. In reality, pollutant removal levels increase over time and can be highly variable. However, as long as an evaluation period is greater than 50 years, then this is a reasonable approximation. The tool uses values for different tree size uptake from Western Washington and Oregon Community Tree Guide (McPherson et al, 2002) which shares similar climatic conditions to those seen in the UK. For more accurate pollutant removal estimates, undertake a bespoke assessment or use tools such as i-tree Eco (http://www.itreetools.org/eco).

Quantifying benefits

The quantified benefit is in terms of *change in level of pollutant (tonnes/year)*. The sources of information used to quantify benefits of SuDS components are shown in Table 4-1.

Table 4-1 Quantifying air quality benefits

Source	Air quality parameter	Av. annual pollutant uptake	Converted
Trees (small) (McPherson et al, 2002)	NO_2	0.08 lbs/tree	0.036288 kg/tree
	SO_2	0.03 lbs/tree	0.013608 kg/tree
	O_3	0.14 lbs/tree	0.063504 kg/tree
	PM-10	0.15 lbs/tree	0.06804 kg/tree
Trees (medium) (McPherson et al, 2002)	NO_2	0.17 lbs/tree	0.077112 kg/tree
	SO_2	0.07 lbs/tree	0.031752 kg/tree
	O_3	0.27 lbs/tree	0.122472 kg/tree
	PM-10	0.29 lbs/tree	0.131544 kg/tree
Trees (large) (McPherson et al, 2002)	NO_2	0.28 lbs/tree	0.127008 kg/tree
	SO_2	0.1 lbs/tree	0.04536 kg/tree
	O_3	0.43 lbs/tree	0.195048 kg/tree
	PM-10	0.45 lbs/tree	0.20412 kg/tree
Green roofs (US EPA, 2014)	NO_2	0.0004770 lbs/sqf	23.290 kg/ha
	SO_2	0.0004060 lbs/sqf	19.823 kg/ha
	O_3	0.0009200 lbs/sqf	44.919 kg/ha
	PM-10	0.0001330 lbs/sqf	6.494 kg/ha

Monetary values

All the values for air quality benefits come from the UK government's air quality economic assessment methodology (Defra, 2013). The tool embeds these values (based on the damage cost approach, i.e. damage to health avoided from reductions in air pollution) and estimates the present value automatically based on the quantitative estimates provided. Table 4-2 summarises these.

The government's methodology includes a number of values related to PM (particulate matter) air pollution. The tool and Table 4-2 includes some of those values related to transport. The tool defaults to using the PM transport average values which are typically conservative. It defaults to these since transport (e.g. roads) is likely to be the key driver of air pollution problems in areas where considering SuDS. However, other values for PM (e.g. relating to emissions from industry or waste) are available, as are values for transport within London or other urban conurbations (some of which are significantly higher than those in Table 4-2). If air quality impacts are likely to be significant for the scheme (the government guidance suggests a threshold of around £50 million), this will warrant a more detailed analysis of the impacts. If it is appropriate to use these different values, enter them in the user defined cell next to 'PM transport average' in the values library.

Table 4-2 Monetary values - air quality

Parameter	Value (2014 prices)			Units	Source	When to use
	Low	Central	High			
NO_2	802	1,029	1,169	£/tonne/yr	Defra 2013	Use range if impacts on NO2 are known
SO_2	1,422	1,760	2,000	£/tonne/yr	Defra 2013	Use range if impacts on SO2 are known
NH_4	1,657	2,125	2,415	£/tonne/yr	Defra 2013	Use range if impacts on NH4 are known
PM transport (average)	40,935	52,282	59,411	£/tonne/yr	Defra 2013	Use range if impacts on PM are known
PM transport (urban big)	73,683	94,109	106,942	£/tonne/yr	Defra 2013	Use range if impacts on PM are known
PM transport (urban large)	59,355	75810	86,147	£/tonne/yr	Defra 2013	Use range if impacts on PM are known
PM transport (urban medium)	46,665	59,602	67,730	£/tonne/yr	Defra 2013	Use range if impacts on PM are known
PM transport (urban small)	29,473	37,643	42,776	£/tonne/yr	Defra 2013	Use range if impacts on PM are known

Avoiding double counting

The monetary values provided by the government represent the total health benefits associated with air quality improvements arising from reduction in pollution. As such, they are specific to air pollution and are not expected to overlap with other benefit categories. The risk of double counting in this category is therefore considered to be *minimal*.

Confidence scores

The confidence score relating to the quantitative estimate will depend on the level of certainty in what the scheme will actually deliver in estimated air quality benefits. For example, if the vegetation/trees are in a location that is currently afflicted by air quality issues, and the area is used (heavily or frequently) by people that will see a noticeable change, select a higher confidence score (75%). If the area has a need to reduce pollution (e.g. Air Quality Management Area) and a local study identifies the performance of different tree types to remove pollutants, then a score of 100% is appropriate. On the other hand, if vegetation in the area is already plentiful, such that additional green infrastructure is unlikely to make much of a difference, or if the green infrastructure is dependent on other parties, therefore being less certain that a significant impact will occur, a lower confidence score may be appropriate.

Since the monetary values come from a reliable source and are based on actual market data, the confidence score for the monetary values is 100%.

4.1.2 Amenity

The impact pathway

A number of SuDS or green infrastructure components (e.g. ponds, swales, basins, trees) can have a positive effect on the attractiveness and desirability of an area, independently of other benefits. This in turn can improve the well-being of people that live or work in, or visit or pass through, the area, as Figure 4-2 shows. Amenity benefits can accrue in new build, retrofit or redevelopment situations and often relate to the pleasure derived from or the usefulness of components provided.

Figure 4-2 Impact pathway for amenity

NB Because of the risk of double counting in this category, when assessing and valuing amenity benefits be very cautious about also assessing benefits in other categories, particularly recreation, health, water quality and biodiversity (see 'Avoiding double counting' section below).

Method of assessment

The delivery of benefits in this category depends on the extent to which the SuDS will improve the attractiveness of the immediate area. Information to support the assessment may come from a landscape character assessment, a landscape visual impact assessment (LVIA), greenspace audit or survey. There will inevitably be some subjectivity in interpreting how much SuDS contribute and create a benefit. This is acceptable, but record any assumptions and be explicit about this.

Quantifying benefits

Begin the quantification process by considering the amount of SuDS components that the scheme will include, e.g. increased area of green space or number of trees. Consider the quality of the urban space being created compared with existing land for a retrofit situation. For new development, when completing the baseline, consider the likely design of the conventional drainage design which may have similar non-water management components (e.g. planting). Finally, estimate the number of beneficiaries, i.e. the number of residents (over 18) or households who are likely to see a noticeable improvement. To convert one to the other, assume that there are, on average, 1.85 adults per household in the UK. This is based on 2011 census data (ONS), which shows there are 63.2 million people in the UK, approximately 77.4% of whom are adults, and 26.4 million households.

Although there is limited evidence around benefits to workers/commuters and visitors from improvements to amenity, estimate the number of potential beneficiaries in these categories when expecting significant benefits to accrue to these groups. However, take care to avoid counting the same beneficiaries twice, so estimate the numbers of workers/commuters and visitors where they are *additional* to residents.

Base the assessment of beneficiaries on local knowledge and common sense. However, a good rule-of-thumb is to include those residents/workers either overlooking the feature or (to obtain a high/maximum estimate) those within a five minute walk (approximately 400m) of the feature.

Monetary values

There is a growing body of evidence to suggest that people enjoy and value changes to the landscape and visual character of an area that SuDS can provide. Table 4-3 includes the values selected drawn from studies that, whilst not related to SuDS specifically, are applicable to the kind of improvements brought about by SuDS in a UK context. They are generally based on either willingness-to-pay studies, or on 'hedonic pricing' studies, which model the impact on property or land values from enhancements to the local environment. Consider which of the values in Table 4-3 most closely matches the proposed works and record that value in the tool. For example, if a scheme involves green infrastructure with associated planting, use the numbers from the first row. If it includes a new, permanent body of water, use the values for 'new ponds'. If it includes park creation or enhancement that will lead to significant additional benefits (beyond those that would be enjoyed without any SuDS components), use the RICS (2007) figures. Further details around the context of these values are provided in the 'Values Library' within the tool. (Note that the RICS figures are not completely 'internally consistent', e.g. it could be expected that values for 'city park' to always be higher than 'local park' since green space is generally more scarce and has a higher premium in cities. However, this information is based on a robust study and is the best available.)

The original valuation studies cited here do not discuss the availability of substitute sites in detail, so the impact of substitute sites on the values presented is unknown. Therefore, where a number of potential substitute sites in the locality exist (e.g. streets are already green or there are existing ponds with amenity value), select the low value. Where few or no substitutes exist, the mid or high values will be more appropriate.

The values in Table 4-3 can also be applied to workers/commuters and regular visitors, but only if these are *additional* to residents.

If the value selected relates to house prices, investigate the average house price in the area. This information is readily available from house price tracker web sites. To increase robustness and reliability of results, consider identifying different types of affected homes (e.g. detached, terraced, flats) and apply appropriate average house prices to each of these.

Avoiding double counting

It is likely that the values shown in Table 4-3 cover a range of benefits associated with amenity/visual improvements arising from SuDS. In general, economic studies do not explore the reasons or motivations behind willingness-to-pay values and house price differentials. However, it is generally accepted that, apart from the additional satisfaction of living in/looking at a more attractive area, such values also capture elements of other benefits, including:

- recreation (e.g. improved access to or quality of recreational opportunities in the area);
- health (e.g. psychological or physical benefits);
- water quality (especially where SuDS include permanently 'wet' components or will improve the quality of existing watercourses); and
- biodiversity (e.g. increased appreciation of or access to nature).

Table 4-3 Monetary values - amenity improvements

Context	Value (2014 prices) Low	Mid	High	Units	Reference	Guidance on use
Street improvements including planting of trees and green verges.	1.72 (small trees)	1.98 (large trees)	2.46 (large trees and planting)	£/ resident/ month	Mell et al (2013)	Use for green infrastructure in streets. Be wary of combining with values for recreation, biodiversity or health
New ponds	5.93	11.56	19.75	£/ house-hold /month	Bastien et al (2011)	Use only where new pond(s) is (are) created. Be wary of combining with values for recreation, biodiversity, water quality or health
Park enhancement (homes <450m away)	**Flat**	**Non-detached**	**Detached**	% change in house prices	RICS (2007)	Use only where parks will be created or significantly enhanced in quality and there are homes within 450m. Be wary of combining with values for recreation, biodiversity or health
City park	7.54	2.93	19.97			
Local park	7.92	9.44	9.62			
Open space	4.70	0.44	2.71			

For these reasons, the risk of double counting in this category is considered to be *high*. Therefore, when valuing amenity benefits, only seek to assess and value benefits in the following categories where there is confidence there are truly additional benefits (or apply to different groups/populations).

- Recreation
- Water quality
- Traffic calming
- Biodiversity
- Health
- Crime
- Tourism

Confidence scores

The confidence score relating to the quantitative estimate will depend on the level of certainty of the SuDS actually delivering the estimated amenity benefits. For example, if the area is currently visually unattractive and the SuDS includes landscaping, new water bodies, etc, then a significant improvement in this category could be expected and select a higher confidence score (75%). Where a completed detailed assessment is available, such as a Landscape Character Assessment, then a value of

(100%) may be appropriate. On the other hand, if the area is already green/pleasant, such that additional SuDS components are unlikely to make much of a difference, or if the SuDS are dependent on other parties, then there may be less confidence that a significant impact will occur and a lower confidence score may be appropriate.

If the context of the monetary values is similar to the scheme (i.e. similar types of components and improvements expected), then select a higher confidence score for the monetary values (75% or 100%). If the context is very different (e.g. the scheme is in a mainly non-residential area) or the quality of the improvement is not considered to be as high as that referred to in Table 4.3 (e.g. the scheme involves some green infrastructure but not trees), select a lower confidence score for monetary values (25% or 50%).

4.1.3 Biodiversity and ecology

The impact pathway

There are a number of SuDS or green infrastructure components that can make a significant contribution to the biodiversity (ecological) value of an area (e.g. green roofs, ponds, swales, basins, wetlands, trees). Figure 4-3 shows the potential impact of SuDS on biodiversity.

Figure 4-3 Impact pathway for biodiversity

Method of assessment

Where possible, undertake an ecological assessment of the proposed scheme. This doesn't have to be detailed or expensive – a simple and quick walkover assessment by a suitably experienced ecologist should be adequate for identifying and assigning 'value' to existing habitats.

The tool contains a supporting table to help the user complete their assessment, capture their reasoning and evidence and input quantities and monetary values. Begin the biodiversity assessment by recording the existing land use, designated status and the dominant habitat types present. The tool includes drop-down menus for these categories. Whilst the tool does not use this information to calculate the value of biodiversity-related benefits, it is nevertheless important for maintaining a qualitative record of the benefits of the intervention and for capturing evidence to support decisions taken.

To keep the process of assessing impact of potential SuDS schemes on biodiversity as simple and consistent as possible, assess the ecological importance of existing and predicted habitats using an objective, rapid, proportionate and repeatable approach. The assessment approach references widely used classification systems to ensure consistency.

Designated status: Information on statutory designated sites of international or national value (e.g. SSSI, SAC, SPA, Ramsar) is available in the form of web-based data (www.magic.gov.uk), which provides accurate locations and descriptions of these sites. Sites with local or regional designations are more difficult to define in terms of their value. Although a site may have a regional or local designation (e.g. Sites of Interest for Nature Conservation (SINCs) and Local Nature Reserves (LNRs)), these are considered to be inconsistent between regions and areas (Environment Agency, 2009). For this reason if sites have such designations, consider their ecological value on a case-by-case basis, using expert judgement of a suitably experienced ecologist.

Dominant habitat types: There are two categories of habitat type provided in the Tool. The first category captures information on Habitats of Principal Importance (previously known as UK Biodiversity Action Plan priority habitats). Such habitats are considered to be of at least regional significance and are the most threatened habitats in the UK requiring conservation action. The drop-down menu in this category lists the most likely habitats to encounter, and others can be added from the 'NERC S41 habitats list' (http://jncc.defra.gov.uk/page-5706). There is standard, easily accessible data available on these habitats, via web-based data (www.magic.gov.uk).

The second category captures other, locally valued habitats, with the drop-down menu listing those most likely to encounter. Again, other habitats can be added as the user sees fit.

Non-designated habitats will vary greatly in their ecological importance (baseline) or ecological potential (scheme) and therefore require a suitable experienced ecologist (i.e. using professional judgement) to assess. If the input of an ecologist is not possible, Appendix 1 provides some simple guidance on the most common habitat types associated with urban areas and SuDS. Note that this appendix is not intended to be a fully comprehensive guide to habitats, but rather provides a photographic record of some of the typical habitats associated with SuDS and urban areas where SuDS may be planned.

The next step when using the tool is to select options relating to habitat *quality* and *connectivity*. These categories are more complex and are likely to require input from an ecologist:

Habitat quality: Determining the quality of habitats (in terms of their potential to support a diverse range of typical species) requires professional judgement by an ecologist. There is no simple or quick method of assessing quality, so unless a detailed ecological survey and interpretation of results is undertaken, any values applied to habitat quality are likely to be subjective.

Habitat connectivity: Connectivity with other similar or associated habitats influences the quality and functionality of a habitat. Connected habitats support migration of animals between suitable locations during times of environmental stress (e.g. flooding, pollution). For example, an isolated pond surrounded by pavements, roads or intensively managed amenity grassland, is likely to support far fewer species than a pond surrounded by semi-natural habitat (wildflower verges, open grassland, ditches, sensitively designed grass swales etc.).

Providing connectivity between habitats created/enhanced as part of a SuDS scheme and the surrounding landscape can add significant ecological value to the wider biodiversity within an area. However, assessing the quality of connected habitat and thus the ecological functionality of a SuDS component is complex and difficult to undertake without specialist ecological knowledge. Even with this expert knowledge, attributing monetary value to this is very difficult and there are no widely accepted methods of doing this.

Quantifying benefits

There are two sections available in the Biodiversity sheet: BE1 and BE2. Complete only one section:

BE1 – Complete this if a completed assessment of the present value benefit of the change in biodiversity and ecology exists. This section allows entry of other monetary values.

BE2 – this section allows the entry of *Basic* or *Detailed* information, before estimating monetary values. There are two separate tables available within the BE2 Tool – one for the baseline option and one for the proposed option. For new developments, complete both the baseline proposed option tables. For retrofit schemes, only complete the proposed option table.

For each table, enter one row for each type of habitat present within an area of the site. It is important to keep this categorisation of habitats as simple as possible, so record only the *dominant* habitat within a location.

Basic – Information can be found and inserted by a non-expert, using web-based data (MAGIC). This is the minimum data requirement in order to determine biodiversity gains/losses. Inputs include:

- Surrounding land use – this provides context e.g. a small pond constructed in an otherwise urban area is likely to provide more benefit than a small pond constructed in a very rural, semi-natural area.
- Designated status
- Dominant habitat type (Habitats of Principal Importance)
- Dominant habitat type (other, locally important habitats)
- Habitat connectivity
- Area of habitat (Hectares)

Detailed **–** As well as including the basic information, enter additional information to improve the certainty of the biodiversity assessment. This more detailed input data is likely to require some level of ecological expertise, as it will require more subjective assessments/decisions (professional judgement). The tool allows for the following extra information:

- Quality of habitat
- Additional information (a blank cell that provides flexibility to add additional text to describe the site)

Monetary values

Because of the intrinsic complexity of ecology, applying any monetary value is very difficult and research is still ongoing. However, the systematic review of the available monetary evidence (Appendix 3) indicates some useful work, and Table 4-4 shows the most appropriate monetary values. Since the tool only includes a limited set of values, the tool has further functionality within the values library to add in user-defined values that will appear in the tool if added. The 'inland marsh' 'high' value is only likely to be relevant to the creation or significant improvement of wetland habitats (e.g. ponds, reed beds, marshy grassland or ditches) *and* in cases where no similar habitats in the area currently exist. For dryer habitats (e.g. grassland or woodland) where water will not always be present, or where a number of similar habitat sites with biodiversity value already exist in the area, the 'low' value is more appropriate.

Because monetary values are not available for habitat ***quality*** or ***connectivity***, report these in non-monetary terms only.

Avoiding double counting

It is possible that values for biodiversity include elements of value partly covered by the amenity, recreation and water quality categories. This is because people derive a variety of benefits from 'green' or environmentally important places and find it hard to differentiate between their motives and reasons for enjoying such places. As a result, take care when combining valuation here with the amenity, recreation or water quality categories. Only undertake a valuation in more than one of these categories where the benefits derived would be truly additional.

Confidence scores

The confidence score for biodiversity relates to certainty of existing land use, reliability of data used to assess the baseline position and the expertise applied in predicting development or creation of new habitats.

Table 4-4 Values for biodiversity improvements

Context	Value (2014 prices)			Units	Reference	Guidance on use
	Low	Mid	High			
Inland marsh - willingness to pay for creation/ improvement of habitat	215	1,400	4,634	£ /ha / year	eftec (2010)	Only use mid or high value where wetlands, ponds or basins are created / improved
Mitigation and restoration costs of riparian buffers offering biodiversity protection		1,744		£/ha/yr	Environment Agency (2010)	Use where SuDS components will border watercourses and create or improve habitats.
Biodiversity preservation		24.74		£ / person/ yr	Nijkamp et al (2008)	Use where non-specific habitats with significant biodiversity benefits are created / improved

For example, if the area currently consists of only hard-standing areas or mono-culture amenity grassland, then it is appropriate to apply a higher level of confidence to the base position (e.g. 75% or 100% and then factoring the assessment type – see below). If however, existing habitat is present (for example unmanaged grass verges), then the confidence level is likely to depend upon the level of ecological expertise applied to the assessment. So, if an experienced ecologist is undertaking the assessment, then a higher level of confidence could be applied (75%-100%), whereas if this is done by a lay-person, a lower confidence level may need to be selected (50% or lower).

For the proposed scheme, ecological expertise will also affect the confidence level. So if an experienced ecologist is involved in the assessment and subsequent design of the SuDS, then a higher confidence level could be applied.

Given the limited set of monetary values available in this category, and the difficulty in relating these clearly and unambiguously to SuDS, it may be appropriate to attach a relatively low confidence score (50% or less) to the monetary value, especially where benefits in related categories (amenity, recreation and water quality) have also been assessed.

4.1.4 Building temperature

The impact pathway

Some SuDS components, particularly green roofs and trees, can moderate the temperature of buildings, helping to regulate thermal comfort by offering a shading/cooling effect in summer and insulation in winter. This can reduce the need for mechanical ventilation/air conditioning and reduce energy costs. For example, a 10% increase in tree canopy could reduce expected surface temperatures in the urban area by 2.5^{0}C (Gill et al, 2007). However, a review of available approaches indicated that assessing the general air temperature changes is difficult. If a detailed study is undertaken, then a ‘user defined’ benefit can be used to capture the monetary benefit (for example to health or a reduction in energy usage). This impact focuses on more local impacts on buildings using green roofs. Figure 4-4 shows a possible impact pathway.

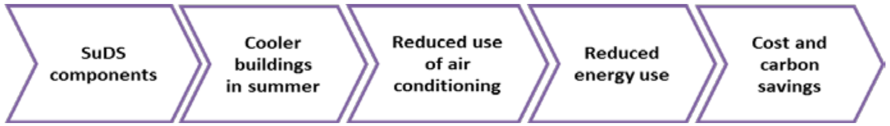


Figure 4-4 impact pathway for building temperature

Furthermore, the heating and cooling impact by trees on properties is highly variable as shown through various 'tree' guides in the US, depending upon the position of the tree, how far away from the house and type. Due to this level of complexity, and the individual relationship of one tree to a property, it has not been included for assessment at this stage.

Method of assessment

The tool supports two levels of assessment:

- BT1 – if an assessment is compete of the annual energy savings (Kw/year) for heating and cooling; and
- BT2 – provides support to estimate the impact of green roofs and trees on energy use in buildings.

BT1 calculates the benefits based on the Kw/year saved, the proportion of gas/electricity used (estimated by the user) and the associated carbon saving.

BT2 calculates the energy benefits through estimating the change in energy use provided by a green roof on properties, following the approach applied by CNT (2010). It is based on the number of heating or cooling degree days and the potential thermal properties of roofs using the following equation:

$$Energy\ reduction = \frac{Green\ roof\ area}{kWh\ to\ Btu} \times \left(\frac{dd \times 24}{R\ roof} - \frac{dd \times 24}{R\ green\ roof}\right)$$

Where:

- Btu = British Thermal Units
- kWh to Btu = conversion rate
- R = a measure of thermal resistance where R is assumed for (Clark et al, 2008):
  - conventional roofs = 0.585 m2 °C h / btu
  - green roofs R = 1.208 m2 °C h / btu
- dd = Degree days = heating or cooling degree days (in °C) and supporting information can be obtained from 77 UK Weather Stations (http://www.eci.ox.ac.uk/research/energy/degreedays.php) or other sites such as Degree Days (http://www.degreedays.net/. Note careful selection of sites is required regarding quality of data).

This approach considers that the existing roof has specific properties and may not be insulated to current standards or requirements.

Quantifying benefits

For green roofs, enter the green roof size for buildings using air conditioning (m^2) and the annual number of heating and cooling (using air conditioning) degree days. Enter the type of energy used (gas or electricity) and where unsure about the type of energy used, assume a 50:50 split between gas and electricity.

Monetary values

The tool automatically calculates the change in energy use based on the long-run variable costs (LRVC) of energy supply, rather than the retail price. Using the retail price would introduce distortions, since it includes fixed costs and transfers between groups in society. DECC (2013) provides LRVC estimates.

Select a fuel type, an energy tariff type (e.g. residential, industrial) and an energy rate (low, medium or high). An illustration of the LRVC (central estimate) for electricity and gas until 2030 is shown in Figure 4-5. The tool uses the 2030 rate for any future years beyond this period.

In addition, to estimate the value of carbon impacts associated with the change in energy use, select an appropriate traded price of carbon (low, central or high). Section 4.1.5 discussed the traded price of carbon further.

Avoiding double counting

The energy price projections provided by the government relate specifically to energy use and do not overlap with other benefit categories. The risk of double counting in this category is therefore considered to be *minimal*.

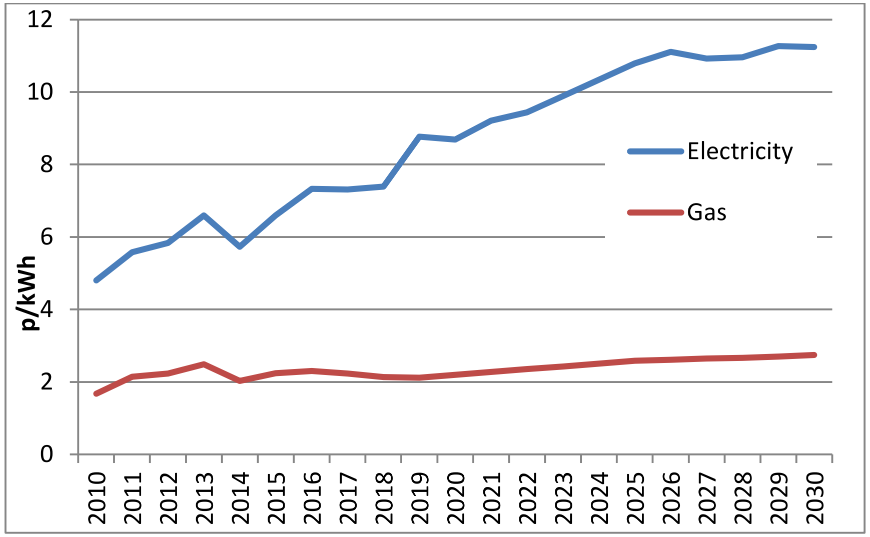


Figure 4-5 Long run variable costs of energy (source: Decc, 2013)

Confidence scores

The confidence score relating to the quantitative estimate will depend on the level of certainty that the scheme will actually deliver the estimated energy savings. If this has been modelled, select a higher confidence score (75 or 100%). If it based on estimates, then a lower confidence score may be appropriate.

Although the monetary values related to energy costs come from a reliable source and are based on actual market data, they are projections only and therefore a confidence score of 75% is suggested.

4.1.5 Carbon reduction and sequestration

The impact pathway

SuDS components can lead to a reduction and/or sequestration of carbon. Other categories cover the reduction of carbon and the associated methods of assessment, and include:

- Reduced surface water pumping, wastewater pumping/treatment, leading to reduced energy use and associated carbon emissions (NB: '*Pumping*' and '*Treating Wastewater*' categories consider such carbon benefits);
- Embodied carbon (avoided) as a result of reduced consumption (e.g. due to rainwater harvesting) (NB the '*Rainwater harvesting*' category considers carbon benefits); and
- Cooling/shading of buildings, leading to reduced energy use and associated carbon emissions (NB the '*Energy – building temperature'* category considers carbon benefits).

Carbon sequestration impacts include sequestration of carbon by newly planted trees and other vegetation. Figure 4-*6* shows a possible impact pathway for carbon sequestration.

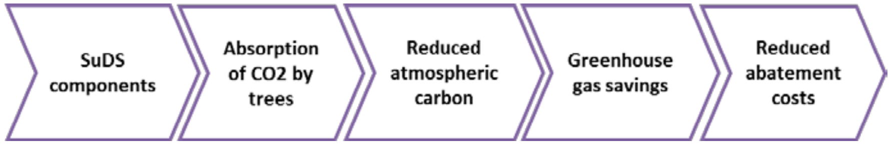


Figure 4-6 Impact pathway for carbon

It is important to note that, since the tool focuses on estimating the *benefits* of SuDS, it does not include or take account of the *costs* associated with carbon, such as those embodied in capital investment. These are generally included in carbon costing tools used widely by water companies and others.

Method of assessment

For carbon reduction, values are determined using Government data (HM Treasury, 2013) tables to convert energy avoided to carbon for example for gas and electricity using long run marginal emission factors

The SMUD Tree Benefits Estimator (SMUD, 2015) has been used to approximate the carbon sequestered for general tree types and size in an urban context over the life of the tree. The Tree Benefits Estimator, developed in the USA, estimates the benefits from trees including cooling and heating benefits to properties. For more information, see https://www.smud.org/en/residential/environment/shade-trees/benefit-estimator.htm. The values used in BeST are for carbon sequestration only. Apply these when planting additional trees specifically associated with the scheme (i.e. not including planting that would have occurred anyway). BeST allows the user to enter sequested carbon values after using such tools with specific tree details (SMUD, 2015) or use BeST direct to estimate the quantity .It uses four categories of tree types. These are:

- Deciduous – small e.g. Cockspur Thorn, Crab Apple
- Deciduous – medium e.g. Wild Cherry, Field Maple
- Deciduous – large e.g. Walnut, Horse Chestnut
- Conifer – large e.g. Yew, Scots Pine

Use the evaluation period to define the life of the tree, i.e. when they are planted and their expected life (which may be shorter that the scheme evaluation period).

Quantifying benefits

The amount of carbon reduced is automatically calculated. The user identifies the sector type that is most appropriate to the impact by the scheme in each case. Insert the number of trees planted for each tree type and the tool automatically calculates the amount of additional carbon sequestered per year using estimates from the SMUD tree estimator. When requiring a more detailed estimate, use tools such as i-tree eco.

Monetary values

According to UK government guidance on carbon valuation in policy appraisal (https://www.gov.uk/government/collections/carbon-valuation--2), changes in emissions in the traded sector (i.e. covered by the EU Emission Trading System (EU ETS)) should be valued at the **traded carbon price**, whereas changes in emissions in the non-traded sector (i.e. outside the EU ETS) should use the **non-traded carbon price**. Since reductions in carbon are generally associated with energy use, monetary values here are based on the traded price the. Sequestered carbon is based on the non-traded price. The traded and non-traded price of carbon is that which will enable the UK to drive sufficient abatement to meet the targets set out in the Climate Change Act (2008). Figure 4-7 shows the price of carbon over time (central estimate), with the traded price currently lower than the non-traded price. These converge by 2030 and increase steadily until late in the century.

The price of carbon is embedded into the tool with present value estimates calculated automatically using the quantitative estimates provided by the user.

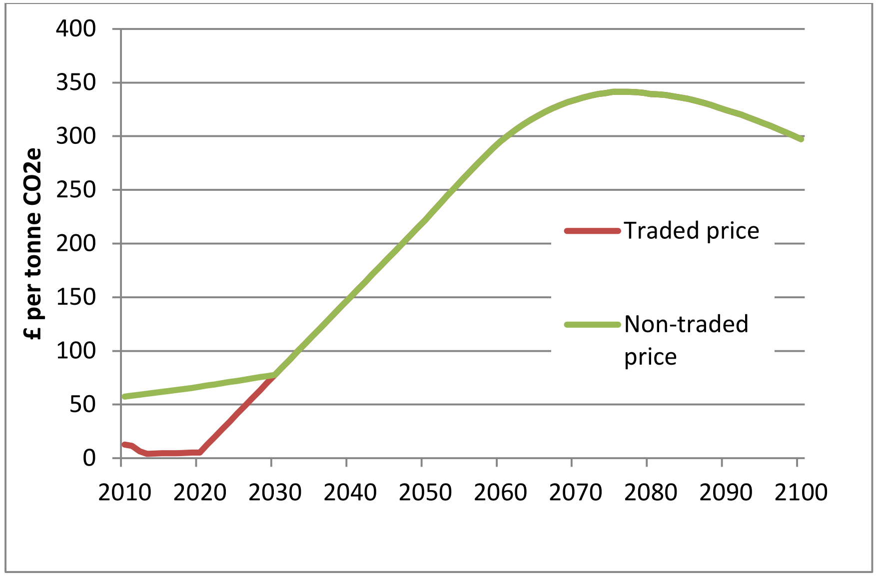


Figure 4-7 Price of carbon (source: Decc, 2013)

Avoiding double counting

The monetary values provided by the government represent the total value associated with changes to carbon emissions. As such, they are specific to carbon and are not expected to overlap with other benefit categories. The risk of double counting in this category is therefore considered to be *minimal*.

Confidence scores

When using this estimation for carbon sequestration of trees, consider using a confidence value of 50% to account for tree mortality and uncertainties related to the simplified approach for the number/type/sequestration potential of trees.

The monetary values come from a reliable source based on robust estimates of carbon abatement needed to meet UK reduction targets, apply a confidence score for the monetary values of 100%.

4.1.6 Education

The impact pathway

There is some limited evidence that SuDS can play a role in extending or enhancing educational opportunities, in schools or elsewhere. Figure 4-19 shows a potential impact pathway.

Figure 4-8 Impact pathway for education

Method of assessment

The assessment approach adopted here uses the number of additional nature-based school trips created by a SuDS scheme to the educational benefits provided by such trips. These trips can be to any location (within the school premises or externally) where learning about nature, SuDS and drainage plays a central role.

Quantifying benefits

To enable potential benefits in this category to be assessed, you should estimate the additional number of number-based school trips that will be created as a result of the scheme. Ideally, this will be based on local evidence, consultation with schools in the area or an evaluation study.

Table 4-5 Values for educational improvements

Context	Value (2014 prices)			Units	Reference	Guidance on use
	Low	Mid	High			
Cost of investing in nature-based school trips	15.94	20.16	24.38	£ per trip	Mourato et al (2010)	Use where new or enhanced SuDS features are likely to lead to educational visits that would not otherwise occur.

Monetary values

There is currently only one source of monetary values to support assessment in this category. This is Mourato et al (2010) and is from the UK National Ecosystem Assessment. This is based on a 'cost of investment' approach. This will not provide an estimate of the welfare benefit of the knowledge gained in nature visits or projects but rather an indication of outlay that is made in its acquisition. Nevertheless, and given the current scarcity of valuation evidence in this category, we can assume that such investment would not be made unless it resulted in educational benefits, and the values from this study therefore provide a reasonable proxy to the welfare benefits delivered. Table 4-5 shows the values.

Avoiding double counting

It is possible that any benefits in the 'Amenity' category may include some values related to education. However, this risk is considered to be low and the risk of double counting benefits is therefore low.

Confidence scores

Given the current scarcity of clear evidence relating to the impact of SuDS on education, a low confidence score is likely to be appropriate for any quantitative estimate of benefits derived in this category (either 25% or 50% depending on the likelihood of such impacts occurring). Given the basis of the monetary evidence presented (related to the cost of investment rather than to welfare) a confidence score of 50% is recommended for the monetary value.

4.1.7 Enabling development

By reducing the volume and flows of surface water runoff entering into the drainage/sewerage system, SuDS can help to create more 'headroom' in the drainage network of a catchment. This can allow land that would otherwise be unavailable for development (due to lack of drainage capacity say in a combined sewer system or flood risk) to become 'unlocked'. Figure 4-9 *shows* a potential impact pathway.

Figure 4-9 Impact pathway for enabling development

Method of assessment

If this is an important area of potential benefits, consider the following:

- The process by which additional land will become available;
- The amount and location of land that could become available;

- The potential uses of this land and associated values; and
- Other factors/barriers that may be relevant to enabling development.

The impact contains a subjective scoring approach if the benefit is not quantified that considers the magnitude of the scheme to help enable new development and the potential size of the area impacted. These are summarised for all the relative non-quantified benefits to enable a comparison when more than one option is being considered.

Quantifying benefits

Quantifying the benefits in this category is unlikely unless it requires a specific drainage scheme to create the capacity in the drainage network to enable development. Where quantification is possible, set out the estimates clearly (e.g. ha of land or avoided scheme costs) and record any assumptions made.

Monetary values

There are no monetary values to support assessment in this category without local evidence or evaluation study. Typically, this would be the cost of the scheme.

Avoiding double counting

The benefits in this category most likely relate to avoided spend on new drainage infrastructure, through created headroom enabling a development to connect into the drainage network. Whilst benefits estimated in this category may include some element of benefits related to 'economic growth', if no monetary assessment is undertaken (in '*economic growth'* or '*enabling development'*, there is no risk of double counting benefits in this category.

Confidence scores

Given the lack of clear evidence relating to the impact of SuDS on enabling development, attach a low confidence score to any estimate of benefits derived in this category (either 25% or 50% depending on the assessment of the likelihood of such impacts occurring).

4.1.8 Flooding

The impact pathway

One of the functions of SuDS is to manage rain as close as possible to where it falls, reducing the volume and flows of run off the land or into the drainage system. Depending upon the design, conveyance and storage techniques, this can reduce the frequency and/or severity of flooding if the scale and size of the measures can accommodate larger rainfall events. This in turn leads to a number of benefits (e.g. reduced damage to property, avoided stress and anxiety), as Figure 4-10 shows.

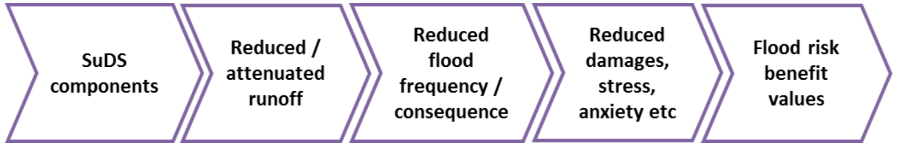


Figure 4-10 Impact pathway for flooding

Method of assessment

The assessment of benefits in this category will be made considerably easier by modelling the flood risk before and after (drainage interventions). Where no modelling is available, apply engineering judgement based on knowledge of previous flooding to estimate the potential degree of flood risk reduction in terms of the number/type of properties and other buildings, and the change in frequency of flooding. The tool is designed to accommodate either of these approaches and to be consistent with:

- WTP estimates obtained by a water company (F1 in tool);
- Annual average damage (AAD) assessments, such as those using the Multi-Coloured Manual (FHRC, 2014) (F2 and F3 in tool);
- Damage cost approaches based on grant-in-aid (GiA) assessments (https://www.gov.uk/government/collections/flood-and-coastal-defence-funding-for-risk-management-authorities); and
- Situations where no prior flood risk modelling has been undertaken.

In certain circumstances, it may be appropriate to combine these approaches. For example, estimating the benefits of flood protection up to a certain standard (e.g. 1 in 20) using the F1 method, and estimating further benefits from exceedance management (e.g. beyond 1 in 20 and up to 1 in 100) using F2 or F3. However, where this is the case, take care to consider the benefits to any individual property/building only once, so to avoid double counting the benefits.

Quantifying benefits

Where there is a completed a flood risk assessment for the scheme, no further quantification of the benefits should be necessary. Proceed straight to valuation. If however, there is no such modelling or assessment work, provide an estimate of:

- The number of properties of different types at reduced risk;
- The change in risk (flood frequency);
- Any quantitative information relating to non-property impacts (see below); and
- The reduction in time lost by people through flooding (an estimate of the number of people and time).

Even where a completed flood risk assessment exists, consider other potential impacts of flooding, e.g. non-residential properties. These are generally harder to estimate, such as loss of business, but can be significant, and may encompass the commercial and retail sectors, other private or public operations (e.g. schools), transport routes/networks and productive land (e.g. agricultural). To help capture such values, e.g. through disruption and time lost, F5 enables an estimate of time to be included.

Monetary values

The tool allows the user to insert values covering both damage cost and WTP approaches. In both cases the majority of values are not freely available to the public. Attempt to obtain the reports/material relevant to the scheme (e.g. the Multi-Coloured Handbook (FHRC, 2014) or the water company's WTP results). *Note that these values, even if assessed separately elsewhere, do need to be added to the tool to help provide a complete picture of the full range of SuDS benefits.*

It is important to note that damage cost approaches are based predominantly on the physical costs of damage caused by flooding (e.g. to property). As such, they tend to be somewhat lower than those obtained using WTP surveys, which encompass a wider range of values (e.g. distress) and motives (e.g. altruism – values of people not affected by flooding but concerned about its impacts on others). However, a further consideration is that WTP values have been obtained from a broad population base (all customers within that water company boundary). If this population is greater than that which is likely to benefit from the scheme, this may result in an overestimate of benefits.

The choice between using damage cost and WTP values will probably come down to data availability for the scheme, and the funding stakeholders' requirements. However, where different values are available, it is advisable to consider the impact on the result by applying more than one value (see Section 6 on Sensitivity Analysis). In addition, the risk of overestimation can be minimized by only applying the available values to those impacts (e.g. number of properties) that are likely to see a direct and tangible benefit.

The tool also includes some values related to non-property impacts. The evidence in this area is generally poor and the values are based on experience from specific events (e.g. the 2007 winter floods). Nevertheless, they provide an indication of the scale of impacts that could occur. Where no values are readily available for some of these other impacts that are nevertheless expected as a result of the scheme, they may be estimated using market values. For example, when expecting impacts on productive agricultural land, the value of these impacts can be estimated by multiplying the change in probability (e.g. number of additional 'flood free days' per year as a result of the scheme) by the value of the land. Value of land information can be obtained from the Government Valuation Office Property Market Report (latest version 2011) http://www.voa.gov.uk/dvs/_downloads/pmr_2011.pdf.

A further potential impact of flooding is on time, because of delays or disruption to transport. This will depend on a number of factors, including travel purpose (e.g. commuting), mode of transport and location. The approach to valuing travel time is currently being substantially updated by government (https://www.gov.uk/government/publications/values-of-travel-time-savings-for-business-travellers). In the meantime, the easiest way to account for this is to multiply the expected time gained (hours) as a result of reduced flooding risk by the average hourly wage (£11.56) (Office for National Statistics, 2013).

The Multi-Coloured Handbook also includes a simple method for estimating the potential damage to vehicles as a result of flooding. This method "assumes that the total number of vehicles likely to be damaged during a flood occurring at any time of the day will equate to 28% of the total number of residential *and* commercial properties at risk (from a flood of any depth). Estimate the number of likely vehicles and multiply this by £3,100 (the value per vehicle, not the value of vehicles per household). This method does not require an assumption to be made on the presumed location of vehicles when a flood occurs". Enter such values (including other flooding impacts if not included overall in an assessment (e.g. in F1) in the user-defined section.

Avoiding double counting

Values obtained from either damage cost or WTP approaches relate specifically to the benefits of flood risk reduction, and the risk of double counting is therefore considered to be *minimal*. The exception to this is the 'flexible infrastructure/climate change adaptation' category. Since increased flood risk is one of the main risks associated with climate change, it is likely that any values used in that category will overlap with values for flood risk. Do not seek to value impacts in both categories where this is the case. Note that the tool does not yet include the *'flexible infrastructure/climate change adaptation'* sheet. When making an allowance and estimate in this category (for example considering future impacts with revised rainfall) make use of the *'user-defined'* benefit sheet.

Confidence scores

The confidence score relating to the quantitative estimate will depend on the completed level of supporting assessments. For example, if a flood risk assessment models *the change* in risk. Where this is the case, select a higher confidence score (75%-100%). Where the change in risk or quantities entered is largely based on judgement, apply a lower confidence score (typically 50% or less).

For monetary values, if the valuation uses a reputable damage cost approach (e.g. the Multi-Coloured Handbook) or a water company WTP survey, *and* the population impacted is likely to be similar to that in the original survey, then select a higher confidence score (75%-100%). If this is not the case, or if a significant proportion of the impacts is not related to properties, select a lower confidence score (50% or less).

4.1.9 Groundwater recharge

The impact pathway

SuDS can increase infiltration to groundwater and help to remove contaminants. This can help maintain natural hydrology, increase availability of water for abstraction or reduce treatment costs, as Figure 4-11 shows, this impact assumes that the designer understands whether infiltration is possible and allowed, see C753 The SuDS Manual for more information (Woods-Ballard et al, 2015). It is likely to be relevant only where groundwater is over-abstracted, where the groundwater body is in an area of moderate or serious water stress (Environment Agency, 2013a) or during very dry/drought periods.

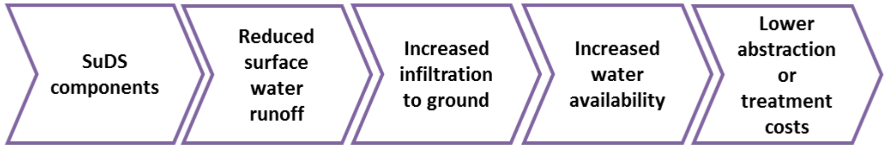


Figure 4-11 Impact pathway for groundwater

Method of assessment

Where there is a detailed assessment of the impact that infiltration has on groundwater recharge, complete GW1. Where this is not available, GW2 provides a simple way to estimate the benefit in the following steps.

<u>Step 1 - Does the infiltration to ground from the SuDS scheme constitute 'additional' groundwater recharge?</u>

For the SuDS scheme to bring a significant benefit to groundwater, it will need to deliver 'additional' groundwater recharge. For example, a SUDS scheme introduced to a Greenfield site is unlikely to provide additional groundwater recharge under normal circumstances. The baseline condition in the location of the area intended for the SuDS will need to be examined in order to determine the answer to this question. Consider the following questions:

Question 1:

a) Will the SuDS be located on an area that is currently covered with impermeable hardstanding (e.g. concrete, buildings, road/pavement surfaces etc)?; and
b) Are the ground conditions beneath the existing hardstanding areas intended for the SuDS components suitable to permit infiltration to the underlying groundwater (Woods-Ballard et al 2015)?

Question 2:

If the location for the SuDS component is currently on a greenfield site, are the ground conditions beneath the surface significantly more permeable than the topsoil layer? (excavating to create SuDS components may encourage additional recharge by 'tapping' in to more permeable sub-surface strata – for example where clay-rich, less permeable topsoil overlays gravel-rich more permeable sub-strata layers).

Note: the information required to answer the above questions can often be found in the geotechnical report for the site in question; if in doubt consult a ground conditions specialist.

If the answers to either Question 1 or 2 above is 'yes', then it is likely that the SuDS scheme would deliver additional groundwater recharge, proceed with the remainder of the costing exercise. If the answers to either Question 1 or 2 above is 'no' then it is unlikely that the SuDS scheme will deliver additional groundwater recharge, therefore stop at this point.

Quantifying benefits

Step 2 - What is the average annual total Hydrologically Effective Rainfall (HER) for the site?

Hydrologically Effective Rainfall (HER) represents the remaining rainfall in any one year after considering the demands of evaporation and water uptake by vegetation. The HER that remains is available to work its way into the groundwater system via infiltration. Average annual total HER is, therefore, a useful measure of average annual total recharge in groundwater dominated catchments and total runoff in surface water dominated catchments.

An average annual total HER value is available for any location in the UK through the Meteorological Office (Met. Office) for a small charge. The data is available through the Meteorological Office Rainfall and Evapotranspiration Calculation System (MORECS). The HER value will normally be provided for a user specified standard climatological period such as 1961-1990.

Alternatively, it is possible to approximate the HER value by applying a reduction factor to the average annual total rainfall value for the site, although this approach is less reliable than obtaining HER data as above.

An estimate of typical annual rainfall for anywhere in the UK can be found on many publicly available websites (such as http://www.metoffice.gov.uk/learning/rain/how-much-does-it-rain-in-the-uk). Reduce the rainfall total by the following factors depending on location to provide an estimate of average annual total HER in Table 4-6.

Note, the use of the reduction factors will provide considerably less reliable estimates of site-specific HER than will be obtained using MORECS data. This is because there is considerable regional variation in the relationship between rainfall and runoff in the UK. In addition, the above factors represent the difference between aggregated observed runoff and recorded rainfall. The observed runoff includes runoff from urban areas which to a degree will also reduce the reliability of estimating HER using the above reduction factors.

Table 4-6 Hydrologically effective rainfall estimates across the UK (CEH, 2004)

Location	England and Wales	Scotland	Northern Ireland	United Kingdom
Rainfall Reduction Factor	0.49	0.73	0.60	0.62

Step 3 - What is the total area that the SuDS scheme is infiltrating?

This is the total area drained by the SuDS. For the purposes of this calculation, this will be the impermeable area directly drained by and infiltrated by SuDS. Calculate the volume by multiplying the impermeable area and the HER.

Step 4 - What is the start and end date during which the SuDS based infiltration scheme would be operational?

Determine this using estimates of when the SuDS component will become fully operational and when it will be decommissioned. For new SuDS components serving new residential schemes the design lifetime should be 100 years. For other developments the design lifetime will be stipulated by the scheme designers although where this is unclear consider using 50 years as a default.

Monetary values

Step 5 - What is the Monetised Value to be used for every cubic meter of 'additional' groundwater recharge delivered by the SuDS scheme?

There are currently no reliable UK-based estimates of the value of groundwater recharge to the general public. The monetary values for benefits to groundwater are drawn from the Environment Agency's Groundwater Appraisal Guidance (2013b, unpublished), part of the wider suite of WAG (Water Appraisal Guidance) documents. Using this approach, groundwater potentially has value as long as it is available for use. Estimating option values (where groundwater is not currently used but could potentially be used in the future) and non-use values (where groundwater is not abstracted or directly used in any way) is more complex and is the subject of ongoing research by the Environment Agency and others, which is currently not publicly available. These values are therefore not included at the current time. Table 4-7 shows the appropriate values.

Avoiding double counting

Provided the guidance above is followed, the risk of double counting in this category is considered to be *minimal*.

Confidence scores

Base the quantitative confidence scores on the approach and assumptions taken to evaluate the volume of groundwater recharge. Therefore it may be appropriate to use 75% to 100% for the quantities in GW1. In GW2, as this is using a simplified estimate, it will be appropriate to use 50% to 75%.

Regarding monetary values, there is a great deal of uncertainty around valuation of groundwater and the approaches and techniques for obtaining monetary values in different contexts are continuing to evolve. Therefore, consider using a maximum confidence score of 75%, with lower scores applicable where the context of the scheme is different to the types of improvements described above. In addition, take account of the fact that groundwater values are likely to be higher in areas of (actual or potential) scarcity or water stress. Consider applying higher confidence scores where this is the case.

Table 4-7 Values for groundwater improvements

Context	Value (2014 prices)			Units	Reference	Guidance on use
	Low	Mid	High			
Water and wastewater treatment savings from direct groundwater abstraction	0.17	0.46	0.90	£/m^3	Environment Agency (2013b)	Represents the average cost to the UK water industry to treat one cubic metre of water or to save one cubic metre through efficiencies. Use only where impacts on groundwater sufficient to allow increase in water company abstraction.
Savings to industry from direct abstraction		0.65		£/m^3	Environment Agency (2003)	Use only where impacts on groundwater sufficient to allow increase in industrial abstraction.

4.1.10 Health and well being

The impact pathway

There is growing evidence that SuDS can have benefits for physical, emotional and mental health (Ashley et al, 2013). However, despite undertaking an extensive review of the research, it is not generally possible to quantify and value these impacts (at this time). This is consistent with research at the European Union level (see http://www.phenotype.eu/), which recognises that

"*indications exist that close contact with nature brings benefits to human health and wellbeing, but the mechanisms are not well understood*"

and a report for the UK National Ecosystem Assessment, which concluded that

"*it is not possible to accurately value, at the present time, the health benefits of created exercise due to additional green space provision*" (Mourato et al, 2010).

Some tangible health benefits (e.g. reduced surface water pollution leading to reduced illness from eating contaminated seafood or swimming in contaminated waters) will be picked up in other categories (water quality in this example). Apply caution in this category. Nevertheless, Figure 4-12 *shows* an example impact pathway

Figure 4-12 Impact pathway for health

Method of assessment

Given the difficulties in valuing impacts in this category, the suggested assessment should be limited to:

- H2A - Valuing the health impacts of new walking and cycling opportunities using the World Health Organisation 'Health Economic Assessment Tool '(HEAT, http://www.heatwalkingcycling.org/) – *this should be used to estimate the health impacts due to SuDS from increased walking and/or cycling*; or
- H2B – Estimating the impact of increased physical activity on avoided costs
- H3 - Impacts on emotional well-being brought about by certain SuDS components.
- In all other cases, unless specific information is available for example through an external assessment (enter the values in Section H1), the health benefits from SuDS should be described in qualitative terms only (i.e. not quantified).

Quantifying benefits

When using the HEAT tool, estimate:

- The additional number of walking/cycling trips; and
- The average duration or distance of these trips.

The UK government recommends that adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity in bouts of 10 minutes or more (e.g. 30 minutes on at least 5 days a week). Currently, only around 6% of men and 4% of women achieve the recommended physical activity level (HSCIC, 2014).

The HEAT tool includes a number of default values to help calculate a quantified benefit, although it recommends replacing these by survey or site-specific recorded data where possible. Useful values include:

- A reference volume of cycling per person based on 100 minutes per week for 52 weeks per year at an estimated speed of 14 km/hour (however, 124 cycling days/year is considered to be a more conservative estimate).
- A reference volume of walking based on 168 minutes per week at 4.8 km/hour.
- 71.5cm per step (walking) and 100 steps per minute (on average).

Where there is no local evidence, make conservative estimates of:

- The increase in population being active. For example, Mourato et al (2010) considers a scenario where an intervention (such as a SuDS scheme) leads to a reduction of one percentage point in the population of sedentary people. In the UK, roughly 23% of men and 26% of women are estimated to be sedentary;
- The appropriateness of the activity (walking and / or cycling); and
- The likely length/duration of the activity. Use the local population numbers to help make a judgment.

Quantitative estimates of emotional well-being benefits may come from a Health Impact Assessment (HIA), landscape assessment or similar. To estimate emotional health benefits using the tool, provide at least one of the following:

- Estimated additional numbers of people having a view over green space from house or regular place of work;
- Estimated additional numbers of people with freshwater or wetland within 1km of home or regular place of work; or
- Estimated additional numbers of people using garden or non-countryside green space monthly or more. Note that this can include any green space (e.g. garden, green roof, park, wetland) where people may spend more time as a result of the SuDS measures. It is not necessarily related to scale/size of the space, since people can enjoy health benefits even from being in a small outside area.

Whilst the links between access to green space and emotional well-being are not well understood, Mourato et al (2010) provides some insight into the potential benefits:

- Having a view of green space from one's house increases emotional well-being by 5% and the general health utility score by about 2%;
- Using the garden weekly or more increases physical functioning and emotional wellbeing by around 3.5% and the heath utility score by 2.7%; and
- An increase in 1% of the area of freshwater within the 1 km radius of the home increases health utility by 0.3%.

Although there is limited evidence around health benefits to workers and visitors, the number of beneficiaries in these categories should also be estimated where significant benefits are expected to accrue to these groups. However, take care to avoid counting the same beneficiaries twice, so estimate the numbers of workers and visitors where they are *additional* to residents.

Monetary values

The HEAT tool calculates the monetary value of health benefits associated with additional walking and cycling activity. For example, it estimates that the annual physical health benefits to each additional person regularly walking or cycling (approximately 2-3 hours per week) are in the range €120 - €1,300 per walker/cyclist.

A potential lower bound for the monetary value of physical health benefits is provided by the UK Active study (Table 4-8). This is based on an estimate of avoided local authority public health costs. Given that public health interventions need to demonstrate value for money (benefits greater than the costs), we can assume that the health benefits of reduced physical inactivity are at least as great as the value cited here.

For emotional well-being benefits, use one of the other monetary values in Table 4-8. Use the results of the qualitative assessment to select low, mid or high monetary values. The qualitative scores are based upon the quality of the urban design of the SuDS and the subjective quality of space assessment. Given the difficulties linking access to environmental features and health described above, treat the values shown with caution. Use the 'low' values in most cases, and only apply the 'mid' or 'high' values where the SuDS scheme is likely to lead to a significant and noticeable change of the type described.

Avoiding double counting

Health impacts in this category refer to recreational and aesthetic health benefits, so there is no risk of double counting with the health benefits of improved air quality. However, although the values shown in Table 4-8 generally relate to specific health benefits, it is possible that they cover other benefits as well as those specifically related to health. The risk of double counting is considered to be *moderate*. Therefore, when valuing health benefits, only seek to assess and value benefits in the following categories where there is confidence that the benefits would be truly additional (or apply to different groups/populations).

- Amenity
- Recreation
- Temperature

Confidence scores

The quantitative confidence scores relate to the estimate of numbers. In the HEAT tool, without any local assessment, apply a 50% confidence score. Add this directly within the HEAT tool. As it is possible to estimate the numbers with a view of green space or freshwater wetland with a high certainty, apply a 75% to 100% confidence score.

For the monetised confidence score, assume a 100% value for walking and cycling in the HEAT tool. Given uncertainties highlighted around other values, consider, even where the scheme context closely matches

Table 4-8 Values for emotional health improvements

Context	Value (2014 prices)			Units	Reference	Guidance on use
	Low	Mid	High			
Having a view over green space from the house/regular place of work (move from no view to having any kind of view)	145	316	487	£/ person/yr	UK NEA (2011)	Use only where increase in number of homes with view of green space expected as a direct result of scheme.
Use of garden or non-countryside green space (move from using less than monthly to using monthly or more)	121	263	406	£/ person/yr		Use only where significant increase in use of gardens or non-countryside green space is expected as a direct result of scheme.
Local freshwater, wetland and flood plain land cover (+1% within 1km of the home/regular place of work)	22	47	73	£/ person/yr		Use only where increase in local freshwater, wetland and flood plain land cover is expected as a direct result of scheme.
Avoided local authority public health costs associated with reduced physical inactivity	-	183	-	£/person/yr	UK Active (2014)	Use only where reduction in physical inactivity is expected as a direct result of scheme.

the evaluation study context, apply a maximum confidence score of 75%. Apply a lower score (25% or 50%) where this is not the case

4.1.11 Pumping wastewater

The impact pathway

By reducing or attenuating runoff, SuDS generally lead to lower volumes of water in combined systems, and therefore reduce flows to sewage treatment works (Figure 4.13). This reduction applies equality in surface water drainage. In pumped networks this results in savings from reduced pumping, primarily in terms of energy use, but also potentially in terms of reduced depreciation and maintenance.

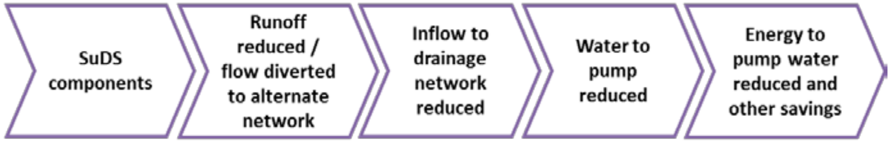


Figure 4-13 Impact pathway for pumping

Method of assessment

The tool supports three levels of assessment:

- P1 – an assessment is complete on the impact on pumping stations;
- P2 - provides support to estimate the impact on energy use per year for pumping stations (wastewater or surface water) if information is available about the pumps and run times where;

$$Energy\ use\ /\ yr = Pump\ KW\ rating \times Pump\ run\ time\ per\ year$$

- P3 – provides support to estimate the impact on energy use per year for pumping stations if information is available about the pumped flows and run times where:

$$Energy\ use/yr = \frac{\begin{pmatrix} Allowance \\ for \\ pump\ motor \\ size \end{pmatrix} \times \begin{pmatrix} flow \\ rate \end{pmatrix} \times \begin{pmatrix} Pump \\ run \\ time \\ per\ year \end{pmatrix} \times \begin{pmatrix} Est. \\ head \end{pmatrix}}{Efficiency\ factor}$$

  Where:

  - an increase of 5% is used to allow for the pump motor size; and
  - an efficiency factor of 80% is used for the pumps which is typically conservative (a lower factor would increase the energy used).

Quantifying benefits

If the pump run time (hrs/year), such as from a hydraulic sewer model and kW rating of the pump under both the baseline and proposed scenarios (P2) is known, the tool will automatically calculate the change in energy use (kW/year). If information about the pumps is not available, P3 provides support estimate the kW reduction. Enter information related to pump flows (ltrs/second), run times (hours/year) and estimated head (metres) to determine energy use.

Monetary values

The tool automatically values the change in energy use. Select a fuel type and energy tariff type (e.g. residential, industrial) and an energy rate (low, medium or high) (Decc, 2013. See Annex F but note that this provides low and high projections dependent on world markets, energy security, etc, rather than energy price forecasts). Energy values use long run variable costs, as discussed in Section 4.1.4.

In addition, to estimate the value of carbon impacts associated with the change in energy use, select an appropriate traded price of carbon (low, central or high), as discussed in Section 4.1.5.

Avoiding double counting

The energy price projections provided by the government (Decc, 2013) relate specifically to energy use and do not overlap with other benefit categories. Double counting may occur if the impact on the WwTW is assessed, and the WwTW contains pumping. To avoid double counting, ensure these pumps are not included in the pumping assessment or only use the gravity assessment in the '*treating wastewater'* section. The risk of double counting in this category outside of these impacts is considered to be *minimal*.

Confidence scores

The confidence score relating to the quantitative estimate will depend on the level of certainty that the scheme will actually deliver the estimated pumping benefits. If using known pump Kw rating and run times, select a higher confidence score (75% or 100%). If using estimates with only the flow rates known, then a lower confidence score may be appropriate (50% – 75%).

The monetary values come from a reliable source (Decc, 2013) based on actual market data and projections. Therefore use a confidence score of 100%.

4.1.12 Rainwater harvesting

The impact pathway

Capturing surface water runoff locally and using it for example for: toilet flushing or gardening reduces the amount of potable water required for such activities. It can, as part of an integrated surface water management strategy, provide localised storage which when available and across a large scale, can help to attenuate flows lowering flood risk and the potential for pollution to water bodies. Using less water can provide a benefit to the consumer with lower bills and to the water company in abstracting, treating and supplying potable water (Figure 4-14).

Figure 4-14 Impact pathway for rainwater harvesting

Method of assessment

The tool provides three levels of support to estimate the present value of rainwater harvesting (RWH) on reducing potable water:

- RWH1: an assessment is complete of the impact of potable water reduction and the present value calculated;
- RWH2: the volume of potable water reduced per annum is known; and
- RWH3: helps to estimate the volume of potable water reduced per annum.

Other wider benefits such as reducing inflows to the sewer that can help to lower flood risk or pollution of water bodies are not included here.

Account for these in the wider outcomes SuDS may bring as a whole e.g. to reducing flood risk.

Quantifying benefits

If as part of the detailed design an assessment of the benefits present value is available, enter them in RWH1. RWH2 and RWH3 help estimate the benefits based on the volume of treated water saved. Where the reduced volume of water is known in properties as a result of RWH, use RWH2 to estimate the present values of benefits. Note that a benefit may accrue to both the water company (lower costs to treat and supply) and the customer (lower bills), and both are estimated here. However, only the benefit to the water company (including carbon reduction) is carried forward (as this would introduce double counting and because the benefit to the customer from reduced bills will be offset by a loss of revenue to the water company).

RWH3 provides support to assess the impact. This requires more information to understand the level of potable water reduction including the annual average rainfall, number of properties, typical usage of RWH and number of people per property or business. RWH3 provides an estimation of the impact in the same way as RWH2.

The quantity of carbon used to treat water is taken from Water UK (2010) at 0.34 tonnes CO_2 emitted per megalitre. This value is used to determine the total quantity of carbon reduced based upon the volume of water not supplied.

Account for the costs to run the pumps including the energy usage when calculating the whole life costs.

Monetary values

The value of rainwater harvesting systems can be estimated in two main ways:

- The avoided cost of obtaining water by a different means (e.g. from the public water supply). This provides a minimum estimate of the benefit; or
- The benefit associated with leaving water in the natural environment (e.g. using WTP estimates to avoid low flows).

Given that rainwater harvesting will generally deliver small, localized benefits, the first of these approaches is more appropriate. Information on the cost to treat water is commercially sensitive and these values tend not to be published. Whilst the operating costs are in the ‘pence’/m^3 range, total cost to treat will be higher (e.g. including capital works). Where appropriate, individual water companies may supply this data. Obtain the benefit to the customer by reviewing local water pricing that are freely available, although do not use estimates based on bills in addition to avoided cost estimates as this would introduce double counting. To estimate the value of carbon impacts associated with the change in energy use, select an appropriate traded price of carbon (low, central or high), as discussed in Section 4.1.5.

Avoiding double counting

Provided the guidance above is followed, the risk of double counting in this category is considered to be *minimal*.

Confidence scores

The quantitative confidence scores depend on the approach to evaluate the volumes, and the assumptions made. Therefore, it may be appropriate to use 75% to 100% for the quantities in RWH1 and RWH2. In RWH3, as this is using a simplified estimate, it will be appropriate to use 50% to 75%.

Since the monetary values for customer charging, cost to treat and carbon come from a reliable source and are based on actual market data, the confidence score for the monetary values is 100%.

4.1.13 Recreation

The impact pathway

A number of SuDS or green infrastructure components can generate recreational benefits, particularly where these specifically designed with a dual recreational purpose (e.g. detention basins, wetlands, rain gardens, swales and planting trees). Figure 4-15 shows the potential impact of SuDS on recreation.

Figure 4-15 Impact pathway for recreation

Method of assessment

The delivery of benefits in this category depends on the extent to which the SuDS scheme will provide or enhance the opportunity for recreation. This in part will also link to the attractiveness of the area (see Amenity 4.1.2). There will inevitably be some subjectivity in interpreting the degree to which SuDS contribute to benefits in this category. This is acceptable, but it is important to be explicit about this and to record any assumptions made. Where possible, obtaining visitor numbers will support the assessment. Four categories are provided in this assessment. More local / specific impacts may not be included on the '*recreation'* sheet. Where these occur, use the *user defined* benefits to capture these.

Quantifying benefits

The key parameter needed to estimate in this category is the number of additional or enhanced recreational visits created because of building SuDS. Often local research on visits to some sites can indicate the number of visits currently being undertaken to help estimate the scale of change. As a guide, the total number of adult visitors to a locally important site (one which generally attracts visitors living within a few kilometres) ranges from 10,000 to 30,000 per year. The number of visitors to a 'honeypot' site (drawing visitors from several kilometres away) generally ranges from 60,000 to 250,000. A regionally important site may attract between 180,000 and 540,000 visitors per year.

Be partly guided by the choice of quantitative estimate by the availability of potential substitute sites (other recreational sites in the area) in detail. For example, where a number of potential recreational sites in the locality already exist, apply a low quantitative estimate. Where few or no substitutes exist, a higher quantitative estimate will be more appropriate.

Monetary values

There is considerable evidence to suggest that people enjoy and value new or enhanced recreational changes that SuDS can provide. Table 4-9 shows the values selected for use and are drawn from studies that are particularly applicable to the kind of recreational activities brought about by SuDS in a UK context. They are generally based on either WTP studies, or on so-called 'travel cost' studies, which use costs as a proxy for the value to visitors of different recreational sites. Consider which one of the values in Table 4-8 most closely matches the scheme and record that value in the tool. The key thing to consider is whether the scheme, irrespective of its size, type or location, is likely to lead to an increase in recreational use of the type, or within the habitat type, listed. Further details around the context of these values are provided in the 'Values Library' within the tool. It is likely that other local values may be available or can be used in this category.

Avoiding double counting

Although the values shown in Table 4-9 generally relate to specific recreational activities, it is possible that they cover other benefits as well as those specifically related to recreation. For example, values for walking and cycling are also included in the 'Health' category. Of course, walking and cycling could potentially deliver many different kinds of benefits, including health (physical and mental), recreation (spending time outdoors, with family, etc) and many others. However, it is currently not possible to disentangle these effects.

The risk of double counting is considered to be *moderate*. Therefore, when valuing recreation benefits, only seek to assess and value benefits in the following categories when confident that the benefits would be truly additional (or apply to different groups/populations).

- Amenity
- Biodiversity
- Water quality
- Health
- Tourism

Confidence scores

The confidence score relating to the quantitative estimate will depend on the level of certainty in that the scheme will actually deliver the estimated recreational benefits. For example, if the area currently offers no or few recreational opportunities and the SuDS includes specific design components that will facilitate recreation (e.g. cycle paths), then a significant improvement in this category could be expected so select a higher confidence score (75%). Where a completed detailed assessment is available, such as a recreational user survey, then a value of (100%) may be appropriate. On the other hand, if the area is already heavily used for recreation, such that additional SuDS components are unlikely to make much of a difference, or if the SuDS are dependent on other parties, then a lower confidence score may be appropriate.

If the context of the monetary values is similar to the scheme (i.e. similar types of components and improvements expected), select a higher

Table 4-9 Values for recreational improvements

<table>
<tr><th rowspan="2">Context</th><th colspan="3">Value (2014 prices)</th><th rowspan="2">Units</th><th rowspan="2">Reference</th><th rowspan="2">Guidance on use</th></tr>
<tr><th>Low</th><th>Mid</th><th>High</th></tr>
<tr><td>Recreational benefits from constructed wetlands</td><td>153</td><td>421</td><td>974</td><td>£/ha/yr</td><td>Hölzinger (2011)</td><td>Use where new wetlands are expected to result in more recreational opportunities.</td></tr>
<tr><td>Willingness to pay for additional angling visit (coarse)</td><td>-</td><td>4.86</td><td>-</td><td>£/visit</td><td rowspan="2">Defra (2007b)</td><td>Use where increased quality/quantity of water as a result of the intervention is expected to result in more coarse angling opportunities.</td></tr>
<tr><td>Willingness to pay for additional angling visit (game)</td><td>-</td><td>6.12</td><td>-</td><td>£/visit</td><td>Use where increased quality/quantity of water as a result of the intervention is expected to result in more game angling opportunities.</td></tr>
<tr><td>Value of general recreational visit (grassland)</td><td></td><td>1.57</td><td></td><td>£/visit</td><td rowspan="3">Sen et al (2014)</td><td rowspan="3">Use where increased quality/quantity of green space is expected to result in more recreational opportunities.</td></tr>
<tr><td>Value of general recreational visit (freshwater & flood plains)</td><td></td><td>1.85</td><td></td><td>£/visit</td></tr>
<tr><td>Value of general recreational visit (greenbelt & urban fringe)</td><td></td><td>5.46</td><td></td><td>£/visit</td></tr>
</table>

confidence score for the monetary values. If the context is very different (e.g. the scheme is in a mainly non-residential area), select a lower confidence score for monetary values.

4.1.14 Treating wastewater

The impact pathway

By reducing or attenuating runoff, SuDS can reduce the volume of surface water to treat in combined systems (Figure 4-16). This results in savings from reduced treatment, for example in terms of reduced nutrient removal or compliance with legislation (e.g. Urban Waste Water Treatment Directive).

Figure 4-16 Impact pathway for sewage treatment

NB It is expected that a change in flows to works, and associated reduced treatment, will only occur for a retrofit or redevelopment scheme.

Method of assessment

The tool supports two levels of assessment:

- ST1 – an assessment of the impact on treatment due to reduced flows is known; and
- ST2 – provide support to estimate the impact by understanding the change in flows to the works.

Quantifying benefits

If the average flow (Ml/day) is known, under both the baseline and proposed scenarios (ST2), the tool can automatically calculate the quantified impact on treatment. It is important to enter both the baseline and proposed average flow to indicate the potential change in flows arriving at the treatment works.

The tool uses some typical Ofwat category of works, enabling the user to select the most appropriate works category (3, 4 or 6), size (large, medium or small), application (nutrient removal or UWWTD) and whether the works are gravity or pumped. The tool uses three Ofwat category works to cover the broad range of WwTW and Table 4-10 provides information to help select the appropriate size. ST2 requires the daily average volume (including storm flows) in the baseline and proposed situation. Obtain this by using a hydraulic model to predict the flows to treatment.

Monetary values

The tool automatically values the change in treatment based on the volume difference between the baseline and proposed situation. The tool uses monetary values based on MWH's internal models for a 'Unit Cost of Treatment' (simplified further for this application) with the size of the works (defined by the population equivalent) related to a generic treatment works. This means that small changes at small works will not lead to a significant, monetised benefit. The costing models for which the tool predicts values include operational costs (staff, chemical and maintenance), energy and carbon. Energy and carbon costs are estimated in the same way as for other impact categories (i.e. using the long run variable costs of energy and the traded or, for process emissions, the non-traded price of carbon respectively), whilst other costs are assumed to be constant.

Avoiding double counting

Double counting may occur if the WwTW includes pumping and this forms part of the pumping impact. To avoid double counting, ensure pumps in the WwTW (e.g. at the inlet) are not included in the pumping assessment or only use the gravity assessment in this category. Otherwise, the risk of double counting in this category outside of these impacts is considered to be *minimal*.

Table 4-10 Wastewater treatment works Ofwat categories used in the tool

Works Ofwat Category	Size	Application		Typical PE range
6	Large	Urban	Nutrient Removal	> 150k
6	Large	Urban	UWWTD	> 150k
6	Medium	Urban	Nutrient Removal	75-150k
6	Medium	Urban	UWWTD	75-150k
6	Small	Urban	Nutrient Removal	< 75k
6	Small	Urban	UWWTD	< 75k
4	Medium	Rural	Sensitive receiving water	> 5k
4	Medium	Rural	UWWTD	> 5k
4	Small	Rural	Sensitive receiving water	< 5k
3	Small	Rural	UWWTD	< 5k

Confidence scores

Scores for ST1 will depend on the knowledge of the accuracy behind the values used. In ST2, the volumes that generate quantities should range between 50 and 75% as it uses a generic model. Where there is greater confidence in the volumes to treatment, e.g. through modelling, then 75% is appropriate. Monetary values typically use Government data and projections (Decc, 2013), therefore 100% is appropriate, since this is the best available data.

4.1.15 Water quality

The impact pathway

A primary function of SuDS is to improve the quality of water discharged from drainage. This can lead to improving the quality of the receiving water body such as streams, rivers, lakes, bathing or shellfish waters. Furthermore, where SuDS reduce flows entering combined sewers, this can lead to reduced combined sewer overflow discharges, again improving the quality of the receiving water body. Such water quality improvements (or prevention of deterioration) can lead to a number of benefits including aesthetic, health (e.g. reduced risk of infection from bathing) or enhanced opportunities for wildlife and biodiversity (Figure 4-17).

Figure 4-17 Impact pathway for water quality

Method of assessment

Assessing the impact SuDS may have on water quality can be difficult. Avoid assuming SuDS will deliver significant water quality benefits, for example over several kilometres without sound evidence and following best practice. In general, small schemes/changes are unlikely to lead to significant or identifiable improvements in water quality. Where it is a small scheme, it may be appropriate to consider the contribution it may make as part of larger works, therefore estimate a short length of watercourse and a delayed benefit start year.

Wherever possible, use a dynamic water quality model replicating the impact SuDS may have on reducing pollutant loads discharged directly (e.g. the storm water through the SuDS) or indirectly (e.g. reducing combined sewer overflow spills). This may also include modelling the receiving water, to understand the impact and potential change in classification. For example, a retrofit scheme that significantly reduces the pollutant load discharged from CSOs and directly from the storm water discharges may not change the water course status, because the receiving water quality is so poor that significant other changes in the catchment need to take place upstream before a change in status can occur.

Table 4-11 provides a hierarchal assessment to indicate potential ways to estimate the impact a SuDS solution may have, with the confidence reducing as the assessment method and data requirements become simpler, less stringent and less evidence based respectively. Nationally available information, such as the *Reasons for Failure* (contact the local environmental regulator) will indicate the status of each water body and why it is failing. This provides a sound starting point, along with discussions with local environmental regulators to understand the issues in the watercourse and where the SuDS scheme may have a positive impact and over what length of watercourse. Take a precautionary approach to the magnitude and scale of the impact.

Where it is not possible to demonstrate a full change in water body status, but a significant shift towards a change may occur, it may be appropriate to include a percentage of what the change would be e.g. 50% of the monetary value.

Quantifying benefits

WQ1 allows the entry of values from a completed assessment outside of the tool that may be relevant to a funding stakeholder. WQ2 provides support to estimate the impact of changing water body classification. WQ2 requires:

- The expected change in water quality. This should be aligned with the WFD classification system (e.g. poor to moderate, moderate to good). Further information on the classification system can be found at http://ec.europa.eu/environment/water/water-framework/objectives/status_en.htm;
- The region (river basin district). A map of these is available from the Environment Agency; and
- The length (km) or area (ha) of watercourse improved.

Monetary values

The monetary values in this category are based on the results of the National Water Environment Benefits Survey (NWEBS) by the Environment Agency (2013b). This reports values from a major study for the benefits of improving water bodies and achieving compliance with WFD objectives. This includes low, central and high values for each river basin district in England and Wales. Table 4-12 summarises the monetary values used in this category.

Where no change in WFD class is expected or can be valued, it may still be possible to value water quality improvements. Most water companies included water quality improvements in their WTP studies. The specification of these improvements varies but they generally include reduction in the number of pollution incidents associated with CSOs. Where such values are publicly available, they are included in the values library and can be input to the tool. Alternatively, complete a user-defined benefit to assess capture such a benefit.

Table 4-11 Hierarchy of assessment approaches

Assessment approach	Points to consider
Integrated water quality catchment modelling that predicts the change in water quality and the change within or between Water Framework Directive (WFD) status.	• Does the modelling indicate a significant change in water quality?
Modelling that indicates the chemical or urban diffuse pollutant loads and the impacts a scheme may have with a known WQ driver.	• Does the chemical or urban diffuse modelling indicate a significant change in water quality?
Flow only modelling in the drainage and water bodies	• What are the flow proportions and how do they change? If the proportion of flow entering is small compared with the watercourse flow, impact will be small or minimal.
Flow only modelling in the drainage	• Is it possible to estimate the relative change in flows and estimate the flow in the watercourse? Is it possible to indicate the potential SuDS performance?
Estimate the change in impermeable surface connected to drainage systems and the contributing area to the water body	• Assess the change in contributing impermeable area of the scheme as a proportion overall of the area upstream. Will it make a recognizable difference in the watercourse?

Where an expected improvement to bathing waters is likely to occur directly through SuDS, use WQ1 to capture the benefits, inputting the monetary benefit directly. Adopt values for bathing water improvements provided by the water company. To estimate the improvements to shellfish waters also use the WQ1 approach and input directly into the tool. Note, predicting improvements to bathing and/or shellfish waters is complex, and carefully consider whether the SuDS are demonstrably contributing to creating a significant benefit.

Avoiding double counting

Values from NWEBS include elements related to recreation, amenity and biodiversity. The risk of double counting is therefore considered to be *high,* therefore only seek to assess the categories below when confident that the values obtained will be additional to those in the water quality category (or apply to different groups/populations):

- Amenity
- Recreation
- Biodiversity

Confidence scores

Table 4-13 indicates potential confidence scores to assess the quantitative impact of SuDS on water quality. Note the confidence score to select will be dependent upon the body of evidence available and the appropriateness of the model and assessment technique. For example, if flow only modelling demonstrates a significant reduction in CSO spills, and these discharges make a significant proportion of the watercourse flow, then a 50 to 75% confidence score may be appropriate.

The monetary values are nationally accepted values, therefore where a full change in classification is likely to occur, apply 100% of the monetary value. If a partial change in classification is expected, use the monetary value confidence score to alter the value to its appropriate value (25% to 75%).

Table 4-12 Monetary values - water quality for watercourse

Change	Value (2014 prices)			Units	Source	When to use
	Low	Central	High			
Bad to poor	9.1 - 25.5	11.1 – 31	13.1 – 36.5	£000/km/yr	Environment Agency (2013b)	Change in WFD class, bad - poor
Poor to moderate	10.1 – 29.9	12.3 – 36.5	14.5 – 43	£000/km/yr		Change in WFD class, poor - mod
Moderate to good	11.5 – 35.4	14 – 43.1	16.5 – 50.7	£000/km/yr		Change in WFD class, mod - good

Table 4-13 Confidence scores for assessing the quantitative impact

Assessment approach	Confidence score
Integrated water quality catchment modelling that predicts the change in water quality and the change within or between WFD status.	100%
Modelling that indicates the chemical or urban diffuse pollutant loads and the impacts a scheme may have with a known WQ driver.	75% to 100%
Flow only modelling in the drainage and water bodies	50% to 75%
Flow only modelling in the drainage	25% to 50%
Estimate the change in impermeable surface connected to drainage systems and the contributing area to the water body	25%

4.2 Non-quantified benefits

The tool contains a number of benefits where it is currently difficult to quantify and monetise the impact of the SuDS. To support the estimation of these benefits, in particular when comparing more than one option, BeST contains a simple approach to assess the benefits qualitatively. This enables such benefits to be recorded and not overlooked, even if they are not monetised. Where local evaluations have taken place, the tool provides the facility to capture these.

The tool uses a matrix approach to consider the magnitude and area of the impact of the SuDS. A potential impact score can be estimated, and a single confidence value applied to alter the values. Given the lack of evidence to support a more detailed approach, it is not possible to provide specific guidance on how impact scores for the magnitude and area of impact should be derived.

Each non-quantified benefit sheet provides the opportunity to add in a monetised assessment, if local data (or new information) is available.

4.2.1 Crime

The impact pathway

Some studies have found a meaningful relationship between increased greenery and reduced crime. For example, Kuo and Sullivan (2001) found that levels of reported property and violent crime tend to be higher amongst people living in barren buildings compared to those in greener buildings. Compared to buildings with low levels of vegetation, those with medium levels had 42% fewer total crimes, 40% fewer property crimes, and 44% fewer violent crimes. The comparison between low and high levels of vegetation was even more striking: buildings with high levels of vegetation had 52% fewer total crimes, 48% fewer property crimes, and 56% fewer violent crimes than buildings with low levels of vegetation.

However, the location of this study (Chicago) and the socio-demographic characteristics of the population are very different to the UK. In addition, there is as yet no comprehensive and conclusive evidence that clearly links SuDS and crime levels. Indeed, poorly maintained green spaces can be the focus of anti-social behaviour (Dunse, White et al, 2007, cited in Natural England, 2014) such as littering, loitering with intent, noise pollution and vandalism. Nevertheless, a potential impact pathway is shown in Figure 4-18.

Figure 4-18 Impact pathway for crime

Method of assessment

Given the observations above, there is no need to assess potential benefits in this category, beyond a simple qualitative assessment or description of possible benefits based on the matrix in the tool. The impact contains a subjective scoring approach that considers the scale of the likely reduction in crime and the size of area/number of people affected. These are summarised for all relevant non-quantified benefits to enable a comparison when more than one option is being considered.

Quantifying benefits

Benefits in this category should not be quantified without local evidence or evaluation study.

Monetary values

There are no monetary values to support assessment in this category.

Avoiding double counting

It is likely that any benefits in the 'Amenity' category will include some values potentially related to reduced crime or fear of crime. However, if no monetary assessment is undertaken, there is no risk of double counting benefits in this category.

Confidence scores

Given the lack of clear evidence relating to the impact of SuDS on crime, attach a low confidence score to any estimate of benefits derived in this category (either 25% or 50% depending on the likelihood of such impacts occurring).

4.2.2 Economic growth

The impact pathway

There is some evidence that SuDS and green infrastructure can help stimulate local economic growth, perhaps through increased consumer spending, enhanced attractiveness of an area to new businesses, creation of green jobs or improved productivity of workers (Figure 4-19).

Figure 4-19 Impact pathway for economic growth

Research from the United States (reported in Natural England, 2014) found that shoppers were willing to travel further to visit, stay longer once there, and more frequently visit, business districts with trees. In addition, green infrastructure has been credited with significant positive employment impacts (Stratus Consulting, 2009). In the UK, developers would be willing, on average, to pay 3% more for land in close proximity to open space (Landscape Institute, 2014). There is (largely anecdotal) evidence that SuDS can unlock developable land, thereby creating opportunities for future growth, and that green areas used for food can increase the productivity of landscapes. There is certainly evidence that increasing the attractiveness of an area through investment in high-quality parks, increases inward investment (eftec, 2013).

It is also possible that SuDS schemes lead to an increase in employment or contribute to a more highly skilled local economy.

However, it is very difficult to identify whether these effects are truly additional, or whether they are simply displacing economic growth and job creation elsewhere. It is also very difficult to attribute such effects to specific kinds of green infrastructure. This may change in the future, and there have been attempts for example to link flood risk management to benefits to the local economy such as increases in gross value added (Frontier Economics, 2014). A particular opportunity may be to link SuDS to regeneration, measured in terms of different indices of deprivation, currently being updated by government.

Method of assessment

Given the observations above, there is no need to assess potential benefits in this category, beyond a simple qualitative assessment or description of possible benefits. The impact contains a subjective scoring approach that considers the magnitude that the scheme may contribute to supporting economic growth and the size of area impacted. These are summarised for all relevant non-quantified benefits to enable a comparison when more than one option is being considered.

Quantifying benefits

Benefits in this category should not be quantified without local evidence or evaluation study.

Monetary values

There are no monetary values to support assessment in this category.

Avoiding double counting

It is likely that any benefits in the 'health' and tourism categories will include some values related to increased economic growth (via enhanced well-being and productivity). It is also likely that economic development is reflected in higher property/land prices used in the 'amenity' category, and that any benefits in the 'enabling development' category also contribute to economic growth. However, if no monetary assessment is undertaken, there is no risk of double counting benefits in this category.

Confidence scores

Given the lack of clear evidence relating to the impact of SuDS on economic growth, attach a low confidence score to any estimate of benefits derived in this category (either 25% or 50% depending on the likelihood of such impacts occurring).

4.2.3 Tourism

The impact pathway

SuDS can potentially, through enhancing the attractiveness of an area, lead to an increase in visitors and contribute to specific areas of tourism such as nature-based holidays (Natural England, 2014). A potential impact pathway is shown in Figure 4-20.

Figure 4-20 Impact pathway for tourism

Method of assessment

This work identified no studies rigorous enough to quantify and value the contribution of SuDS to tourism to include in the tool. Therefore, there is no need to assess potential benefits in this category, beyond a simple qualitative assessment or description of possible benefits. The impact contains a subjective scoring approach that considers the magnitude of the scheme to tourism and the size of the area impacted. These are summarised for all relevant non-quantified benefits to enable a comparison when more than one option is being considered.

Quantifying benefits

Benefits in this category should not be quantified without local evidence or evaluation study.

Monetary values

There are no monetary values to support assessment in this category.

Avoiding double counting

It is possible that any benefits in the 'Amenity', 'Economic growth' and 'Recreation' categories may include some values related to the potential for increased tourism. However, if no monetary assessment is undertaken, there is no risk of double counting benefits in this category. Nevertheless, if benefits to tourism are important for the scheme, consider setting out where any overlap in benefits between these categories may exist.

Confidence scores

Given the lack of clear evidence relating to the impact of SuDS on tourism, attach a low confidence score to any estimate of benefits derived in this category (either 25% or 50% depending on the likelihood of such impacts occurring).

4.2.4 Traffic calming

The impact pathway

SuDS components can include measures directly or indirectly related to traffic calming (e.g. build outs such as bioretention areas). These can, in turn, deliver benefits such as reduced risk of road accidents or increased opportunities for street-based recreation. Whilst it is very difficult to directly and robustly link SuDS to traffic calming, Figure 4-21 shows a potential impact pathway.

Figure 4-21 Impact pathway for traffic calming

Method of assessment

The size of the benefits will be very site specific for this impact and is difficult to specifically link SuDS to traffic calming. However, where an evaluation has taken place on the benefits of SuDS (e.g. road build outs), this can be included within TC2. Otherwise assess the potential benefits in this category using a simple qualitative assessment or description of possible benefits. The impact contains a subjective scoring approach that considers the magnitude of the scheme to support traffic calming and the size of the area impacted. These are summarised for all relevant non-quantified benefits to enable a comparison when more than one option is being considered.

Quantifying benefits

Benefits in this category should not be quantified without local evidence or evaluation study.

Monetary values

The government does publish information on the economic value of road accidents (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244913/rrcgb2012-02.pdf) However, impacts in this category should not be valued at this stage without local evidence.

Avoiding double counting

There is no risk of double counting benefits in this category.

Confidence scores

Consider the types of components proposed and whether they will provide the same benefit as non-SuDS traffic calming features. Where a similar impact is expected, a higher confidence value will be appropriate.

4.3 User defined benefits

Other local benefits may arise that the tool currently does not account for. To support this, a separate sheet is provided that enables up to five other benefits to be included in the tool. In this situation, add the annual impact and it will calculate the present value. As these are user defined, it is necessary to link this to the *'Summary Results ESS', 'Summary Results TBL'* and *'Sensitivity Analysis'* to ensure they are displayed in the graphs and overall results. This includes linking its name, and the values

4.4 Defining timescales

The date assumed at which benefits start and end, and the profile of change in benefits over this period, can have a significant impact on the results of the assessment. Figure 4-22 illustrates this.

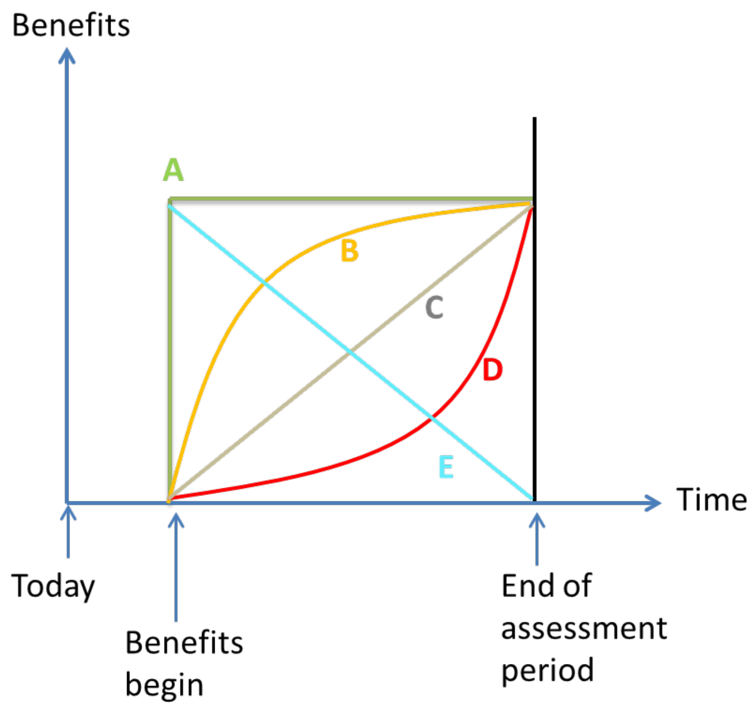


Figure 4-22 Impact of benefits profile

A key assumption in the tool is that in any given benefit category, benefits begin at some point in the near future (perhaps after construction of the SuDS and with a possible delay before they accrue) and end after a certain amount of time (the end of the assessment period). The user can select the start and end period by selecting any year between 2013 and 2120. If benefits are expected to start accruing later than half-way through a year, select the following year as the start date. The tool applies the profile automatically based on selection of start and end dates. It typically assumes that the full amount of benefits accrues from the start of the assessment period until the end (line A), although some increase gradually (line C) and others linked to trees (e.g. carbon sequestration) are variable (line D). However, it may be that benefits in fact increase more gradually, for example in either a linear (line C) or non-linear (lines B and D) fashion. This may be the case for amenity-type benefits in particular, since the attractiveness of the SuDS may take time to develop as vegetation becomes established. It could also be the case that benefits decay over time (perhaps to reduced effectiveness of SuDS components). This case is shown as line E.

In each benefit category, select the evaluation period (start year and end year, although a period of time for plants to mature may be appropriate before the impact truly starts therefore entering a later start date). In most cases, the start year will be the first or second year following construction of the scheme. Typically, consider matching the end year with the life of the asset. In the absence of information on the life of the asset, consider using a default value of 40 years, with a suggested range of 20 to 60 years. It is possible that some benefits will only extend over short time period, in which case enter shorter time horizons. Likewise, some will extend well beyond this (and indeed may continue indefinitely), although the discounting process (see Section 4.5) limits the impact of such long-term benefits.

4.5 Applying BeST retrospectively

At present, the tool does not allow for the assessment of schemes with a start date prior to 2014. This would require monetary values to be deflated (reduced to take account of past inflation) and the discounting process applied in reverse.

Allowing retrospective application of BeST would probably be worthwhile if there was a significant divergence between inflation over recent years and the discount rate applied. However, inflation since 2000 has generally been between 1 and 5%, and has been broadly similar to the default discount rate of 3.5%.

For example, £1 million in 2013 prices is, after taking account of inflation, about £750,000 in 2000 prices. Applying reverse discounting to this at 3.5% per year gives a 2013 value of £1.018 million. So taking a start year of 2013 rather than 2000 is unlikely to make a significant difference to the final result.

4.6 Discounting future benefits and calculating present values

As discussed in Section 1.3, *all* benefits occurring in the future need to be discounted to today's prices, so that present values can be estimated. The tool automatically carries out the discounting process in the *'Present Value'* sheet, recommending a default discount rate of 3.5%, based on the information provided relating to the start and end year of benefits in each category. The default discount rate can be changed on the '*Project inputs*' sheet. Furthermore, it is possible to introduce variable discount rates by directly amending the discount rate in the *'Present Value'* sheet. Note that this overwrites the formula linking to the *'Project Inputs'* sheet.

5 SUMMARISING AND PRESENTING RESULTS

5.1 Summary results pages

5.1.1 Results summary for single option

The tool automatically summarises and presents the results of the assessment based on an assumed 2013 base year. Results are collated under:

- **Summary of outputs – Monetised:** this brings together all the key information for all benefits (whether evaluated or not) including the present value of the benefits (pre and post confidence), confidence values and the start/end year of the evaluation for each benefit. This includes a colour coding that indicates which benefits are greater than 10% of the overall monetised values; and
- **Summary of outputs** – **Qualitative**: this tabulates the non-monetised impacts that have been subjectively scored.

The 'Summary results ESS' sheet shows the monetised impacts, broken down by ecosystem service category. The 'Summary results TBL' sheet does the same by triple-bottom-line category.

Where the tool is run more than once (for example to assess the benefits from different options), save these assessments individually and copy the results into the 'Scheme Comparisons' Tool. This provides a comparison of up to four options, creating a small number of graphs.

Note, if adding user defined benefits, link these (link the cells in the summary sheets to the cells in the user defined or sensitivity analysis pages) to these summary pages, depending upon the ecosystem services or triple bottom line category they fit within.

5.1.2 Assessing the balance of the benefits – flexibility score

When evaluating an option, the tool provides a measure of the balance or distribution of the benefits in the medium to longer term. The tool automatically indicates the flexibility of the option's performance statistically using the monetised present values. The assessment approach uses a simplified version of an established tool called COFAS (Comparing the Flexibility of Alternative Solutions) as developed by Eckart et al (2012). It provides an assessment of flexibility on a scale of 0-100%, with the higher the score signifying greater flexibility. The tool shows these values on the Summary Results pages.

This method is equally applicable to conventional, SuDS and grey/green approaches as it focuses on the size and distribution of the benefits. The evaluation considers the relative homogeneity of the selected benefits, i.e. it considers the uniformity across the various benefits in monetary terms. Therefore where there are large differences in the size of the individual benefits, such as one benefit dominating the overall benefit value, then the flexibility score will be low. It can help to indicate the risk that if dominant benefit was to reduce substantially, or become less important in the future, then the overall benefit value will also decrease substantially.

When an option provides a small number of benefits, the methodology becomes less applicable. For example, if an option generated only two benefits (as is possible for a piped option), then the tool calculates internal homogeneity for these two benefits only (with such benefits likely to occur in the short term). The flexibility score will be high if they are comparable in value. However, given the uncertainties of the future, where an option had very few benefit categories, or a number of relatively low value benefits it would not, by definition, be very flexible. The most flexible options are those with a wide number of benefits each of comparable value. This is because particular benefits may become more or less valuable in the future.

Therefore, flexibility is likely to be more important for the medium to long-term performance of the option. Assessment of the option using the tool in the short term may not necessarily be significant in decision making now. However, the flexibility score gives an indication as to how the option may be modified in the future to ensure it continues to provide benefits in the longer term. Note that further work in 2015 to develop supplementary guidance will explain how to consider flexibility in the medium to longer term.

5.2 Assessing whether detailed/local benefit evaluation is required

In some cases, it may be appropriate to obtain more detailed, locally based information, perhaps to increase the robustness of the assessment or to incorporate new information. This is likely to be the case where benefits in one (or a few) particular categories appear to be very important in terms of the final result. Where this is the case, identify what information or data can be improved and re-run the tool.

5.3 Comparing options

The result of different schemes can be compared in W045b BeST Scheme comparisons Tool.

5.3.1 Bringing in costs

Enter the cost of the option in the ‘Project Inputs’ sheet in the evaluation tool and ‘Scheme Comparisons Tool’. These may include both financial costs (e.g. capital equipment, operating expenditure and opportunity cost of providing land for SuDS) and other costs (e.g. social or environmental costs such as embodied carbon in materials).

Enter whole life costs, that include capital and operational (maintenance) costs of each option. The costs should cover the total, combined costs of all SuDS components related to the option, since this will ensure comparability with the benefits. For example, if it is necessary to include specific design components (e.g. paths, benches) in the option to help realise certain amenity type benefits, then capture these in the costs and bring into the tool.

Crucially, the cost information should be in the same format as the benefits. This means that the base year (generally 2013) and timescales should be equivalent with the same discount rate should be used. If this is not the case, the costs and benefits will not be comparable.

Just as there is uncertainty around any benefits from SuDS that are valued, there is likely to be uncertainty around costs. Where sensitivity analysis using different (e.g. low and high) cost estimates is required, simply re-run the tool using the alternative estimates.

One important aspect to consider when bringing costs into the assessment is the potential for optimism bias, i.e. systematically underestimating costs or the duration of works. The Green Book (HM Treasury, 2013) provides supplementary guidance on optimism bias. This recommends the adjustment of costs for a variety of project types. For example, capital expenditure costs for standard civil engineering projects should be adjusted by 3 per cent (lower) to 44 per cent (higher). The guidance also includes a discussion on reducing optimism bias and applying the concept to operating costs and benefits. There are different methods for taking account of optimism bias (e.g. the Environment Agency uses Monte Carlo analysis in flood and coastal risk management, but a flat rate such as that recommended by the Treasury in other areas).

5.3.2 Decision rules

Decisions around drainage investment will generally take account of a range of considerations, including social acceptance, political will and economic efficiency. The two main decision rules automatically generated by BeST relating to economic efficiency are Net Present Value (NPV) and Benefit Cost Ratio (BCR).

The NPV is calculated as: *NPV = PV of benefits - PV of scheme costs*

The NPV is the basic measure of the economic gains (or losses) resulting from a SuDS scheme. A positive NPV indicates that a project is justified as it yields a rate of return which is greater than the discount rate. When comparing alternative options, that with the highest NPV becomes preferred (as the greater the NPV, the greater the benefits to society). In the (unlikely!) case of an unlimited budget for SuDS, it would be economically desirable to undertake all of the projects for which the NPV is greater than zero. When the budget is limited, such that only one or a few projects can be undertaken, investment funds are scarce (because there are still projects yielding a rate of return in excess of the discount rate). In these cases, project selection includes the use of the BCR.

The BCR is calculated as: $BCR = \frac{PV\ scheme\ benefits}{PV\ scheme\ costs}$

The BCR demonstrates which scheme provides the largest benefit per pound of expenditure. This is valuable information when trying to prioritise between schemes. Because of the revenue competing character of the decision, it is typically important to obtain the largest benefit for every pound of money spent.

5.4 Dealing with non-monetised benefits

It is likely that some of the benefits associated with SuDS schemes are not amenable to valuation, and particular benefit categories have been included in this guidance where valuation is difficult or not possible (see section 4.2). However, these could be important and non-valued effects should remain part of the decision making process.

There may also be other potential benefits that are not currently captured by the tool, including knowledge building, building a skilled workforce, speeding up building for developers, ease of auditing and controlling contractors work (since it is above ground and visible).

Finally, there may also be benefits of wider green infrastructure initiatives of which SuDS form a part but are not the principal component. This may include programmes to develop sustainable transport or to green urban areas. In these cases, it may be possible and appropriate to allocate a certain proportion or percentage of the benefits of the whole programme to the SuDS component.

For these categories, use a qualitative ranking score. Where this score is 4 (high benefit) or 5 (significant benefit), consider explicitly bringing these into the assessment. There are two possible ways of doing this:

- Calculating 'switching values' or 'implied values. For example, for a scheme costing £10 million with valued benefits of £9 million, any non-valued benefits would need to have an implied value of at least £1 million to switch the NPV to positive and make it worthwhile for the scheme to go ahead. It may be necessary for a group of key stakeholders to determine whether such implied values are realistic and whether any further investigation or assessment is required; and
- Formal use of non-quantitative assessment techniques. There are several methods of formally scoring and weighting non-valued impacts, the most notable of which is multi-criteria analysis. The government has provided detailed guidance on this (Defra, 2011b, 2011c; CLG, 2009). The use of such techniques may be appropriate if non-valued impacts are considered to be particularly important or significant, or of specific concern to some stakeholders.

6 CONSIDERING UNCERTAINTY AND APPLYING SENSITIVITY ANALYSIS

6.1 Sources of uncertainty

As discussed in Section 1.4, there are various sources of potential uncertainty in assessments of benefits, although generally these are not specific to SuDS and may equally apply to any type of drainage infrastructure or investment. Indeed, most uncertainties are ubiquitous in the design, function and operation of traditional drainage systems, and in this respect SuDS are no different.

Figure 6.1 illustrates examples of the areas where there are uncertainties in SuDS design, operation and performance. There are also uncertainties in the systems and processes that SuDS interact with. This figure contains the traditional vision for SuDS with the four attributed and established benefit categories:

- water quantity,
- water quality
- amenity and
- biodiversity

However, there is also uncertainty in financial benefits and costs and hence Figure 6-1 also includes this aspect.

Figure 6-1 Examples of areas of uncertainties in relation to valuing the multiple benefits of SuDS (note: this is not an exhaustive list)

There are uncertainties in the main areas of interest for those using SuDS and seeking to create the greatest benefits as illustrated in Figure 6-1. Here generic aspects are considered that allow primary areas of uncertainty to be defined; there are six main aspects considered here under which uncertainties in valuing the impacts of SuDS are being addressed:

1. **Physical data** – the dimensions and attributes of the SuDS and related impacted systems, such as receiving water bodies. This also includes how these dimensions change over time – with staged investments, expansion etc. Significant uncertainties may relate to the location and extent of SuDS, especially where a single or local development is part of a wider catchment.

2. **Construction and decommissioning** (temporary impacts) – e.g. relating to periods of disruption and for which there may mainly be negative impacts (as with any drainage scheme). However, there are some potentially beneficial impacts e.g. reuse or recycling of decommissioned components of SuDS.

3. **Operational performance** – including how well SuDS manage surface water flows and volumes, enhance environmental quality, deliver amenity and enhance biodiversity. Key to operational performance is satisfactory and expected outcome(s) regarding the level(s) of performance (overlaps with 5 below).

4. **Valuation of benefits** – includes how robust the monetary benefits estimates are, related to the performance (in 3) above and if these benefits are actually realised in practice (overlaps with 5 below). In particular, the uncertainties of monetary value transfer from 'standardised' or base data, such as ecosystem services valuations or other deemed similar schemes.

5. **Changes over time** – the external drivers (those outside the control of the decision maker and system operator, such as environmental factors) for the urban drainage system will alter with time due to climate etc. as will the internal drivers (e.g. corporate strategy) and processes regarding e.g. expected and required levels of performance long term (overlaps with 3 and 4 above). Here the particular uncertainties relate mainly to the external drivers and the timing of investment stages, e.g. has/will the climate alter /change as anticipated; the system been/be maintained, upgraded or modified as planned and in the stages envisaged?

6. **Perspectives of users and decision makers -** There are significant cultural aspects of how benefits and uncertainties are perceived (Kenter et al, 2014; Church et al, 2014). Furthermore there are in-built bias in the way decisions are arrived at (Jonas et al, 2008; O'Hagan et al, 2006). Often, preconceived or established practice in ways of delivery of professionals in their practice inhibits their ability to see better ways of delivery. This is sometimes termed the 'Einstellung Effect' and refers to the blocking effect of the first or usual idea as to how to deliver an outcome inhibiting innovative ideas being taken up (e.g. Biliac et al, 2008). It is often recommended that group deliberation is a better way of addressing the need to avoid individual bias, but this depends upon the group, as groups may also have in-built bias.

In each of the above areas, there are varying degrees and scales of uncertainty, depending upon the criteria, attributes and processes involved. For example, 'performance' in (3) will in many cases be assessed beforehand by using appropriate computational models. Therefore the model assumptions, performance and limitations as well as the data input will contribute to the overall uncertainties. Following construction and commissioning, the SuDS performance can be verified by post-project monitoring (against the predicted value).

Figure 6.2 illustrates an example of an impact assessment process, showing where the uncertainty groups above are relevant. This shows only an illustration of the quantitative impacts and some of the key components of the process where uncertainties exist.

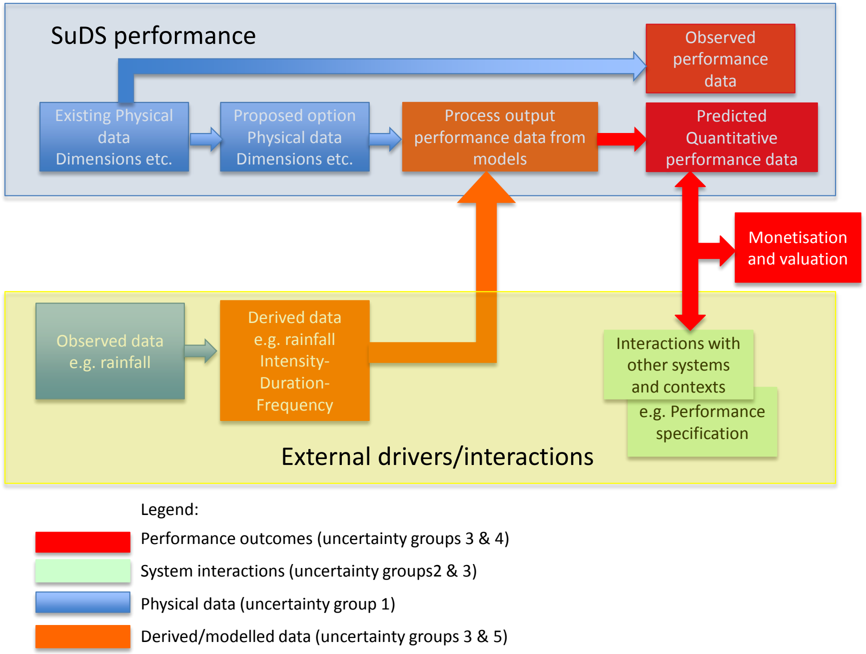


Figure 6-2 Illustration of areas of uncertainties in assessing the impacts of using SuDS

There are uncertainties to a lesser or greater extent in each of the boxes shown. Note also that some boxes overlap, for example, models have originally been developed using data from one context and a particular application may not necessarily be similar to the data and assumptions used in the model development.

6.2 Dealing with uncertainty

The tool includes two primary sets of information:

- the physical base data relating to performance of the SuDS defined in the various criteria and parameters (see outline of impact assessment tool); and
- numerical values related to these and the monetisation or valuation of this data.

For example, a new development using SuDS with green infrastructure may lead to avoided emissions or the sequestration of many tonnes of CO_2 – the numerical data is therefore X tonnes of CO_2. The impact value of this may be determined by standardised, nationally set monetary benefit estimation – monetisation of the benefits shown by the physical data – i.e. £ per unit of CO_2 sequestered multiplied by the X tonnes.

However, there are certain criteria or impacts that are not readily quantifiable. For example, it is generally accepted that SuDS have greater flexibility and are more adaptable than traditional piped drainage systems. However, there are no ‘easy’ means (yet) of quantifying this flexibility, although techniques that show SuDS to be more flexible have been developed (Peters et al, 2010). Given the ongoing challenges from urbanisation and changing climate over time, flexibility is a significant factor in considering the best option for managing surface water and potentially a major benefit provided by SuDS. Especially as many practitioners and researchers are now claiming that flexibility in urban drainage infrastructure is essential (Willems et al, 2012). For such impacts, their quantification is not yet possible and a set of preferences is typically used, such as high-medium-low categories of flexibility, or some indicator(s) that can be used as a ‘measure’ of flexibility are determined. This approach is useful for comparative purposes, whereby considering one option against a baseline or compared with alternative option(s).

The tool considers uncertainty in two ways for monetised benefits, using confidence scores (as outlined in each benefit category in section 4) as a surrogate. It is built into the spreadsheet tool accordingly:

1. Ranges of quantitative estimates and monetary values are permitted and/or recommended (before selecting a single value);
2. User-defined confidence scores relating to both quantified estimates and monetary values.

For non-monetised benefits, a single confidence score is used to apply to the subjective scores developed.

This approach complies with a number of the standard approaches, amending the format in a way to suit the application. The use of ranges and confidence scores helps to ensure outputs are grounded in reality and consistent with expectations. However, for greater investments, such as the use of SuDS in major developments, strategic retrofitting (over a period of time) masterplanning or costly 'showpiece' investments like the Olympic Park, more complex techniques to assess the uncertainty and manage its consequences on the decision process are recommended.

6.3 Sensitivity analysis

Sensitivity analysis involves testing the robustness of the result by changing one or more of the key parameters in the assessment. When undertaking sensitivity analysis, it is important that the user carefully considers which parameters are having the most impact on the results of the assessment, and whether there is a justification for adjusting these to test the robustness of the result.

The tool includes a separate sheet to help users undertake simple sensitivity analysis, and illustrate whether categories form >20% or 10-20% of the total value of benefits (before confidence applying scores). It carries forward a number of key parameters from the main assessment and allows the user to alter the confidence scores (25%, 50%, 75%, 100% and 125% values). Where more detailed sensitivity analysis is required, then the tool can be re-run and the results used to consider a wider variety of changes such as amending:

- **the discount rate** - (for comparability, the discount rate used should be applied throughout the assessment, i.e. to all monetised benefit categories and to all costs)
- **assessment period** (when benefits start and end)
- **quantified estimates of physical impacts -** to keep the tool as simple and user-friendly as possible, the sensitivity sheet only carries forward the final 'quantified value'. Where a number of separate quantities or components go to make up this final number, the user has the choice to either: (a) override the quantified value from the main assessment and insert a lower or higher number, or (b) run the assessment again using different 'sub components' to come up with a new final quantity. In any case, the approach taken and assumptions made should be recorded in the final column of the sensitivity sheet.
- **alternative monetary values** (or use of high and low values where available)
- **alternative cost estimates**
- **confidence scores**

One particular consideration when undertaking sensitivity analysis is the risk of double counting, a risk which is highlighted throughout this guidance. For example, when valuing impacts for a scheme where the risk of double counting is high (e.g. amenity, recreation and biodiversity), a useful approach can be to set impacts in all but one of these categories (that with the largest monetary value) to zero. Achieve this by setting the confidence score to 0% in the sensitivity sheet. View the results of the assessment having essentially eliminated any risk of double counting across impact categories.

Finally, note that where the user has brought in values relating to the above parameters from elsewhere (e.g. from modelling work), any changes to these as part of sensitivity analysis will mean the tool has to be run again, since there is no mechanism by which the sensitivity sheet can incorporate these values and automatically update the results.

7 USING THE RESULTS

7.1 Summary report of inputs, selected values and reasoning

The tool automatically generates a number of graphs, tables and other information. These are offered to help the user and can be copied directly into presentations and reports. The tool also contains an export function to word for the graphs, for ease of use. Alternatively, the data can be copied and new graphs created.

7.2 Using and applying the results to support decisions

The guidance highlights throughout that the tool can only provide an *indication* of the likely benefits associated with SuDS (or other drainage scheme). There are many potential sources of uncertainty, relating to both benefit and cost estimates. Whilst we have attempted to adopt a conservative approach throughout (so that benefits are not exaggerated), actual benefits could be higher or lower than those estimated using the tool. Therefore, where significant investment is planned, or where a decision may be contentious, consider completing a locally specific, bespoke analysis.

7.2.1 Equity and distributional issues

As discussed in Section 2.3, the tool does not currently include an assessment of distributional impacts (i.e. who benefits). However, some key points that may inform a distributional assessment are worth re-iterating.

- For some impact categories (e.g. amenity, recreation, health), the 'beneficiary population' will be limited to those who will make use of or directly benefit from the improvement (e.g. those living or working nearby or visiting). In other cases (e.g. water quality and biodiversity improvements), the beneficiary population may also include 'non-users', i.e. those who do not directly make use of the improvement but still derive some benefit from it.
- Whilst some beneficiaries may be involved in funding or implementation, in many cases there may be no apparent or straightforward rationale for linking funding, implementation, responsibility and benefits.
- In general, the direct beneficiaries of SuDS schemes (as with many drainage interventions) tend to be local, whilst those typically funding the schemes tend to include a larger population (e.g. water company customers or council tax payers).
- Some of the benefits of SuDS are likely to be private benefits, i.e. they accrue only to specific groups or organisations. Examples of private benefits include household flood risk reduction and health benefits to recreational users. However, there are also likely to be public benefits arising from any SuDS scheme, e.g. mitigation of carbon emissions or reduced burden on the NHS due to health improvements.
- Where the distribution of benefits is of specific concern and/or the magnitude of its impact is large, it may warrant further analysis.

7.2.2 Stakeholders and funders

Section 2.3 highlighted the key issue of beneficiaries related to SuDS and the different stakeholder groups to which these beneficiaries may or may not belong. At the end of the assessment, consider revisiting the list of potential stakeholders and the expected benefits that different groups or organisations may derive from the SuDS scheme. In particular, it may be possible to identify potential new funding routes based on the assessment. Further possibilities and case studies are available via Defra's 'payments for ecosystem services' web pages, see https://www.gov.uk/government/publications/payments-for-ecosystem-services-pes-best-practice-guide (See also Valderrama et al, 2013).

Potential funding routes might include:

- Recent totex-based changes to water company accounting rules, which mean that SuDS components no longer need to automatically treated as opex;
- Biodiversity offsetting schemes, where organisations offer financial contributions to schemes that deliver biodiversity benefits;
- Public private partnerships;
- Community or crowd financing;
- Credits for and trading of surface water management;
- Funding from third parties (e.g. health service providers); and
- New business models for delivering drainage solutions (e.g. stormwater service companies).

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9 APPENDICES

Appendix 1 - Common habitat and biodiversity types
Appendix 2 - Glossary of terms
Appendix 3 - Abbreviations

APPENDIX 1 – BIODIVERSITY AND ECOLOGY IMAGES

Urban & suburban habitats

Grass verge

Low biodiversity value verge – monoculture grassland heavily managed, offering little structural diversity.

Moderate connectivity with existing grassland and gardens

Image courtesy of Kenneth Allen (license CC BY-SA 2.0)

Grass verge

High biodiversity value wildflower verge. Structurally diverse with numerous native species present.

Good connectivity with existing hedges, trees and grassland.

Image courtesy of Dave Spicer (license CC BY-SA 2.00)

Urban & suburban habitats

Linear wetland/ditch

Attenuation ditch designed to maximise biodiversity value, with good range of wetland plants.

Good connectivity with existing grassland and scrub habitats.

Image courtesy of Susdrain

Drainage ditch

Drainage ditch with low biodiversity value. Trapezoidal ditch offering no marginal habitats and very heavily managed.

Moderate connectivity with existing heavily managed grassland.

Image courtesy of JThomas (licence CC BY-SA 2.0)

Urban & suburban habitats

Typical urban hedge

Low biodiversity hedgerow. Heavily managed and single species, offering little structural diversity.

Moderate connectivity with existing hedges, trees and garden shrubs

Image courtesy of SJB (license CC BY-SA 2.0)

Road-side hedge

High biodiversity value hedgerow. Structurally diverse with numerous native species present.

Excellent connectivity with existing hedges, trees and garden shrubs

Image courtesy of Rob Allday (license CC BY-SA 2.0)

Urban & suburban habitats

Amenity grassland

Monoculture amenity grassland with little structural diversity. Low biodiversity value.

Moderate connectivity with existing grassland habitat and ornamental shrubs.

Image courtesy of Jonathan Kington (license CC BY-SA 2.0)

Suburban grassland

Meadow adjacent to housing estate. This is less intensively managed and has some structural diversity. Moderate biodiversity value.

Good connectivity with existing grassland habitat and garden trees/shrubs.

Image courtesy of Michael Hogan (license CC BY-SA 2.0)

Swales

Linear wetland (wet swale)

Moderate biodiversity value – good use of native planting of reed to provide a wetland habitat.

Reasonable habitat connectivity with grass banks.

Image courtesy of Susdrain

Grass (dry) swale

This heavily managed swale is more typical of amenity grassland. The biodiversity value of this swale could be improved through changes in management to provide a more diverse sward.

Reasonable habitat connectivity with grassland and scrub

Image courtesy of Susdrain

Attenuation ponds

Attenuation pond habitat

High biodiversity value – this SuDS pond has been designed to incorporate gentle margins and includes wetland plants.

Good connectivity to existing habitat.

Image courtesy of Susdrain

Attenuation pond

Low biodiversity value – no natural profiles or wetland planting incorporated. Pond is very ‘engineered’.

Image courtesy of Jonathan Wilkins (license CC BY-SA 2.0)

Detention basins

Drainage pond

Low biodiversity value – steep profiles and monoculture grassland provides very little habitat.

Image courtesy of Robert Struthers (license CC BY-SA 2.0)

Detention basin

High biodiversity value – this SuDS pond has been designed to incorporate gentle margins and includes wetland plants.

Moderate connectivity to existing habitat.

Image courtesy of Susdrain

Detention basins

Detention basin

Mono-culture grassland managed as amenity grassland. Low biodiversity value.

Reasonable habitat connectivity with adjacent 'gappy' hedgerow

Image courtesy of Susdrain

Detention pond

Moderate biodiversity value – some wetland plants incorporated within SuDS, but adjacent grassland is species poor.

Good habitat connectivity with mature hedgerow.

Image courtesy of Susdrain

Constructed wetlands

Constructed wetland

Moderate biodiversity value.

Moderate connectivity with existing habitat.

Image courtesy of Susdrain

Constructed wetland

Moderate biodiversity value – good use of native planting of reed to provide a wetland habitat.

Good connectivity with existing grassland and woodland habitat.

Image courtesy of Susdrain

Green roofs

Traditional sod roof

Moderate biodiversity value – more diverse sward could increase biodiversity value of grass-roofs.

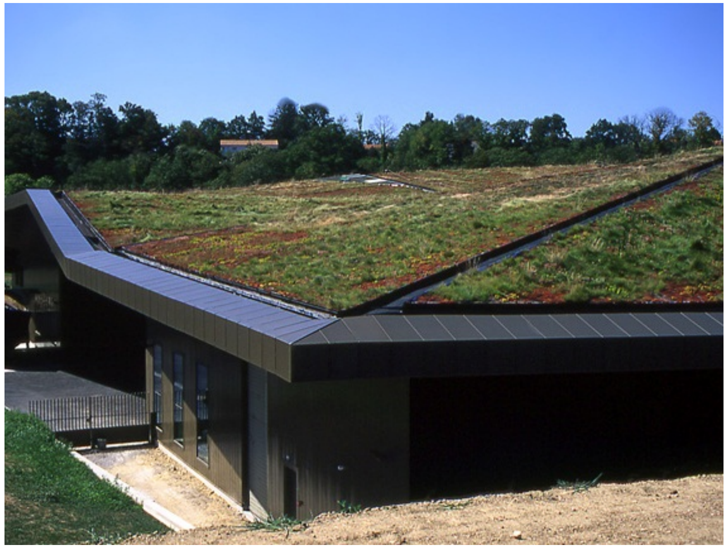
No connectivity with existing habitats, except via birds and insects

Image courtesy of Erik Christensen (license CC BY-SA 3.0)

Sedum roof

This roof has been planted with native species, potentially with high biodiversity value.

No connectivity with existing habitats, except via birds and insects



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APPENDIX 2 – GLOSSARY OF TERMS

Baseline	The actual or assumed situation at the present time, often used as a starting point for comparisons or future projections.
Benefit category	A classification used to group benefits.
Capital costs	The monetary costs required to establish a project such as purchasing equipment and land. It includes all costs such as construction, equipment and labour to the point of operation, after which costs become maintenance and operation costs.
Confidence	A value attributed to the method to estimate a quantity or the monetary value to indicate the confidence in the values being used / applied.
Cost savings	An action that will result in the desired outcome at a lower cost than previous or projected costs.
Discount rate	The rate at which future costs and benefits are discounted to bring them into today's prices (present values). The social discount rate recommended by HM Treasury is currently 3.5%.
Discounting	A method for converting future costs or benefits to present values using a discount rate.
Ecosystem goods and services	The benefits that people get from the natural environment.

Long run variable cost	The cost of providing (in this case) energy in the long run, based on retail prices but excluding fixed costs (that will not change in the long run despite a sustained marginal change in energy use) and transfers between groups in society.
Maintenance costs	The costs required to keep a project or enterprise working as intended, such as repairs.
Option	Action available to deal with improving an asset. For example reducing flood risk by introducing SuDS.
Millennium Ecosystem Assessment	A project which assessed the consequences of ecosystem change for human well-being. Carried out between 2001 and 2005, the Millennium Ecosystem Assessment provided an appraisal of the condition and trends of the world's ecosystems and the services they provide.
Operating costs	The costs required to administer a project or business on a day to day basis. These include things such as overheads and materials.
Present value	The value of a future amount of money today.
Value	The contribution of an action or object to user-specified goals, objectives or conditions
Valuation	The process of expressing a value for a particular good or service in a specific context, usually measured by something that can be counted, such as money

APPENDIX 3 – ABBREVIATIONS

AAD	Annual Average Damage
BeST	Benefits of SuDS Tool
BCR	Benefit Cost Ratio
Btu	British Thermal Unit
CBA	Cost Benefit Analysis
CSO	Combined Sewer Overflow
ESS	Ecosystem Services
EU ETS	European Union Emissions Trading Scheme
HEAT	Health Economic Assessment Tool
HER	Hydrologically Effective Rainfall
LEAPs	Local Environment Action Plans
LNRs	Local Nature Reserves
LRVC	Long Run Variable Cost
MORECS	Meteorological Office Rainfall and Evapotranspiration Calculation System
NPV	Net Present Value
NWEBS	National Water Environment Benefits Survey
RFF	Reasons for Failure
RICS	Royal Institute of Chartered Surveyors
SINCs	Sites of Interest for Nature Conservation
SMUD	Sacramento Municipal Utility
SuDS	Sustainable Drainage Systems
TBL	Triple Bottom Line
UPM	Urban Pollution Management
WACC	Weighted Average Cost of Capital
WFD	Water Framework Directive
WTP	Willingness to Pay
WWTW	Waste Water Treatment Works