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HOMBRE

"Holistic Management of Brownfield Regeneration"

D 5.2: Decision support system on soft reuses

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Title	Decision support system on soft reuses.
Lead Author	Victor Beumer, Deltares, (www.deltares.nl)
Main contributors	Paul Bardos, r3 environmental technology ltd (r3), (www.r3environmental.com) Pierre Menger, Tecnalia (www.tecnalia.com)
Additional contributors	Jaimie Bingham (Derbyshire County Council), Linda Maring (Deltares), Sophie Moinier (Deltares), Erika Rizzo (University of Venice), Ian Stephenson (Vertase-FLI), Peter Storey (Derbyshire County Council)
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Disclaimer

Summary

Often brownfields reuse is considered in the context of hard reuses such as for housing, business parks or infrastructure. Soft end uses, such as green space or biomass production, can tend to be overlooked. However, soft end uses can provide services which enhance regeneration, both in their own right and when integrated with hard uses such as for buildings.

Depending on design, some examples of these services are:

- Provision of open space in urban areas of in and around new development areas, which brings benefits for well-being, health, leisure and sense of place,
- Providing green infrastructure and services related to mitigation of heat island effects, mitigation of urban air pollution and encouraging habitat and wildlife
- Supporting the renaissance of and innovations in urban gardening, community gardens and urban farming increases demand for urban brownfields
- Supply of renewable energy and other environmental services (such as sustainable urban drainage).

Some services may generate revenue in their own right, some may be important assets to support public investment in regeneration, and some may have direct or indirect impacts on the value of built redevelopment (for example providing a framing which enhances property values, or providing local energy supply or other environmental services). Regeneration / redevelopment projects that deliver a broad range of services have both improved overall sustainability and enhanced economic value.

HOMBRE (Holistic Management of Brownfield Regeneration) was a major EU FP7 project which concluded in November 2014 (www.zerobrownfields.eu). One of its outputs is a simple design aid to help developers and others involved in brownfields to identify what services they can get from soft reuse interventions for their site, how these interact and what the initial default design considerations might be.

This report is the presentation and explanation on how to use this design aid to better assess and design soft reuse interventions and services within brownfield regeneration processes. We explain and show how we connect services with interventions and the other way around. How to implement this in the regeneration process in order to increase the overall project success and sustainability?

In the context of HOMBRE WP5, we have developed further the idea of soft reuse interventions being planned in brownfield regeneration projects to provide specific project services which in turn may also provide wider benefits, hence add further value to the project. In stakeholder engagement processes it is of utmost importance that stakeholders can understand the connection between interventions and services. For stakeholders services can be understood as ambitions (political) and desires (local). We have designed a matrix (the “Brownfield Opportunity Matrix”) that shows how these soft reuse interventions are connected to services. The matrix is intended for discussion purposes in stakeholder engagement processes and visualises the value projects may have for stakeholders, synergies between services or interventions and overall gives insight in the opportunities for regeneration of the Brownfield.

HOMBRE's "Brownfield Opportunity Matrix" is a simple Excel based screening tool that essentially maps the services that might add value to a redevelopment project against the interventions that can deliver those services. The "Brownfield Opportunity Matrix" is a simple Excel based screening tool that essentially maps the services that might add value to a redevelopment project against the interventions that can deliver those services, as shown in broad terms in below

Main services and interventions within the Brownfield opportunity matrix

Services	Interventions
• Soil Improvement • Water Resource Improvement • Provision of Green Infrastructure • Risk Mitigation of Contaminated Soil and Groundwater • Mitigation of Human Induced Climate Change (global warming) • Socio-Economic Benefits	• Soil Management • Water Management • Implementing Green Infrastructure • Gentle Remediation Options • Other Remediation Options • Renewables (energy, materials, biomass) • Sustainable Land Planning and Development

The matrix comes with a guide to assist stakeholders in agreeing which services are of most interest. The matrix itself comes in two levels of detail, a simple outlining matrix which simply allows mapping and links to examples of particular opportunities, and for subsequent use a more detailed matrix providing additional information. This maps the prospective range of opportunities that might be realised by a brownfield redevelopment project and the project's consequent sources of value. For each opportunity there is a hyperlink to additional information, including a case study. There is also supporting information to describe the various services and interventions listed in the matrix.

Overall the Brownfield Opportunity Matrix can:

- Support initial identification or benchmarking of soft reuse options for brownfields at early stage
- Support exploratory discussions with interested stakeholders
- Provide a structure to describe an initial design concept, in support for example of planning applications
- Provide a structure for more detailed sustainability assessment of different reuse combinations, and similarly for cost benefit comparisons.

The matrix can be used in stakeholder engagement processes at different moments and activities: during initial phase of collecting ideas, during more profound phase of redefining ideas on desired services and interventions, and during the review of the initial design of the brownfield to be regenerated. The Brownfield Opportunity Matrix has been tested in two case studies: Markham Vale (UK) and Cornigliano (Genoa, Italy).

Contents

1 Introduction

1.1 Brownfield soft reuse as an opportunity for delivering services

Brownfield sites are the secret weapon in delivering sustainable European cities. Such sites have been affected by former uses of the site or surrounding area. They are: derelict or underused; often in or near fully or partly developed urban areas; and possibly impacted by real or perceived contamination problems. They typically require intervention to bring them back to beneficial use (CABERNET 2007). The HOMBRE project's overarching aim is to develop new approaches to improve Brownfield (BF) regeneration in terms of performance and sustainability in a holistic way and show new opportunities to generate greater value for Private and Public investors.

At the core of HOMBRE's approach is the use of integrated processes ("treatment trains") to deliver optimised benefits for targeted beneficiaries, i.e. to deliver services. Thus, from HOMBRE's perspective, expanding and optimising services from Brownfield regeneration are fundamental as they multiply the chances to regenerate Brownfield and broaden opportunities for economic development, ecosystems, people and business.

Soft reuse of brownfield sites, such as for biomass production or green space, can provide services which enhance regeneration, both in their own right and when integrated with hard uses such as for buildings. One of the underpinning concepts of HOMBRE is that BF regeneration / redevelopment projects that deliver a broader range of services have improved overall sustainability and economic value (see Table 1.1). These services may have wider positive or negative effects, and overall sustainability is a function of the services and their wider effects, as set out in Figure 1.1.

Table 1.1: examples of value drivers for soft reuses on brownfields.

• In many European countries, densely urbanised areas still need the development of open spaces. Brownfield sites are potential locations for such open space. • A renaissance of and innovations in urban gardening, community gardens and urban farming increases demand for urban brownfields. • Soft reuses are an option for renewable energy generation (e.g. via biomass production or photovoltaics in open fields). • Soft reuses, if designed appropriately and sited at strategic locations, represent green infrastructure that offers communities such as mitigation of heat island effects, improved urban comfort • Trees and shrubs can improve urban air quality by filtering and retaining air particles and contaminants generated by traffic and industry as well as providing shade and eye-candy. Green infrastructure provides habitat for migrating birds and other species. • Many leisure activities are more enjoyable and effective in soft rather than hard landscapes (e.g. Nordic walking, ball games, boot camps, cricket).

Providing better and earlier identification of wider benefits (services) makes the initial appraisal of 'return on investment' more attractive and therefore more likely to attract support for a project. Equally the wider impacts of regeneration should also be included at an early

stage. Thus, the services delivered by a completed project are the project drivers that incentivise the investment necessary for a BF regeneration to take place. These form the overall "value proposition". The sustainability of the project is the totality of the services with the wider effects.

In specific contexts where the conventional financial benefits of redevelopment are not always easily identifiable, as is the case when brownfields are to be deployed for soft end-uses, decision-makers should be fully aware of the broader opportunities and benefits that can emerge. Soft reuses can address not only local but also regional and even global challenges (for example climate change resilience, energy generation, preserving biodiversity, reducing car dependency, offering educational and health facilities). Hence examining wider effects may actually also identify additional and hitherto unconsidered benefits for the project, and so improve overall value.

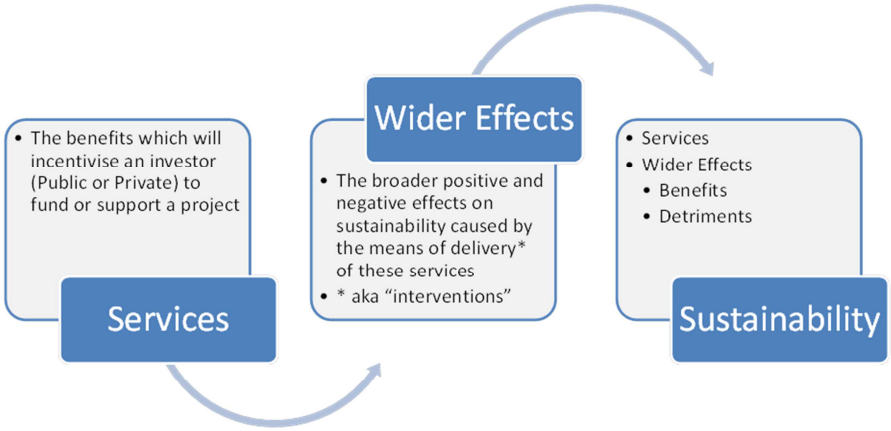

Figure 1.1: Brownfield regeneration project: drivers and sustainability.

1.2 Scope and objectives

The purpose of this report is to describe a decision support system that will allow stakeholders understanding and valuing where opportunities exist on their site and how could these be developed with the appropriate interventions.

HOMBRE's decision guidance for soft reuse is based on an iterative discussion process supported by simple tools to help decision makers identify what services they can expect from possible interventions on their site, how these interact and what the initial default design considerations might be. These support the activities taking place during the pre-exploratory and exploratory stages of decision making (as defined in Chapter 2), with the objective of improving overall sustainability and value.

The principle screening tool used is called the "Brownfield Opportunity Matrix" (BOM) and has been developed under HOMBRE for soft end uses only. It consists in a simple excel spread sheet. The matrix can be used to map the prospective range of opportunities that might be realised by a brownfield redevelopment project and the project's consequent sources of

value. It has been produced in two levels of detail, a simple tool linking to case studies, and one with additional information. It is supported by a simple structure to assist both project initiators, and wider groups of stakeholders identify the services they want from a project in a consistent framework, which can then be used with the matrix.

Overall the BOM can:

- Support initial identification or benchmarking of soft reuse options for brownfields at early stage
- Support exploratory discussions with interested stakeholders
- Provide a structure to describe an initial design concept, in support for example of planning applications
- Provide a structure for more detailed sustainability assessment of different reuse combinations, and similarly for cost benefit comparisons.

The BOM is intended to support an iterative discussion process during which stakeholders are identify opportunities, develop their ideas and finally agree an outline regeneration scheme, as described in Section 2.2. Its purpose is to guide stakeholders towards developing regeneration projects that will improve the overall value as a product of both the services delivered and their wider effects.

A project's overall value is described by HOMBRE as having three broad components (see Figure 1.2):

- Direct Financial Value = returns from services such as site value increase, revenues; vs. direct costs
- Tangible Wider Value = economically visible wider sustainability benefits and impacts
- Intangible Wider Value = wider sustainability benefits and impacts where monetary value is not easily agreed by stakeholders.

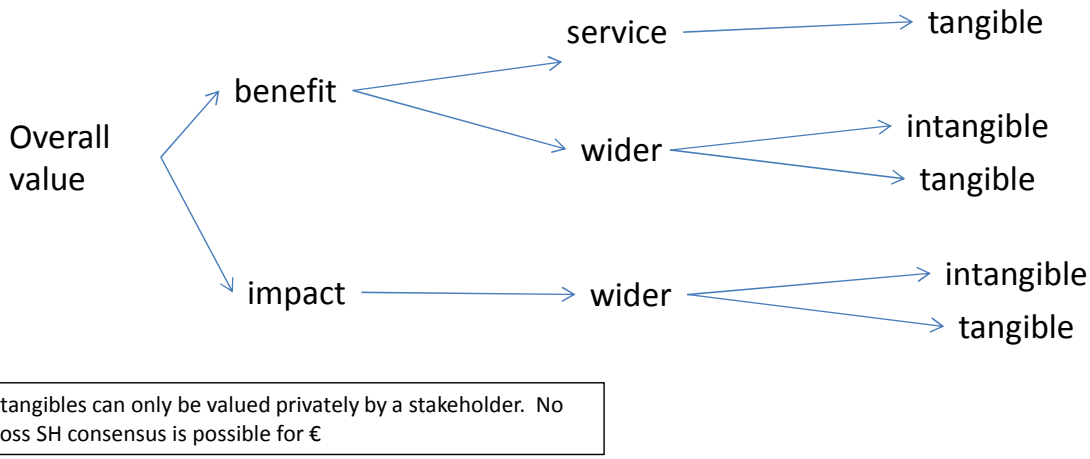

Figure 1.2: Components of overall value.

Additional conceptual tools and a more detailed discussion of "project services", "overall value" and how these link to ideas such as sustainability and ecosystem services is provided in HOMBRE deliverable D5.1 (Menger *et al.* 2013).

The BOM is available for download and use from the *Brownfield Navigator* (http://bfn.deltares.nl/bfn/site/index.php/standard/bfn_home). The Brownfield Navigator is an

online environment which accompanies and supports decision makers through the different management phases in the land cycle which also includes tools for describing and note taking on a geo-spatial basis the various interventions and their opportunities.

The BOM can also work with the HOMBRE Brownfield Remit Response tool (BR2), systems based analysis tool which allows a deeper understanding of urban systems and supports the comparison of the impacts and weaknesses of different regeneration options for a site. More information about and functionalities of the tool can be found in HOMBRE deliverable D6.2 Integrated framework for systematic evaluation of brownfield regeneration options. The matrix can use initial BR2 assessments to identify key driving forces for service requirements. The outputs of the matrix can also be fed back into the BR2 tool to describe a post regeneration/redevelopment status for a site.

2 Decision support for soft reuse

2.1 Decision support for soft reuse and the land management cycle

The decision-making supported by the BOM relates to pre-exploratory and exploratory stages where ideas are taking shape and first decisions are made in the "Make the transition" phase of the land management cycle. However, these stages also will include the definition of project objectives and hence the indicators against which these will be monitored which maps to "Check Performance" in the land management cycle as shown in the figure below.

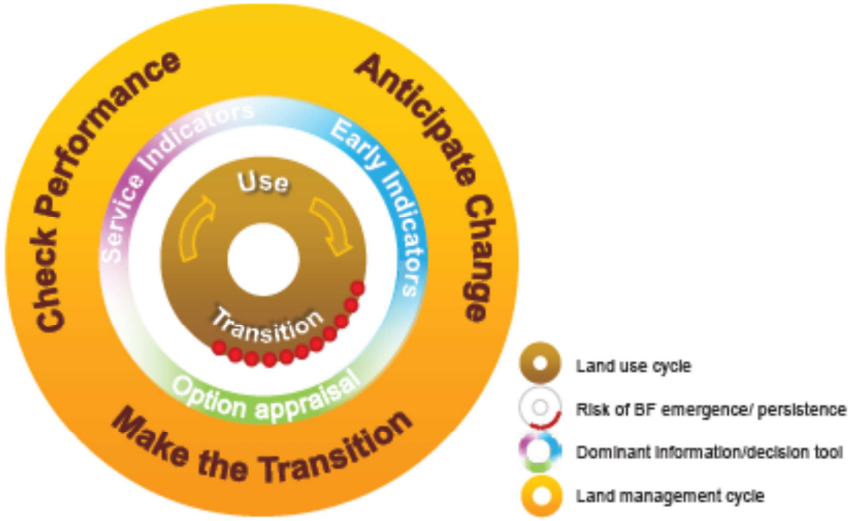

Figure 2.1: HOMBRE Zero Brownfield framework with land management cycle (outer cycle) and land use cycle (inner cycle). (From HOMBRE Deliverable D2.3)

2.2 Stakeholder engagement in the regeneration of Brownfields

The fine-tuning of soft reuse interventions needs to be in full discussion and as far as possible in consensus with all substantively interested stakeholders. Mutual understanding facilitates agreement which in turn will increase prospects for successful implementation and sustainability on the long run. Stakeholder engagement during the regeneration is necessary for effective assessment of sustainability, but it also increases the chance on identifying possibilities for creating more value. Often, stakeholder engagement procedures are applied when the ambition exists for a certain level of sustainability, multi-functionality or societal support (Cundy et al. 2013). Often these three ambitions are closely related. Box 1 uses the example of biomass energy from BF regeneration to illustrate this process.

A typical BF regeneration project will proceed with a series of developmental stages from its original inception as set out in Figure 2.2 below:

1. Opportunity and constraint analysis (Stage 1): a limited group of stakeholders connected with the initialisation of a project develop their ideas and ambitions sufficiently for presenting them to other interested or involved parties.
2. Holistic design (Stage 2): a fuller group of stakeholders agree an outline regeneration scheme. This is often an iterative process containing three phases (for example in a series of charrette workshops): Stakeholder engagement (what are the specific

desires/ambitions?), Reuse planning (what soft reuse interventions are needed for specific desires/ambitions?), and Property repositioning (how do soft reuse interventions combine in order to create value?).

3. Detailed design (Stage 3): when the agreed scheme is developed in detail for implementation based on site specific attributes and information. Stage 3 is largely beyond the scope of this report.

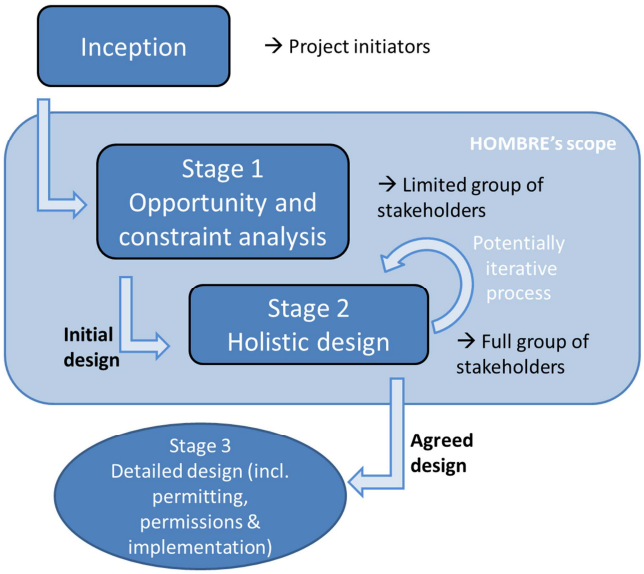

Figure 2.2: Developmental stages in Brownfield regeneration project design and where HOMBRE can provide support.

The HOMBRE project aims to increase the breadth and depth of service and sustainability consideration in the decision making to both facilitate more sustainable and valuable BF regeneration *and* to enable projects to take place for which societal support is lacking. The latter is accomplished by improving potential overall value or providing more understanding and awareness on the potential overall value. It is beyond the scope of HOMBRE to provide detailed project design on a site specific basis, but it can provide generic and conceptual support at early stages of project conceptualisation and stakeholder engagement to assist the development of more durable, robust and well thought out schemes for detailed regeneration, as shown also in Figure 2.2. Hence, principally the reports of HOMBRE WP5 support decisions at the stages of 'Opportunity and constraint analysis' and 'Holistic design' where we focus on BF soft reuse.

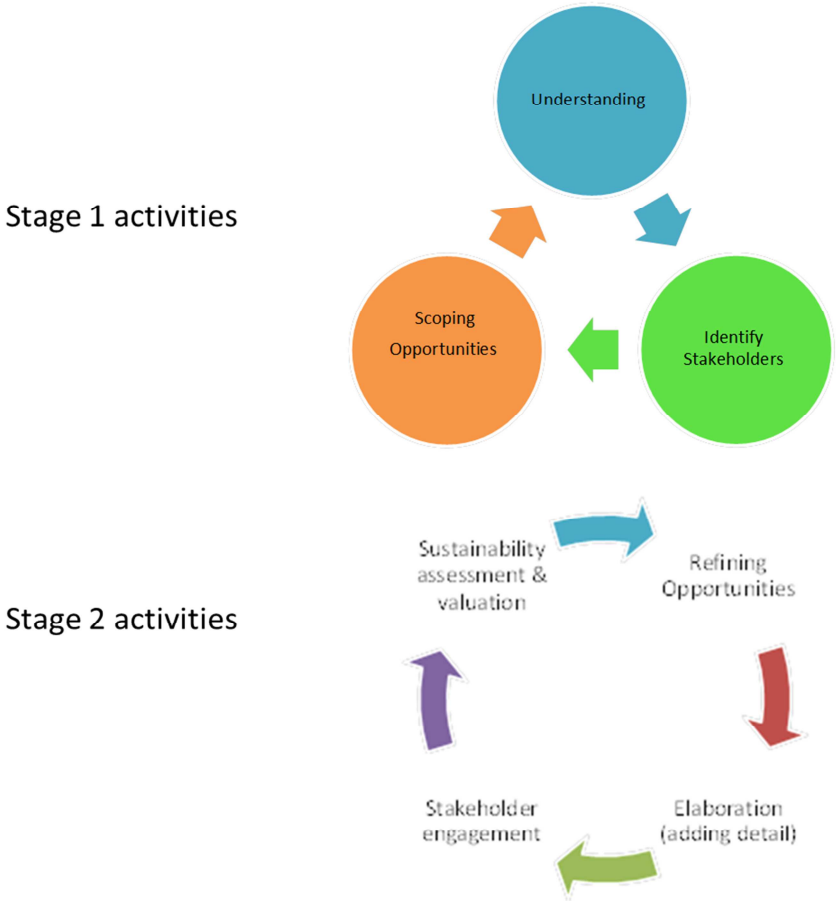

Figure 2.3: Activities taking place in the 'Opportunity and constraint analysis' (1) and 'Holistic design' (2) stages of a decision making process.

Stage 1: Pre-exploratory. The project initiation consists largely in an opportunity and constraint analysis, which is usually carried out with a limited group of stakeholders that have clear interest in the BF to be regenerated, the "project initiators" (Cundy et al. 2013). Often these stakeholders have the ability to fully or at least partially finance the regeneration with soft reuse interventions. This stage contains the key activities of:

- Understanding, of the physical features and the societal imbedding of the BF and hence the opportunities and constraints for regeneration of the BF
- Identifying stakeholders, and
- Scoping opportunities.

The understanding activity is summarised with the following questions:

- How did this BF originate?
- What are the major ambitions for regenerating the BF?
- What constraints of the BF impact the achievement of these major ambitions?
- What would be the potential function, hence what services and benefits could the BF provide that would be of value in the economic, societal and environmental context where it is located?

Another activity in this stage is the identification of a wider stakeholder group. Their engagement is important because it helps to ensure societal support, improves chances for

sustainability and improved overall value by developing the initial project scope from the pre-exploratory stage.

A preliminary scoping of opportunities and hence overall project value will necessarily be a part of the pre-exploratory discussion, and will strongly condition the willingness to invest and bring the project forward for generating value. At this preliminary stage the project initiators might be interested in being aware about the potential wider effects and co-benefits linked with the implementation of specific interventions on the site. If these wider effects are compatible with their ambitions on the site, then there is a chance that the overall value of the project might be enhanced. This might be the moment for stakeholders for structuring their ambitions using the benchmarking approach described in Section 3.1.

Stage 2: Exploratory. The exploration of initial ideas from the pre-exploratory stage with a wider group of stakeholders is intended to make the design more holistic, more widely supported and of a higher value, leading to a shared design concept or vision that can be taken forward for more detailed implementation (stage 3).

2.3 Considering services and interventions

The success of stakeholder engagement processes is dependent on good communication between a wide range of stakeholders with particular expectations of a BF regeneration and solution providers, site managers or others with particular technical expertise (as shown in Figure 2.4). As a group, the stakeholders are interested in knowing what is reasonably achievable on a site and finding the best options (or combination of options) to realise their ambitions for BF regeneration. Such expertise might be provided by the expert group around the project. However, the experts, in turn, need to know what possible benefits and disbenefits could be achieved by the regeneration and the future land-use in its local and broader context. This will support them in selecting those interventions that will best deliver expected services. The BOM is intended to support this process by facilitating dialogue within and between each of these broad groups of interested parties by:

1. Providing a structured approach to integrating ambitions and expectations for the soft reuse(s) of the BF as a coherent list of project services
2. Providing an outline matrix that links these services to the interventions that might deliver them, supported by hyperlinks to examples / case studies, showing possible interactions and synergies and the degree of dependency on site specific circumstances. It is based on a simple idea displayed in Figure 2.5. It can be used by stakeholders to check which soft reuse service can be provided by which soft reuse intervention. The other way around, stakeholders can check for each intervention which soft reuse services are possible to retrieve.
3. Providing a detailed informational matrix in the same format which, using the same mapping of services and interventions provides a more in depth range of supporting information about value outcomes, technical details and signposting to further information.

These three components are described in Chapter 3. Box 1 uses the example of biomass energy from BF to illustrate this process.

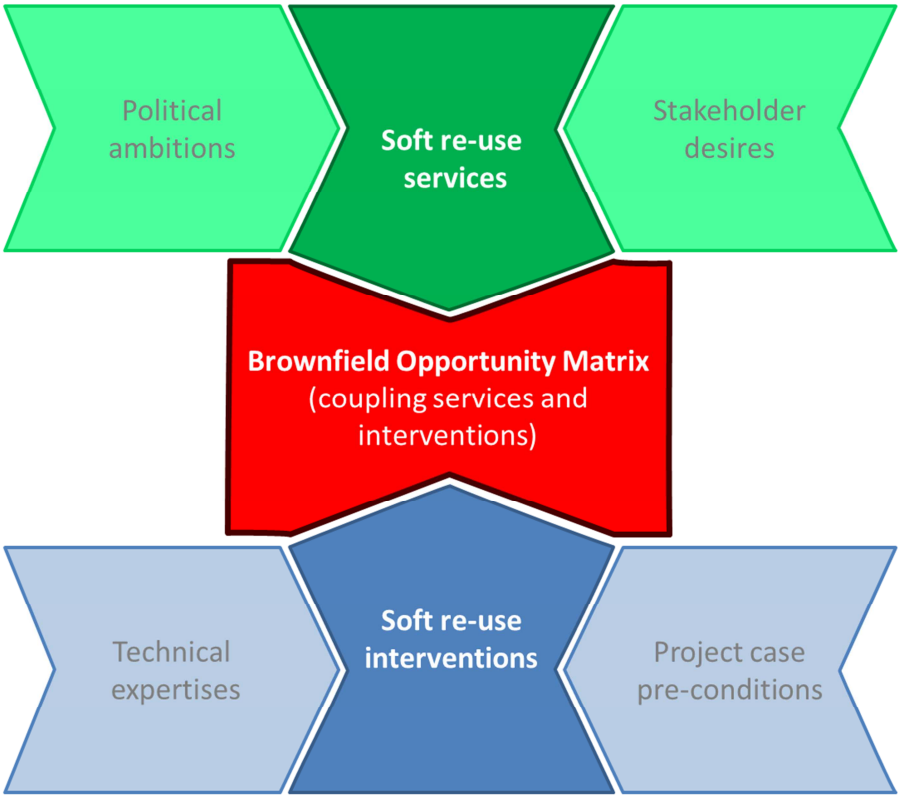

Figure 2.4: Holistic approach of coupling services and interventions.

Soft re-use	Service 1	Service 2
Intervention 1		
Intervention 2		

Figure 2.5: Coupling of soft reuse services and interventions in a matrix.

Box 1: Services and biomass from Brownfields: finding a shared vision.

This is a simple example looking at a case where the initiators of a BF regeneration project begin by putting forward the idea that renewable energy from biomass might fund or at least offset the cost of long term management of a BF, manage its risks and also provide a means of restoring its value over time.

The preliminary vision for the site already includes several services from the interventions needed to develop the BF for biomass production:

- Risk mitigation (biosphere and water environment)
- Renewable energy generation and
- Land value recovery over time.

However, the involvement of wider stakeholder interests might identify additional services, that for example link to national or local policy interests, or meet community aspirations for a site, such as:

- Soil improvement
- Improving landscape
- Enhancing ecosystems (developing habitat)
- Greenhouse gas mitigation
- Area value uplift (as the "greening" BF site becomes less intrusive and less blighting), so the value of neighbouring housing improves and liveability improves (Greenspace Alliance 2010).
- Mitigation of Heat Island Effect (in urban areas) (Doick and Hutchings 2013).

These additional services might improve the acceptability and support for the project, or might even act as drivers for additional investors (for example, Public Sector support resulting from a contribution to meeting goals of local or regional policy targets).

Discussions may also identify how additional, perhaps incremental, interventions might add yet further value, for example

- Linkage to sustainable urban drainage solutions might improve water resource management, reduce flood risks, and provide irrigation support for biomass production
- Creation of footpaths and trails might open up leisure activities such as walking or biking with benefits for public health
- Provision of on-site facilities might create opportunities for environmental education or activities such as bird watching.

These are just examples, and not meant as definitive for all biomass on BF projects. However there is a challenge for this kind of debate and engagement. It is unlikely that all of the stakeholders interested in the outcomes of the BF project will possess all of the technical expertise or information at their "fingertips" to identify what services might be possible from which interventions. Indeed, even the ambitions for the BF, and the vocabulary used to describe them, may be somewhat diffuse. Ambitions might arise from:

- The preliminary concept advocated by the project initiators
- Opportunities to meet public policy goals stated at national, local or regional levels
- Desires of local communities (e.g. somewhere to walk the dog), local action groups (e.g. nature conservation) or NGOs including charities (e.g. environmental participation)

- Neighbours (e.g. avoidance of nuisance, improved living conditions).

Stakeholders may be unaware of opportunities (for example that their home might appreciate in value). But fundamentally, stakeholders might not express their ambitions using a shared vocabulary, leading to complexity and lack of mutual understanding.

On the other side of the equation are the technical interests such as solution providers and site managers from whom the design and supply of interventions will be sought. However, this group is not necessarily homogenous in their opinions or expertise. Several different solution providers may be required, particularly for a larger BF project. They may each have their own domains of expertise, which do not necessarily extend over the whole range of benefits and impacts their interventions might give rise to. The availability of information and willingness to be flexible in approach may also be constrained by commercial / business interests as well as institutional cultures. These factors can act to prevent a holistic approach that optimises the range of service delivery while at the same time minimising the number of interventions actually required for delivery.

The BOM process (Chapter 3) acts as a means to facilitate dialogue, initially in providing a coherent statement of ambitions for a BF soft reuse project, and then to identify which interventions might be considered to deliver these ambitions. This supports discussion between the interested parties who define the rationale and service requirements for the BF project. However, as shown in Figure 2.4, it also facilitates discussion with the technical interests who will provide interventions by providing a cohesive suggestion of the services desired and the interventions identified as providing them, which can then go forward to a more detailed design and development plan.

2.4 Modes of Deployment

The matrix can be used to map the range of opportunities (and hence value) that might be achieved from a BF regeneration project and the projects consequent sources of value. For each opportunity there is a hyperlink to additional information including a case study. There is also supporting information to describe the various services and interventions listed in the matrix.

Overall the matrix can be used as a tool to:
1. Support initial identification or benchmarking of soft reuse options for BFs at early stage:
During the regeneration of a BF with stakeholder engagement the first phase is one of inception and opportunity and constraint analysis (see Figure 2.2). In this phase it is important to have a clear overview of all possible interventions or services that can be expected. Here a first shift is made between ‘possible and impossible’ services and interventions. The matrix can also serve as an inspiratory tool in this phase.

2. Support exploratory discussions with interested stakeholders:
The matrix should be filled with information on the possibilities whether certain services can be ‘extracted’ from one intervention or whether certain interventions are possible to combine. More detailed the matrix should give hints how the combination of interventions are affecting

each other's services. To really function as a supporting tool in exploratory discussions the matrix should give immediate clarification on these matters, as well as giving clear insight on the wider possible effects of interventions.

3. Provide a framework to describe an initial design concept, in support for example of planning applications:

The matrix will show which services can be expected when one or more interventions are applied. Here the initial coupling of services and interventions are being used. An initial design concept within a BF regeneration with soft reuses often exists on a simple map of the area featuring the desired services (i.e. as objectives of regarding to policy ambitions, and stakeholder desires). The options for applying interventions can be checked in the matrix, and a simple map with intervention opportunities will be the result.

4. Provide a framework for more detailed sustainability assessment of different reuse combinations, and similarly for cost benefit comparisons:

This is in a stakeholder engagement process for BF regeneration in the second stage (Figure 2.2). Here most choices on desired services and interventions are made and the matrix will provide more detailed information on the compatibility of interventions, main restrictions and optimization options. Doing this together with the relevant stakeholders it will provide mutual understanding on the services desired and the opportunities and constraints that come with them.

3 Brownfield Opportunity Matrix

The BOM process provides a structure to assist the consolidation of different BF regeneration goals to a coherent and consistent list of service categories (Section 3.1). The outline BOM (Section 3.2) can then be used to identify which types of intervention are likely to deliver these services, linked to examples or case studies for each particular opportunity for a service from a particular intervention. These examples help assure the reality of the opportunities being considered. It shows how interventions and services interact and through this may help stakeholders see additional service opportunities for their particular BF project. A detailed BOM (Section 3.3) has also been provided to allow facilitators (or other stakeholders) at planning meetings access to more detailed information about the sources of value and beneficiaries for particular opportunities, descriptions of services, outline technical information and wider sustainability drivers for interventions; along with signposting to more detailed sources of information and further examples and case studies. The outline matrix is intended as a discussion aid, with the detailed matrix serving to provide back-up information for points or issues of particular interest, as well an initial technical overview of the shared project concept emerging from the exploratory stages of the project discussion process outlined in Chapter 2.

To test the BOM and to re-adjust it was applied at two cases: the Genoa Cornigliano and the Markham Vale, described in Chapters 4 and 5 respectively. A version of the detailed BOM was also tested by students looking at a series of mixed BF redevelopment projects in the Netherlands and Sweden as part of the Balance 4P project (www.snowmannetwork.com/main.asp?id=255). Feedback from these examples was limited, but included in Chapter 6.

3.1 Integrating ambitions and expectations into a coherent set of expectations

A series of services are possible from the soft reuse of BF. Often interventions may provide more than one benefit or service and several interventions may significantly improve overall value. The BOM is a tool for exploring these possibilities for expanding their overall value of a BF project. However, to make an effective and optimised plan for which interventions to use to maximise or optimise overall value there needs to be a shared ambition for the services desired from the BF regeneration project. This shared vision needs stakeholders to be able to ascribe their particular requirements, policy goals or simply desires to a common framework.

Table 3.1 provides a structured list of services, using two levels of broad categories, and providing some examples of services fitting into each of these categories. This is the structure used in BOM. The experience of the BOM case studies, especially the Genoa case study (see Chapter 4) indicates for some stakeholders it is not a simple step to map their own ambitions to this structure.

Table 3.1: Soft services listed in level 1, 2 and Example subsections.

Level 1	Level 2	Examples
Risk mitigation of contaminated land and groundwater	Biosphere (including human health)	Human health protection
		Protection of ecology
	Water resources (hydrosphere)	Surface water treatment and protection
		Groundwater treatment and protection
Soil improvement	Fertility	Managing nutrient and micronutrient availability to support vegetation
		Improving soil biological functionality
		Improving soil condition to support desired plant/crop
	Soil structure	Improve soil resilience
		Providing vegetative cover
		Mitigation measures for soil erosion and land sliding
Water resource improvement	Water resource efficiency and quality	Supply of (treated) water for on-site uses
		Provision of potable water resource
		Improved quality of surface water on site or in the vicinity
	Flood and capacity management	Retention of runoff / surface water storage
		Flood mitigation (incorporating mitigation of severe weather events)
	Rehabilitation of water	Rain / drainage water (including sustainable drainage)
		Contaminated leachate/drainage treatment and reuse (landfill leachate, acid mine drainage, etc.)
Provision of green infrastructure	Enhancing ecosystem services	Protection of habitat and biodiversity (where existing and for protected sites)
		Developing new habitat and increasing biodiversity
	Enhancing local environment	Improve urban soundscapes and air quality
		Limiting visual intrusion by landscaping (buildings, transport links etc)
		Urban climate management (such as mitigation of urban heat island effect)

Mitigation of human induced climate change (global warming)	Renewable energy generation	Energy for on-site use
		Energy for off-site use
		Supply to an integrated energy mix
	Renewable material generation	Bio feedstock (for biofuel/gas/plastics)
		Reuse of organics
	Greenhouse gas mitigation	Reduced GHG emissions
		Carbon sequestration
Socio-economic benefits	Amenity	Open space
		Leisure
		Education
		Improved health and wellbeing
		Access (footpaths, cycle routes)
		Tourism
		Community centre
		Views and viewpoints
		Framing built developments
		Grazing
	Economic assets	Job generation
		Land value recovery over time
		Area value uplift
		Interim land management

To assist with any communication barriers and to guide the stakeholders into the matrix we have designed a Service Guide, an example of which is shown in Table 3.2. A simple principle of possible political ambitions on the left side and possible stakeholder desires on the right side. A stakeholder could scan for their ambition or desire and connect this to the service group (level 1) in the BOM. It is not really feasible to produce a single prescriptive guide for all policy ambitions and stakeholder ideas that might be encountered on BF sites across the EU. Rather the service guide development needs to be a site/project specific activity carried out by the project initiators in the first instance, and then supplemented by other stakeholders during the exploratory stage of discussions, for example using flip charts. In the Genoa case (Chapter 4) we have introduced it within the exploratory phase with a wide group of stakeholders. The stakeholder group contained a broad variety of backgrounds and using the service guide approach everybody was able to transform her or his desires/ambitions into the associated services.

Table 3.2: The Service Guide with political ambitions and stakeholder desires.

Political ambitions	Service group in the BOM	Stakeholder desires
Society and economy		
Ambition: A liveability improvement in the area. Ambition: Economic development of the area.	Group: **Socio-Economic Benefits**	I want to create open space. I want to create recreation possibilities. I want to create educational elements. I want to attract tourists. I want to improve health and well-being for the neighbourhood. I want to generate jobs. I want to increase the land and area value.
Ambition: Compensation of global warming. Ambition: Sustainable energy production.	Group: **Mitigation of Human Induced Climate Change (global warming)**	I want to produce sustainable energy for the Brownfield and/or it surroundings. I want to produce bio-fuel, gas, or plastics. I want to grow or breed something while re-using organics. I want to sequester carbon. I want to decrease greenhouse gas emissions.
Ambition: Green elements for people or ecosystem. Ambition: Nature and liveability for the living environment.	Group: **Provision of Green Infrastructure**	I want to protect existing habitat and biodiversity. I want to develop habitat and increase biodiversity. I want to improve air quality. I want to decrease noise. I want 'green' looks in building environment. I want to cope with flooding, heating, and water shortage effects.
Ambition: To optimise water quantity (too much, too little water). Ambition: An efficient water reuse.	Group: **Water Resource Improvement**	I want to recharge the groundwater or store water at the surface. I want to protect from flooding or decline runoff. I want to reuse waste water.
Ambition: To improve the soil quality for 'soft use'?	Group: **Soil Improvement**	I want to improve nutrient dynamics, biological activity or soil conditions to grow certain crops/vegetation. I want to improve soil resilience, provide vegetation cover or prevent soil erosion.
Ambition: A cleaner environment for people and ecosystem.	Group: **Risk Mitigation of Contaminated Land and Groundwater**	I want to protect the human environment and ecology from pollution in soil and groundwater. I want to protect surface water and groundwater from pollution.

3.2 Outline Brownfield Opportunity Matrix

The "Brownfield Opportunity Matrix" is a simple *MS Excel* based screening tool that essentially maps the services that might add value to a regeneration project against the interventions that can deliver those services. There are two levels of detail, a simple outlining matrix which simply allows mapping and links to examples of particular opportunities, and for subsequent use a more detailed matrix providing additional information. The simple or "outline" matrix (see Figure 3.1) maps the prospective range of opportunities that might be realised by a brownfield redevelopment project and the project's consequent sources of value. For each opportunity there is a hyperlink to additional information, including a case study. The BOM uses a colour code to describe the interaction between the intervention and service; indicating both the likelihood of a positive interaction, and its degree of dependency on site specific circumstances, as well as identifying the (relatively few) instances where an intervention might be antagonistic with the development of a particular service. The colour coding is shown in Table 3.3 below. This is considered to be a critical feature of the matrix, as this will provide a visual incentive at the highest level of the matrix for stakeholders view the potential for valorisation and will directly motivate stakeholders to actively engage in reintegrating BF land into the land use cycle – a key purpose of both the matrix and HOMBRE.

Both the outline and detailed BOM link the services listed in Section 3.1 with the interventions listed below in Table 3.4. (Note for the purposes of simplicity the outline BOM does not include the example services and example interventions).

Table 3.3: colour key for intervention/service interaction cells.

Intervention/Service Interaction Cells (ISICs)	
	Intervention strongly contributes to delivery of this service under most circumstances
	Intervention can contribute to delivering this service in a substantive way on some sites (but not others) and/or may have a more modest contribution more generally across sites
	Intervention may contribute or be detrimental to delivery of service, depending on site specific circumstances including management/design
	No influence - potential to apply complimentary intervention with further services and added value as output
	Intervention may be detrimental to delivery of this service if not managed/designed appropriately

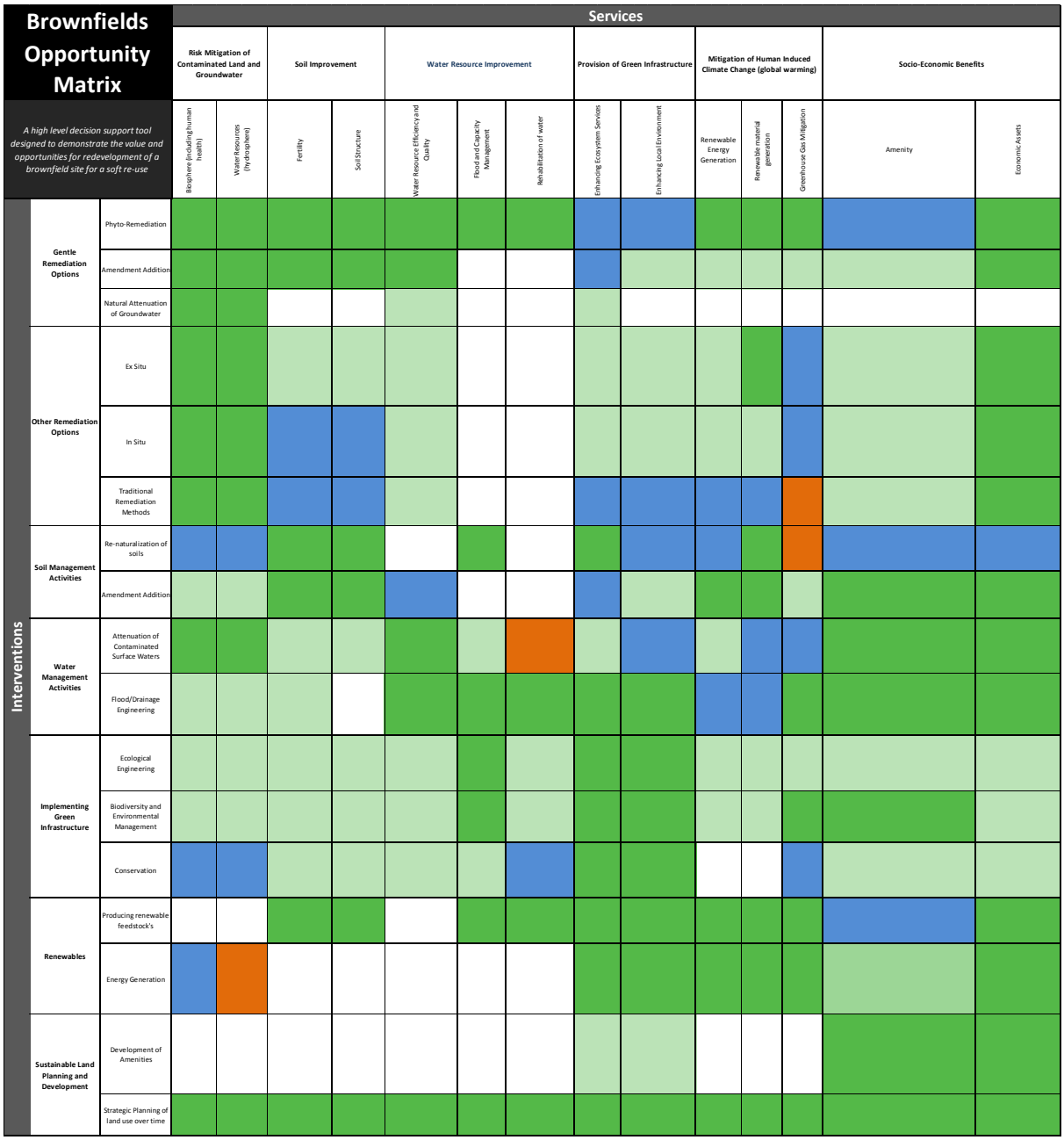

Figure 3.1: View of the Outline Brownfield Opportunity Matrix.

Table 3.4: Interventions listed in level 1, 2 and Example subsections.

Level 1	Level 2	Examples
Gentle remediation options	Phyto-remediation	Phyto-extraction
		Phyto-stabilisation
		Phyto-containment
		Phyto-filtration
		Phyto-degradation/stimulation
	Amendment addition	In situ stabilisation - char/biochar
		In situ stabilisation - slags, compost etc.
	Natural attenuation of groundwater	Monitored natural attenuation of groundwater
Other remediation options	*Ex situ*	*Ex situ* bioremediation
		Soil washing
		Ex situ chemical treatment
		Stabilization/solidification
		Ex situ thermal treatment
		Screening
	In situ	Mass recovery (dual phase extraction, free product recovery)
		Soil vapour extraction (SVE)
		Air sparging
		In situ chemical oxidation
		Permeable reactive barrier
		In situ bioremediation
	Traditional remediation methods	Capping
		Dig and dump
		Source isolation (sheet piles, cut off walls, pump and treat)
Soil management activities	Re-naturalization of soils	Breaking out/removing artificial (concrete, tarmac for e.g.) surfaces and substructures.
		Cultivation activities (for example to manage soil structure / soil nutrient status)
	Amendment addition	Use of organic matter (mushroom compost/sludge/CLO etc.)
		Use of inorganic amendments
		Use of biochar
Water management activities	Attenuation of contaminated drainage and leachates	Passive treatment (lagoons, wetlands, aeration weirs etc.)
		Active treatment (high density sludge process plant, chemical dosing).
	Flood/drainage	Flood/storage engineering

	engineering	Drainage design (sustainable urban drainage systems (SuDS) for e.g.)
		Maintenance and improvement of water ways onsite
Implementing green infrastructure	Ecological engineering	Bioswales, wetlands
		Ecoducts and green bridges
		Plants for slope stability
	Biodiversity and environmental management	Creating parks in urban areas
		Densely populated forests
		Natural revegetation
		Wetland creation
	Conservation	Developing, enhancing, protecting habitat (e.g. meadowland)
Renewables	Producing renewable feedstock's	Bio feedstock/biomass
		Topsoil substitute production
		On site recycling/valorisation
	Energy generation	Geothermal/ground source
		Biomass energy creation (e.g. wood, biofuel, biogas etc.)
		Photo-voltaic/solar panels for power generation and heating water
		Wind turbines
Sustainable land planning and development	Development of amenities	Landscape planning and development
		Leisure design, development and management
		Educational facilities
		Facilities, fencing, paths, paving and other small building works
		Visitor facilities
	Strategic Planning of land use over time	Promotion of green/soft reuse
		Integration of hard and soft developments

3.3 Detailed Brownfield Opportunity Matrix

The detailed BOM uses the same overarching structure as the outline matrix, supported with examples. In addition it provides:

- Greater detail on the overall value of services from which intervention
- More information about the opportunities provided
- More information about the technical characteristics of the different interventions
- An outline description of the different service categories.

A fragment of the detailed Brownfield Opportunity Matrix is shown in Figure 3.2.

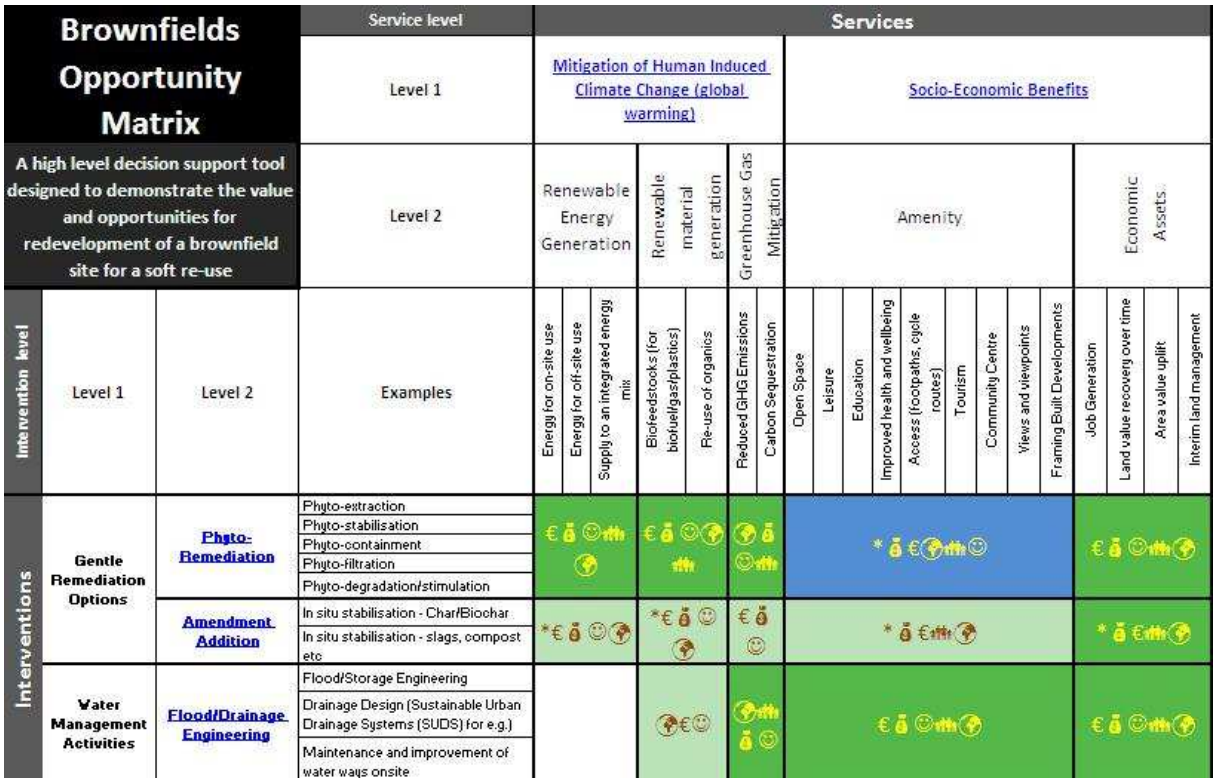

Figure 3.2: A fragment of the Brownfield Opportunity Matrix with soft reuse services on the horizontal axis and interventions on the vertical axis.

3.3.1 Specification of services and interventions

The scope of the detailed and outline versions of the BOM are the same. Both operate on the basis of a two level system; however the detailed BOM service and intervention listings are supplemented by examples (as illustrated in Figure 3.2):

1. Level 1: provides a general grouping of services (risk mitigation, mitigation of climate change) and interventions (gentle remediation options, installation of renewable energy technology);
2. Level 2: describes groups within the generic level 1 services (renewable energy generation, renewable materials generation and greenhouse gas reductions for mitigation of climate change) and interventions (phyto-remediation soil amendment addition, natural attenuation for GRO);
3. Examples provide a detailed selection of interventions and services that provide direct examples of what specific interventions could be deployed (phyto-stabilization, phyto-containment etc. for phyto-remediation) and what services could be an output (Reduced GHG gas emissions and carbon sequestration for greenhouse gas mitigation).

3.3.2 Structure of the Brownfield Opportunity Matrix

The key features of the detailed BOM are shown in Figure 3.3 and described in turn below.

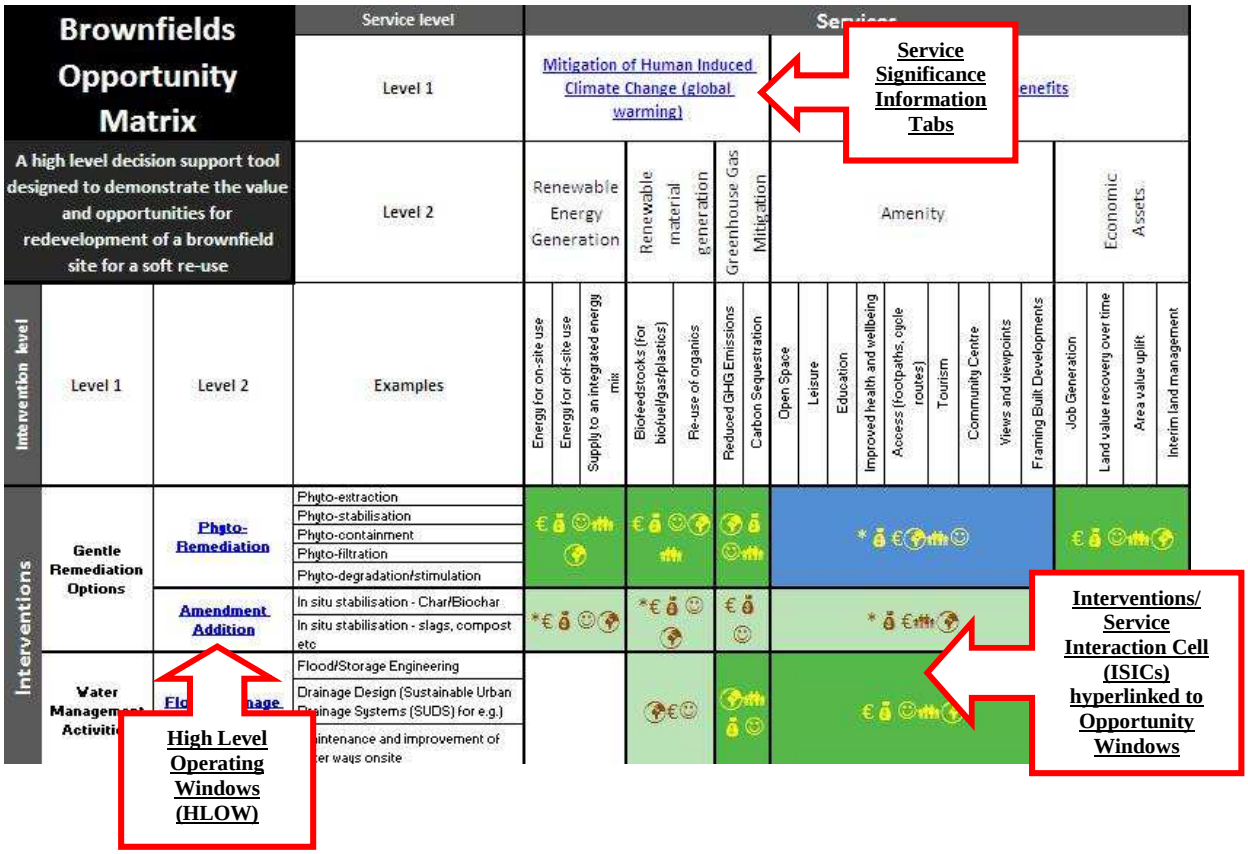

Figure 3.3: Key features of the detailed Brownfield Opportunity Matrix.

Service Significance Information Tab

Each cell containing level 1 services is hyperlinked to a tab providing a brief description of each group of services and the importance and potential benefits of providing these services.

High Level Operating Windows

Operating window methods are primarily used in engineering to improve reliability (Scott and Nathanail 2004). In this context operating windows are defined in terms of limits for a critical factor above or below which failure of a machine or process occurs. The FP7 projects HOMBRE and GREENLAND have developed the concept of operating windows and adapted it to fit in the frame of decision support guidance for brownfield soft re-use and GRO applications respectively. In relation to brownfield soft re-use, the two project aims are synergetic and complement each other. HOMBRE and GREENLAND have distinguished two levels of detail:

i) "High level operating windows" and
ii) "Detailed operating windows".

The detailed operating windows follow the traditional operating window rationale where the function is to identify the optimal conditions for applying a GRO in terms of its process parameters (such as effective soil pH, soil texture etc.).

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However, the operating windows idea was also seen as having great value in providing a unifying concept for more general decision making for helping stakeholders understand when a particular technique or intervention might be most applicable to deliver a particular outcome (i.e. service) in a Brownfield redevelopment / regeneration project.

HOMBRE has therefore developed “high level operating windows” HLOWs, primarily for soft re-use scenarios, as instruments to provide relevant information to stakeholders and support them in taking decisions for the selection of appropriate interventions in brownfield redevelopment / regeneration projects to deliver particular services.

The data available in HLOW are intended to provide stakeholders with key information about intervention groups which stakeholders might be interested in considering as a mean for providing the services they have themselves identified as possible project objectives or preferences. For this purpose, the content of HLOW should respond to the broadest possible interests that could arise in early stages of regeneration project design. Hence, the information provided through the HLOW is intended to be of a wide spectrum, i.e. addressing technical, environmental and eventually social and economic issues that might trigger and drive stakeholders to opt for some type of intervention (or group of interventions) rather than another from a qualitative perspective. The types of information provided in the HLOWs are listed in Table 3.5.

Each group of level 2 interventions is hyperlinked to a separate tab containing a HLOW for that specific intervention. The HLOWs are a significant feature of the detailed BOM.

Table 3.5: High Level Operating Windows information.

Information	Description
Definition	A brief summary of what the 'level 2 group of interventions' entails. This is important as users will have varying levels of expertise in different areas. This section explains what the HLOW and the associated row in the matrix relates to.
Technical applicability	Brief summary of the technical information regarding the level 2 intervention grouping. Brief description of each of the example interventions that fall under the level 2 category. The information provided at this point may be different depending on the intervention grouping. For example, in the HLOW for *ex situ* remediation a section is included for what types of contaminants can be treated by each example remediation intervention – whilst this is not applicable to other interventions outside of the remediation HLOWs where other specific information may be supplied,
Pros and Cons	A technical list of the pros and cons associated with each example intervention where relevant and some generic pros and cons associated with the overall group of interventions. This section does not appear in HLOWs where this information is not applicable.
Compatibility with other interventions	A checklist indicating the potential synergy with each other level 2 interventions groups through a simple positive (+) or negative (–) symbols. Synergy opportunities are critical to the matrix as application of interventions in synergy with more services and value as outputs is fundamental to the purpose of the matrix.
Potential sustainability benefits and disbenefits	A list of potential key sustainability indicators (both positive and negative) associated with application of the interventions. The sustainability indicators are derived from SuRF-UK "Annex 1" categories, and are not exhaustive and are indicative only.
Further information	Includes detailed information on the intervention via signposting; relevant technical references and case studies demonstrating deployment of the specific example interventions in the field.

Service/Intervention Interaction Cells (ISICs)

These cells are the interception between (Level 2) interventions and services. These are colour coded in the same way as for the Outline BOM described in Section 3.2. In addition to the colour coding, where there is an interaction between an intervention and a service, each cell provides an indication of the forms of value created by this opportunity, using the symbols shown in Table 3.6, and a link to a tab of additional information called an "Opportunity Window".

Table 3.6: Forms of value identified in the detailed BOM ISICs.

€	Revenue Generation Opportunity	Direct revenue generation opportunities. Revenue generation opportunities may be exploited by an investor, the local community, and/or by other suppliers
	• Natural Capital	Natural capital may be generated, primarily for the local community and possibly for wider society. Natural capital is developed in a number of ways, including (but not limited to) providing green infrastructure, improvement of the local climate, improvement of water resources etc). The investor and or other suppliers may benefit from economic tangibles and intangibles.
	• Cultural Capital	Cultural capital may be generated, primarily for the local community. Cultural capital is developed by improving the social environment (by improving the aesthetics of an area and/or creating a sense of place/belonging for e.g.) and can be a direct result of an increase in natural capital. The investor and may benefit from economic tangibles and intangibles, whilst other suppliers may benefit from direct revenue generation in the future, if for example, the intervention increases tourism.
	• Economic Capital - tangibles	If intervention is applied to provide service then it is expected that tangible economic capital may be the result. For example, land and property values in the area may increase (feeding back into cultural capital) providing benefits to the local community and also the investor. The investor may save money by facilitating planning and permitting processes.
	• Economic Capital - intangibles	These benefits can only be valued on a stakeholder by stakeholder basis and include for example, an reputational benefits, brand awareness etc.

Opportunity Windows

Each ISIC within the matrix is hyperlinked to a tab containing supplementary information describing the circumstances in which a service can emerge form a particular intervention. These are described as 'Opportunity Windows'. Their information content is listed in Table 3.7. This information should be seen as *indicative* or *typical* findings, and provides a starting point or "default" information for decision making.

Table 3.7: Opportunity windows Information - For Level 2 only.

Information	Description
Benefit	The benefit of applying the intervention to provide the service. This is colour coded based on the ISIC colour code in table WW and clearly, but simply stated in a line.
Pros and Cons	Brief discussion of the *typical* strengths and weaknesses of deployment of that particular intervention for that particular service.
Grouping	A checklist indicating the potential synergy with each other level 2 service groups through a simple positive (+) or negative (–) symbols. Synergy opportunities are critical to the matrix as application of interventions in synergy with more services and value as outputs is fundamental to the purpose of the matrix.
Beneficiary and Value	A key goal of Hombre is to incentivise stakeholders to bring derelict brownfield land back into the reuse cycle. It is therefore crucial to state clearly to users of the matrix who will benefit from a service/intervention interaction and what the value may be. This can be discussed in greater detail within the opportunity window, with the possible primary beneficiaries and value and secondary beneficiaries stated. Value is stated expanding upon the value symbols demonstrated in the ISIC within the matrix.
Other relevant stakeholders	A list of stakeholders that should be considered and potentially consulted if applying the selected intervention to produce the desired service. These stakeholders include those who will not get direct benefit from the intervention but who may be impacted by its implementation.
State of the art	A statement on how well developed the intervention is in delivering the service. Can range from ‘well developed with many years of successful implementation’ to ‘field trial stage’.
Further information/ Examples	External links to supporting information / guidance. An important element in the opportunity windows is demonstrating that the interventions have been applied in the field to successfully provide the service through existing case studies.

4 Case: Genoa Cornigliano

4.1 Service Guide for political ambitions and stakeholder desires

In the Genoa case we worked with a range of local and political stakeholders. We realised that the detailed BOM was not appealing to many of the stakeholders because of its complexity. To deal with any communication barriers and to guide the stakeholders into the matrix we designed a Service Guide. This consists of a simple principle of possible political ambitions on the left side and possible stakeholder desires on the right side. A stakeholder could scan for their ambition or desire and connect this to the service group (level 1) in the BOM. The Genoa case led to the Service Guide approach we describe Section 3.1.

4.2 Description of the case

Polcevera Stream valley is an important link between the eastern and the western part of the city of Genoa, in Northwestern Italy. It is an economically privileged lane for the north-south transport of goods, especially along the European corridor Genoa-Rotterdam. Despite substantial recent urban/industrial developments, the Polcevera valley still displays obvious signs of its recent past, characterised by agricultural and light manufacturing activities. This stream corridor also represents one of the most widely used migratory routes for birds (and to a lesser extent insects, larvae and pollens) during their annual migrations from the African continent to the great plains of the Eurasian continent. Nowadays, the Polcevera stream delta is a heavily urbanised area, within the borough of Cornigliano, with a 6 ha Brownfield situated west of the stream. The area used to host steel industries that ceased production in 1996, due to the iron crisis (caused by loss of competition position to 'low salary countries'), stricter environmental laws and public protests. In 1998 a buffer zone was created around the industrial area. After a strong intervention of local communities, in 1999, all industrial activities were stopped.

Figure 4.1: Impressions of the Cornigliano case in Genoa, Italy.

In 2005, the factories were demolished to regenerate the area. A competition was held by the municipality to select possible projects, bun op choices were made in short term. In the following years contaminations have been cleaned up to the first level (industrial use is again possible for this location, but if the site is to be developed for other types of use such as residential areas, further remediation will be necessary. In 2006 a feasibility study to create a natural area in the stream and the brownfield was carried out by PN Studio. In 2007, the "Cornigliano Working Group" was founded to look for different regeneration alternatives. The Polcevera delta project aims at complete requalification of the area and at creating a connection between the stream and the garden/recreational area that is planned to be developed on the western bank of the stream in the upcoming years.

In 2011 Genoa Municipality commissioned to PN Studio to develop the "City Green Plan", detailing green areas role and management, impact of urban transformation in terms of biodiversity, ecological webs inside the city. The results, delivered in March 2011, showed that Polcevera river is one of the main ecological connection in the city of Genoa and the Polcevera Delta is one of the main strongpoint, taking in consideration his strategic role for migratory birds, potential as a recreational site and regenerating for local communities. The City Green Plan has been included in the PUC (Municipality Urban Plan) since late 2012.

4.3 Stakeholder involvement

In May 2014, a stakeholder workshop was organised in Genoa. During the workshop, the HOMBRE project was presented to the stakeholders. Presentations about the Brownfield Navigator and the Opportunity Matrix were given to explain the concepts. A total of 19 stakeholders attended the workshop; 6 stakeholders participated in the working session to test the Brownfield Navigator (BFN, http://bfn.deltares.nl/bfn/site/index.php/standard/bfn_home) and the BOM.

It was clear we needed a tool for non-expert stakeholders to 'translate' policy ambitions and stakeholder desires into the services used in the BOM (see Paragraph 4.4). The tool is titled 'The Service Guide' and was used to define the ambitions and societal demands for Cornigliano. The results are listed below in Table 4.1. Taking into account the priority of the ambitions; human well-being and health were defined as the main priority. There were no ambitions defined on sustainable food production, resources efficiency and energy production. However, stakeholders are interested in avoiding contaminated areas now and in the future. The connectivity between the area and the sea had a high priority. Stakeholders are more interested in social improvements than in economic change.

The ambitions were related with the services that were defined in the BOM, by using the Service Guide. The results are listed in Table 4.1. The BOM was used to link the desired services with the interventions connected and thereby conclusions were drawn on which interventions can be used to deliver the desired services. This is shown in Table 4.1, which is an adjusted version of the BOM. More efficient land-use is promoted by choosing interventions that (potentially) serve multiple services at the same time. For the Genoa case, examples of suitable interventions are Phytoremediation, Green-Infrastructure approaches such as Ecological Engineering or Biodiversity and Environmental Engineering, and Active Water Management. Some ambitions could not be addressed with the BOM at the time the

workshop was held, such as connectivity of the area with the sea. This is probably because the focus of the matrix is on soft reuse.

4.4 Results & Conclusions: Strengths and improvements for the BOM

The BOM was easy to comprehend and use: 90% of the content was easily understood when tested during the workshop while using the Service Guide. The example library (in particular regeneration of success) was considered to be very useful to give a suggestion of which kinds of interventions are needed and of the potential results of the implementation of the interventions. It was expected that the Mapping and Sketching tool would be a tool that could produce drawings with a higher resolution, or something 'more tangible'. Using a touch screen could have promoted (more) active participation of the stakeholders. If the sketch produced during the workshop would have been showed to the Mayor of Genoa for instance, it wouldn't be understood or appreciated.

The Service Guide might link well with the BFN. The version of the BOM used for the workshop contained too many rows and columns. Using fewer rows, columns and symbols, as in the Outline Matrix (Section 3,2) have made it easier to read. Furthermore, according to the participants of the workshop, there were too many colours and icons used in the matrix and the names used for the description of the cells (e.g. ISICS or HLOWS) need to be simpler. The detailed BOM works best for a desk study, with a regular computer screen. When it is used for a group with a beamer, the matrix does not fit on one screen, or (when zoomed out) the font size is too small to be read from a distance. The Genoa experience led to the development of the outline BOM (see Section 3.2) which is now seen as the tool for initial guiding of group discussions.

During the Genoa workshop, it took too much time to explain the BOM; even well informed and motivated participants such as the stakeholders that attended the workshop had difficulties with understanding the matrix.

Table 4.1 Service Guide, adjusted for the Genoa case. Ambitions are linked to desired services.

	AMBITIONS	GROUP OF SERVICES	SERVICES
SOCIETY & ECONOMY	To create space for recreational purposes and sport More structures for education & culture To attract tourists To improve health and well-being for the neighbourhood To connect the area with the sea and river	Socio-economic benefits	Open space, leisure, education, improved health & well-being, access (footpaths and cycle routes), tourism, community centre, view points
SUSTAI NABILIT	To sequester carbon To decrease greenhouse gas emissions	Mitigation of human-induced climate change	Reduced GHG emissions, carbon sequestration
NATURE & GREEN	Open spaces for recreational purposes Decrease noise Increase biodiversity Improve air quality	Provision of Green-Infrastructure	Improve urban soundscapes & air quality, protection of habitat and biodiversity, developing new habitat and increasing biodiversity
WATER MANAG	Avoid flooding Recharge groundwater and use for leisure	Water Resource Improvement	Retention of run-off, flood mitigation, enhanced groundwater recharge
PRODUCTIV E SOIL	(possible) agriculture No industrial activity in the area	Soil Improvement	Managing nutrient and micro-nutrient availability to support vegetation, improving soil biological functionality, improving soil conditions to support desired plant/crops

5 Case: Markham Vale

5.1 Description of the case

The Markham Vale site straddles the M1 motorway, which is one of the main arterial routes from the South to the North of the UK. Coal had been mined in the Markham area for centuries. However, large scale production at the Markham Colliery began in the late 19th century. The figure below shows the former colliery adjacent to the M1.

Figure 5.1 Markham Vale along the M1 motorway.

The closure of Markham Colliery in 1994 brought to an end more than 150 years of deep mining in Derbyshire. Not surprisingly, it resulted in very high levels of unemployment – 3,300 miners living in Derbyshire lost their jobs. It had a knock-on effect on service and supply industries and left high levels of social deprivation - the northern coalfield was in England's top 20% of the most deprived districts. The site is part of a complex of deprived urban areas and other brownfield areas.

After the cessation of mining the Coal Authority, which is the residuary body for British Coal (the UK nationalised mining company), handed the site to local authority ownership and it is now owned by DCC. The Coal Authority retains responsibility for the abandoned underground workings.

"Markham Vale" was born out of a Coalfield Task Force Report in 1998 (DETR 1998) which challenged local authorities to create an employment growth zone centred on the former Markham Colliery. Derbyshire County Council (DCC) led a partnership of other interested bodies in taking up the challenge, the Markham Employment Growth Zone (MEGZ). This aims to create 5000 jobs to regenerate the local area, as well as providing environmental improvements including establishing short-rotation coppicing on the North heap. MEGZ

became known as Markham Vale, with the coppicing project being known as “Markham Willows”.

Markham Vale site lies in the East Midlands of England, between the city of Chesterfield and the town of Bolsover, straddling the M1 motorway. In total, it consists of 127 hectares of the former Markham Colliery site, plus two spoil heaps. The main colliery surface occupied some 37.5 hectares. The largest spoil heap (the North Tip) is 105.9 ha. The South Tip spoil heap extends to 33.5 hectares. The total area is 360 ha, and includes some agricultural land that was incorporated to make a more economically feasible development platform. Some 205 Ha of the overall Markham Vale platform has been previously developed. The figure below is an aerial photograph of Markham Vale shortly after the colliery installations were cleared. This picture shows the development plots which were to be developed in a phased way. Markham Vale is DCC’s largest-ever regeneration project and aims to reverse the unemployment and deprivation which followed the closure of deep mines, loss of textile jobs and the general decline in heavy industry in north east Derbyshire.

Figure 5.2: Markham Vale plots to be developed in a phased way.

A major opportunity foreseen for the site is its proximity to the main arterial road routes from the South to the North or the UK. A major part of the development project has been to open a junction on this motorway to serve the development zone and the nearby town of Bolsover. The Figure below is more recent showing the newly created motorway exit and developments in the east and west areas (left and right) the north area (bottom right) and the north and south tip areas (bottom left and top Left).

Figure 5.3: Markham Vale motorway exit and the newly developed area sites.

The MEGZ plans were called in for judicial review following a local residential complaint. While the eventual finding was in favour of the Council, this process caused major delay to the project. Since the completion of the judicial review the local authority formed a joint venture partnership with a development company (Henry Boot Developments Ltd) to provide the built development on the site, while the local authority developed infrastructure such as roads and for the areas of the site such as the South and North Tips that would not have built development. Infrastructure developments include a motorway junction, roads, service utilities, rail and a section of the Chesterfield Canal.

The impact of the judicial review and the 2008 financial crisis which followed just a few years afterwards on the built development was to slow progress. Hence the site is still currently in the transition phase of land management cycle. New infrastructure has been constructed, buildings have been put in place and are in use (www.markhamvale.co.uk). Development is proceeding in a phased way in accordance with a site master-plan, with some phases now complete and occupied, others in development and yet others still at planning stage. In 2012 Markham Vale was included in a large enterprise zone (Sheffield City Region Enterprise Zone) providing valuable tax breaks and capital allowances for businesses locating into the area.

The total cost of the project is estimated at £88 million but this will bring in a further £150 million of commercial investment. The master-plan foresees 80 hectares for built development creating 265,000 m^2 of commercial premises. 200 Hectares of surroundings will be environmentally improved. In the region of 10% of the job creation aim has been achieved as of 2014.

A recent source of uncertainty is the development of a new high speed rail route to the North of England which would cross the development area. As planned this would transect the South Tip and could affect some of the major built development projects under planning. As a result of this short term uncertainty, some re-phasing of works and plot development is underway.

5.2 Use of decision support in the Markham Vale case

Stakeholder discussions took place between the HOMBRE team and staff from Derbyshire County Council. These individuals were both experienced in land regeneration as a practical, applied commercial process, and also the technical interventions necessary to achieve redevelopment and reuse projects. Once introduced to the BOM they found no real difficulties in its interpretation and use, and suggested a number of useful technical enhancements and changes. Discussions using the BOM were principally carried out by Erika Rizzo a secondee to r3 from University of Venice over June to August 2014, with support from r3 directly and from another r3 secondee from the UK contracting company Vertase-FLI. No additional stakeholders were involved in the BOM discussions. However, a scoping workshop in September 2013 also included the Council's private sector development partner and a consultant involved in the original "Markham Willows" project design from outside the HOMBRE team.
As part of the phased development the management of the South and North Tips has recently come under reconsideration. The Brownfield Opportunity Matrix (BOM) was used to explore possibilities for moving forward with the North Tip. The outcomes of this process are largely informal, and remain in development with the site owner. They have however, led to some valuable learning outcomes both for the BOM development and the option appraisal for the North Tip.

The BOM aims to inspire and inform actors responsible for brownfield sites at a strategic level by demonstrating the potential value that can be derived from soft land use services from a brownfield regeneration project. The goal is to encourage redevelopment of brownfield land so that it re-enters the land-use cycle.

The BOM plots soft reuse interventions against services that an intervention for soft land uses may provide in order to demonstrate the value of applying the interventions either on their own, or in synergy with other interventions (see Section 2.1). The figure below shows that the BOM can be applied following two possible procedures:

a. Starting from the identification of the "desired" service/s, the user can check which intervention/s are needed in order to obtain that/those service/s (blue box and line);
b. Starting from the selected intervention/s, the user can visualise which service/s that/those intervention/s may provide (orange box and line).

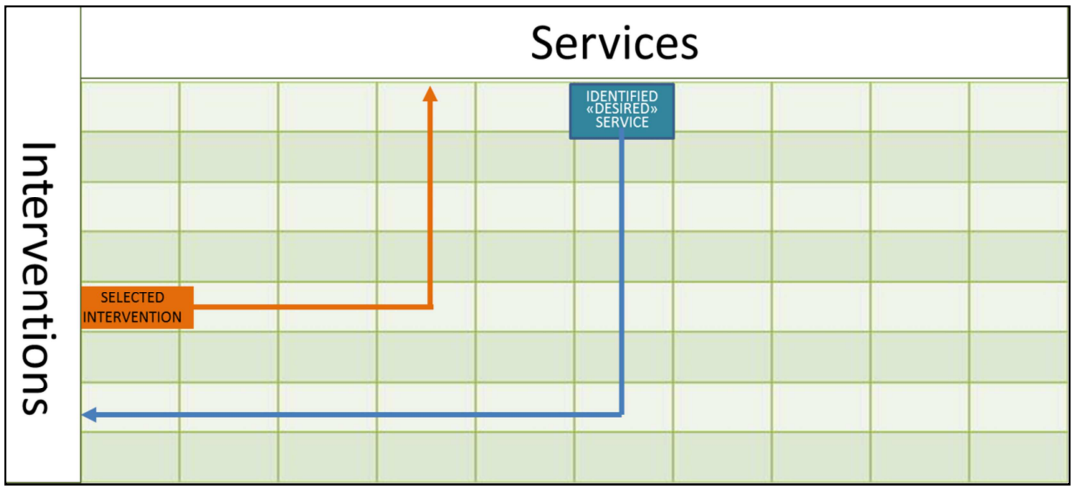

Figure 5.4: Application of the BOM can start from selecting services or interventions.

5.3 Results & Conclusions: Application of the BOM in the Markham Vale Case Study.

The BOM can be applied in the early design stage of a project (i.e., scoping application), but also in a later stage to validate the project or to check if all desired services and interventions have been identified, or need to be identified (i.e., retrospective application). Since Markham Vale is already in a transition phase, many actions have been taken in order to regenerate it, with varying outcomes. The table below summarises the interventions on site identified by DCC, grouped using the example interventions listed in the BOM. As part of the process of discussion with DCCs, some refinements to the BOM intervention categories took place.

Table 5.1 Interventions (including soft reuse) at the Markham Vale case.

Interventions at Markham Vale to mid-2014, as interpreted by DCC	
Markham Vale as a whole	Specifically on the North Tip
1. Phyto-filtration. 2. Phyto-degradation/stimulation. 3. Monitored Natural Attenuation (revegetation) 4. Source Isolation (sheet piles, cut off walls, pump and treat): pump from South Tip. 5. Breaking out/removing artificial (concrete, tarmac for e.g.) surfaces and substructures. 6. Tilling - unsealing the surface and reducing compaction. 7. Use of Organic Matter (mushroom compost/sludge/CLO etc.): sludge. 8. Passive Treatment (lagoons, wetlands, aeration weirs etc.). 9. Active Treatment (High Density Sludge Process Plant, Chemical Dosing): South Tip sludge to sewage.	1. Source Isolation (sheet piles, cut off walls, pump and treat). 2. Tilling - unsealing the surface and reducing compaction. 3. Use of Organic Matter (mushroom compost/sludge tc.). 4. Passive Treatment (lagoons, wetlands, aeration weirs etc.). 5. Flood/Storage Engineering. 6. Drainage Design (Sustainable Urban Drainage Systems (SUDS) for e.g.). 7. Maintenance and improvement of water ways onsite. 8. Wetland Creation. 9. (re)Developing/ protecting existing natural habitat. 10. Biomass Cultivation. 11. Biomass for energy. 12. Landscape planning and development.

10. Flood/Storage Engineering. 11. Drainage Design (Sustainable Urban Drainage Systems (SUDS) for e.g.). 12. Maintenance and improvement of water ways onsite: DCC is doing it. 13. Installing Green Bridges and Eco-ducts. 14. Creating Parks in Urban Areas. 15. Wetland Creation. 16. (re)Developing/ protecting existing natural habitat. 17. Biomass Cultivation. 18. Photo-voltaic/solar panels for power generation and heating water. 19. Landscape planning and development. 20. Leisure design, development and management. 21. Educational Facilities. 22. Facilities, fencing, paths, paving and other small building works. 23. Visitor Facilities. 24. Promotion of Green/Soft Reuse. 25. Integration of hard & soft developments.	13. Leisure design, development and management: partially in place. 14. Educational Facilities: not in place. 15. Facilities, fencing, paths, paving and other small building works: not in place yet. 16. Promotion of Green/Soft Reuse: not in place yet.

Hence for Markham Vale the BOM was applied firstly in a retrospective way to re-consider the original 2004 Markham Willow feasibility study findings, and the subsequent activities; and secondly in a scoping way to check if new services and interventions, which means new opportunities, could be identified from a more recent perspective. The decision support activities undertaken is summarised below.

Table 5.2 Activities undertaken during the stakeholder engagement process in the Markham Vale case.

1. PREPARATION
    - Presentation about the BOM to DCC;
    - Definition of the case study area;
    - Definition of scenarios for application (space and time dimensions have to be considered);
2. RETROSPECTIVE APPLICATION
    - Check which services the on-going project has provided (underline with a colour, for instance yellow);
    - Check the interventions that took place to produce those services (underline with the same colour used to underline services provided);
    - Check Intervention/Service Interaction Cells (ISICs), which show how an intervention interacts with a service;
3. SCOPING APPLICATION
    - Check which other possible services the site could provide and underline them with a colour, for instance pink;
    - Check if, in order to attain those new services, extra interventions are required. If so, underline those interventions with the same colour used to mark new services.

4. OPPORTUNITIES IDENTIFICATION
    - Two possible situations may occur:
        - Few new desired services identified (this could happen in the case of a well-established project such as Markham Vale, where many interventions were planned and have been done or will be done. Identifying relatively few new services, is a validation process.
        - Many new desired services identified. This is more likely to be the case of a brand new project. This situation would then probably then require the prioritisation of the interventions.

The BOM was applied to two scenarios:

- "1. Markham Vale as a whole", i.e. to the entire area under the DCC jurisdiction (e.g. excluding areas handed on to Henry Boot Developments),
- "2. The North Tip" (see below highlighted in yellow).

Both of the scenarios considered a retrospective application as well as a scoping application. Firstly the BOM was applied in a *retrospective* way. All the services included within the Master Plan which have been achieved have been identified. Where planned services have yet to achieved, the reasons have been collated and reported. Afterwards, a *scoping* application has been carried on to check whether additional services were desired / possible. Table 5.1 summarises the interventions that have taken place over Markham Vale as a whole and specifically on the North Tip up to mid-2014.

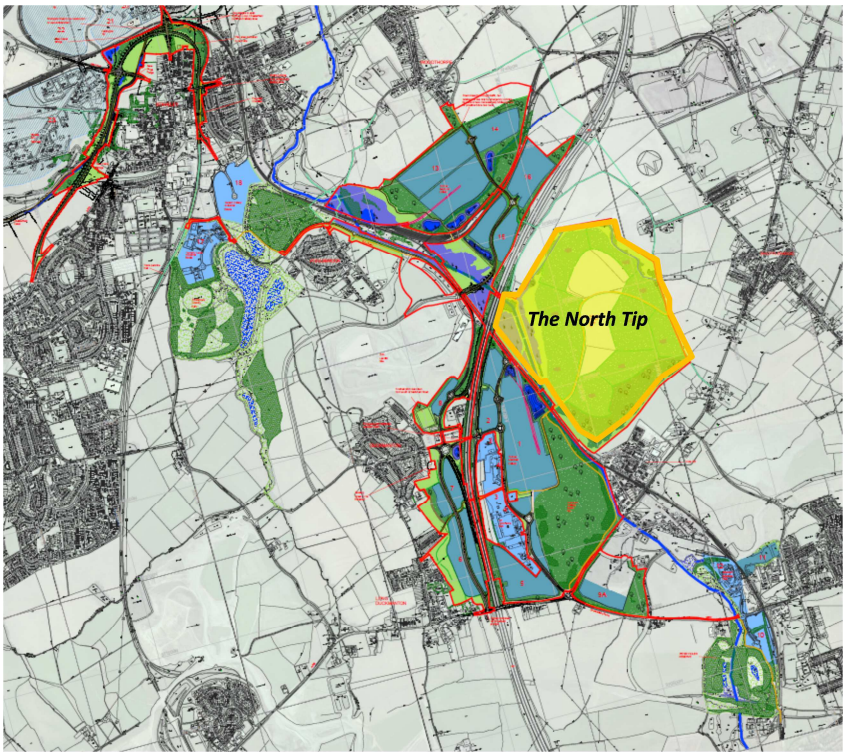

Figure 5.5: Markham Vale case as a whole and its North tip.

With HOMBRE DCC reviewed the services envisaged from the whole site; and from the North Tip only (i.e. those in place or planned). These are grouped in the tables below using the example services listed in the BOM. As part of the process of discussion with DCCs, some refinements to the BOM service categories took place.

The North Tip services provision from soft reuses is very similar to that of the whole of Markham Vale, which is not surprising as it is a major part of the soft reuse segment of the project accounting for 29% of the site area. However, there are some differences, shown in the North Tip table, which are italicised for emphasis. There are some specific factors affecting delivery of the services envisaged, and these are summarised further below.

As expected the BOM identified relatively few additional services and interventions that might be exploited at Markham Vale. The incremental development identified was principally crystallising concepts already being considered by DCC, rather than identifying novel opportunities that had not yet been considered. These are also summarised further below. The potential for new service development is greater for the North Tip rather than Markham Vale as a whole.

DCC foresaw the following possible applications for the BOM:

- Allowing people that do not share the same expertise to work together during the scoping phase;
- As a checklist;
- As a tool to communicate to and persuade stakeholders;
- To tell “good new stories”;
- As a decision support tool for high level assessment.

Table 5.3: Using the BOM: Desired services for the whole area of Markham Vale.

	Service Level 1	Service Level 2	Status	Services in Place
Services being considered	Risk Mitigation of Contaminated Land and Groundwater	Biosphere (including human health)		Human Health Protection: partially in place Protection of Ecology: in place
		Water Resources (hydrosphere)		Partially in place
	Soil Improvement	Fertility		Managing nutrient and micronutrient availability to support vegetation: in place Improving soil biological functionality: in place Improving soil condition to support desired plant/crop: in place
		Soil Structure		Improve soil resilience: in place Providing vegetative cover: in place Mitigation measures for soil erosion and landsliding: in place
	Water Resource Improvement	Water Resource Efficiency and Quality		
		Flood and Capacity Management		Retention of runoff: in place Flood mitigation: in place;
		Rehabilitation of water		
	Provision of Green Infrastructure	Enhancing Ecosystem Services		Protection of habitat and biodiversity (where existing and for protected sites): in place Developing new habitat and increasing biodiversity: in place
		Enhancing Local Environment		Improve urban soundscapes and air quality: in place Limiting visual intrusion by landscaping (buildings, transport links etc): in place
	Mitigation of Human Induced Climate Change (global warming)	Renewable Energy Generation		Solar plant on the rooftop of the Environmental Center Biomass trial plantation - under reconsideration
		Renewable material generation		Re-use of recylates on site for biomass plantation (sewage sludge)
		Greenhouse Gas Mitigation		Potential form re-use of energy, (sequetsration and offsetting not explored)
	Socio-Economic Benefits	Amenity		Open Space: in place Leisure: in place Education: in place Improved health and wellbeing: partially in place Access (footpaths, cycle routes): partially in place Tourism: hotel planned Community Centre: in place View-points: partially in place Framing Built Developments: partially in place Grazing: in place
		Economic Assets		Job Generation: partially in place Land value recovery over time: in place Area value uplift: in place Interim land management: in place

***Key**: status: deep green = significant service supply; light green = partial service supply; white = no service supply*

Table 5.4: Using the BOM: Desired services for the North tip of Markham Vale.

	Service Level 1	Service Level 2	Status	Services in Place
Services being considered	Risk Mitigation of Contaminated Land and Groundwater	Biosphere (including human health)		Human Health Protection: *incomplete* Protection of Ecology: in place
		Water Resources (hydrosphere)		Partially in place
	Soil Improvement	Fertility		Managing nutrient and micronutrient availability to support vegetation: in place Improving soil biological functionality: in place Improving soil condition to support desired plant/crop: in place
		Soil Structure		Improve soil resilience: in place Providing vegetative cover: in place Mitigation measures for soil erosion and landsliding: in place
	Water Resource Improvement	Water Resource Efficiency and Quality		
		Flood and Capacity Management		Retention of runoff: *partially in place* Flood mitigation: *partially in place*
		Rehabilitation of water		
	Provision of Green Infrastructure	Enhancing Ecosystem Services		Protection of habitat and biodiversity (where existing and for protected sites): in place Developing new habitat and increasing biodiversity: in place
		Enhancing Local Environment		Improve urban soundscapes and air quality: in place Limiting visual intrusion by landscaping (buildings, transport links etc): in place
	Mitigation of Human Induced Climate Change (global warming)	Renewable Energy Generation		Solar plant on the rooftop of the Environmental Center Biomass trial plantation - under reconsideration
		Renewable material generation		Re-use of recylates on site for biomass plantation (sewage sludge)
		Greenhouse Gas Mitigation		Potential form re-use of energy, (sequetsration and offsetting not explored)
	Socio-Economic Benefits	Amenity		Open Space: *not in place* Leisure: *not in place* Education: *not in place* Improved health and wellbeing: *not in place* Access (footpaths, cycle routes): *not in place but imminent* Tourism: hotel planned Community Centre: in place View-points: partially in place Framing Built Developments: partially in place Grazing: in place
		Economic Assets		~~*Job Generation*~~ Land value recovery over time: in place Area value uplift: in place Interim land management: in place

Note *some differences to the whole site situation are italicised.*

5.4 Outcome of Markham Vale application

Markham Vale was a useful case study for HOMBRE for several reasons, being relevant to its interests and matching its objectives in several ways.

HOMBRE focuses on strategies, technologies and solutions for brownfield (BF) management that emphasise the positive value of available resources and potential social, economic and environmental benefits. The Markham Vale case study allowed testing of the BOM, tool for finding solutions for BF management. A core concept in the BOM is enhancing the value proposition for the soft reuse of brownfield sites.

For BF regeneration our target is finding new uses that will allow generating revenues (directly or indirectly on the site) and wealth (social, health, economic), while maintaining negative impacts to a minimum (environmental, disturbances of noise, odours, aesthetic, traffic congestion, etc.): the application of the BOM to Markham Vale case study helped to identify possible new uses, mostly for the North Tip scenario.

HOMBRE's research objectives are to provide:

- Better understanding why, how, where and when BF's are formed in order to avoid future BF's , in different areas in the EU and in three main fields: urban, industrial and mining areas: the story of Markham Vale allows to better understand why it has been a BF;
- Better planning and more attractive communication technologies, that allow more holistic appraisal of BF regeneration options and early stakeholder involvement: the BOM could have been used in the development of the Master Plan for Markham Vale during the planning phase as well as during stakeholder engagement activities;
- Better and more creative solutions for long-term land use of current and potential future BF's

The BOM and its application to the case study fits largely into third objective, and partially into the second objective as it can be used as a communication tool.

Markham Vale is the Derbyshire County Council's largest-ever regeneration project that aims to reverse the unemployment and deprivation which followed the closure of deep mines, loss of textile jobs and the general decline in heavy industry in north east Derbyshire. It is both an exciting and a difficult project. The difficulties affecting the project are largely not technical ones but relate to the intractable nature of job creation in the area during the economic downturn since 2008, and a number of specific barriers discussed in Section 5.1.

The reactions from the stakeholder (DCC) to the BOM were not initially positive, but through use became much more positive:

- First reactions: slightly sceptical, possibly reinventing the wheel, questioning whether the BOM had a practical use or was it just an academic exercise?
- Later reactions: The HOMBRE team were enthusiastic, the diverse mix of expertise and perspectives was refreshing to work with. After working with the team and applying the BOM to Markham Vale and more specifically the North Tip its usefulness was apparent as an early planning and possibly a post development validation tool. The BOM could be a useful tool when discussing a scheme with regulators at the Planning Approval stage.
- Overall feelings: pleasant experience, good to have an independent assessment that found that the interventions and outcomes were as predicted at the design stage of the MEGZ scheme.
- The BOM could have been used: at the planning stage to give an overview of the potential interventions and outcomes. And possible as a post development tool to validate a scheme's 'green credentials'.

The collaboration with HOMBRE seemed to be a beneficial experience for DCC technical staff. The MEGZ scheme is large (364 hectares), its original design had been conceived and developed by a team of people that have considerable expertise in the reclamation of brown field land and the techniques available to achieve any given desired end result. This expertise also extends to what was achievable and desirable at a local, regional and national level and an understanding of the limitations that surround such a scheme undertaken by a Local Authority. Consequently, in the case of MEGZ scheme all of the interventions and opportunities that could be practicably exploited and employed were planned prior to the development of the BOM tool and HOMBRE visit. However HOMBRE did bring enthusiasm and some interesting ideas. These may be more suited to being undertaken by an external body wishing to invest in the locality. The collaboration with HOMBRE brought forward a "critical-friend" review of work to date and will feed ideas into future stages of the project.

Broad benefits were identified.

- Benefits: defining new opportunities, exchange of ideas between local stakeholders and the HOMBRE team, which was very beneficial to everybody, promotional benefit to DCC of connecting Markham Vale to FP7 Project, and lastly creation of opportunities and ideas for further collaboration. The HOMBRE team partly acted as critical-friend by encouraging DCC to review reasoning and justifications for areas of work already being actioned. It was useful to the DCC team to consider and reiterate ideas behind the actions.
- The BOM seems useful as a tool for on-going considerations at the North Tip for benchmarking soft reuse options and exploring on going questions. In theory it could also have been used as a template for briefings, planning applications.
- It was useful for the DCC team to consider areas of work where future use of the HOMBRE tools could be put to use to help in project delivery, particularly with decision makers, i.e. funders, regulators and other key stakeholders.
- The BOM will be useful in developing plans, and presenting plans for regeneration, to regulators, funders and other decision makers.
- From HOMBRE's perspective the discussions with Markham Vale were very valuable in testing and assisting the development of the BOM.

Additional benefits might be found for other stakeholders connected with the project (although these were not consulted during this case study): Henry Boot Developments Ltd (land-owners and developers), administration; secondary beneficiaries (local community and businesses).

While the BOM seems highly relevant, of high value for beneficiaries, and reasonably achievable to use; an open question is who would be ready to invest substantial financial resources for obtaining expected benefits in a real life project. There is an interest from DCC in staying engaged with the HOMBRE team and further use of the BOM (potentially on other sites as well which are closer to initial design option appraisal). However, the terms of any future engagement will need to be clearly defined. There are no funds within the existing project to procure advice from HOMBRE and if such funds were available then competitive procurement issues need to be addressed. DCC asked: is the intention that the HOMBRE project group brings funding with it for future work? The main opportunity for this might be via projects in schemes such as Interreg or LIFE+.

DCC have highlighted the need for adequate communication and dissemination of the BOM and other HOMBRE outputs:

- The background and outcomes from the HOMBRE tools and concepts should be disseminated to peers in the reclamation and regeneration professions/industries. Initially as papers through journals/conferences but accompanied or followed by worked examples. The Markham Vale project is a very large and complex project covering many environmental, social and economic aspects of regeneration. As it is complex, it is also a lengthy, time-wise, project. Does HOMBRE work best with this scale of project, or is the opposite true?

6 General conclusions and recommendations

6.1 Stakeholder engagement in BF regeneration

We have described a stakeholder engagement process as having a general order of activities. However, these processes change from project to project. Differences strongly depend on how the regeneration/redevelopment process is initiated. In other words, is the process being started up from top or bottom? When initiated by a local stakeholder with a local or regional desire or ambition, often the first ideas are being set up with a wider group of stakeholders. However, when ideas for BF regeneration are initiated by politicians or companies with financial back-up, the ideas are formed with a narrow group of stakeholders. After having the first ideas better described other stakeholders are being involved. Both processes may lead to sustainable success in BF regeneration as described in Chapter 1 and 2. The BOM is a tool to help shape these first ideas in both contexts.

A wider group of stakeholders tends to have a more diverse collection of backgrounds, knowledge and interests. The BOM is a tool to inform stakeholders on the available service opportunities and interventions which can deliver them, whatever their background and interests. This is important because a lack of shared knowledge and understanding between stakeholders on the connection between interventions with possible services can threaten the success of a stakeholder engagement process. The BOM is intended to alleviate this threat, because it has is summarised the scientific knowledge on the connections and put it in a matrix that shows it in a simple manner. The Service Guide exists to help all stakeholders arrive at a shared description of the services desired, so stakeholders can more readily enter the matrix via the service side.

Somewhere in the stakeholder engagement process, after the input of ideas of narrow or wider groups of stakeholders, a design begins to emerge. At this point the BOM is of use to further investigate the synergies between interventions and/or services. The matrix provides the information on the conditions that interventions need, or on the conditions that services need to become feasible.

Note that the key to successfully engage stakeholders in a BF regeneration process is:
1. To give stakeholders the knowledge which services are provided by which interventions, and
2. Knowledge on interventions and how they are affected by a site's context to assist selection of the most feasible interventions and services.

6.2 Use of the BOM

The BOM is a practical tool for use by stakeholders in stakeholder engagement processes during BF regeneration. It provides an immediate view of the potentially multiple services from particular interventions using a simple colour scheme. It also gives a clear view on which interventions are potentially possible to combine without interfering with other services from other interventions. The detailed form of the matrix includes additional layers of information to get in depth insight on interventions and services they provide.

The information in the BOM represents a snapshot in time (2014). New information, new opportunities, additional documents, links, examples and case studies will surely emerge over

time, and the existing links to signposted information will gradually change. In addition, it seems likely that customising the general BOM approach to provide a greater range of regional examples in the Opportunity Windows will also be helpful. Currently there are no confirmed HOMBRE plans to fund on-going revision in the future beyond the end date of the HOMBRE project.

What is clear is that HOMBRE has produced in the BOM, and successfully demonstrated, a structured system for determining and optimising soft reuse of Brownfields in a simple and easily used decision support tool which does not depend on complicated entries of values and numbers, but provides a simple and transparent entry into what might be possible and how it might be achieved.

A version of the detailed BOM was also tested by students looking at a series of mixed BF redevelopment projects in the Netherlands and Sweden as part of the Balance 4P project (www.snowmannetwork.com/main.asp?id=255). Feedback from Rotterdam case showed a simplified version of the matrix for non-experts would be welcome. It has been reported it was easy to apply the BOM at different steps of the design process. A suggestion was to develop a BOM that would also consider regional circumstances (i.e. climate) to make it more specific for the areas of intervention. Further developments of the BOM could include connections with water/sea. Rotterdam stakeholders also mentioned they would welcome information about costs of interventions and time needed for these to be implemented and become effective.

Individual members of the HOMBRE consortium are likely to take the BOM forward, including customising it for example by including more regional (local) reference cases in the Opportunity Windows. The existing system is freely downloadable from the Brownfield Navigator (http://bfn.deltares.nl/bfn/site/index.php/standard/bfn_home) and open for further development. The HOMBRE consortium's intention is to continue working together and develop an HOMBRE+ alliance (HOMBRE D 7-4), which will further develop and implement the outputs of the FP7 project.

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