Sustainable urban Drainage Systems (SuDS) Tool Review

Regulatory Tools

TABLES Project 2012: Mini reviews		
Guidance	*Using your experience and expertise, consider the following tasks in relation to the tool. It may not be possible to complete all tasks for each tool due to a lack of available information, the task not applying to the tool, etc.* ***Please note where this is the case by writing in the reason in the space provided****. Please use a maximum of 6 pages of A4 (excluding diagrams and appendices).* ***Your responses are required in the white spaces****.*	
Task 1: Basic information		
Name of the tool	Sustainable urban Drainage Systems (SuDS) communication and planning tool	
Type of tool (list all that apply) *Learning and skills (pedagogic); participatory; regulatory; collaborative; mapping; valuation; modelling; decision; futures; financial; ecosystem services*		Decision, Collaborative, Valuation, Modelling, Futures, Financial, Ecosystem Services
Group members *(minimum size 3 members, must include a BCU rep)*	1. Chunglim Mak	
	2. Mark Everard	
	3.	
	4.	
	5.	
Please provide a brief synopsis of the tool *This may include: background context, development (and ownership if appropriate), current use and applications etc.* *Please also note any desired outcomes of the tool so that you can make reference back to these in Task 7: SWOT analysis*	Sustainable urban Drainage Systems (SuDS) communication and planning tool is a simple system that illustrate SuDS based on the ecosystem services concept. Ecosystem services are provisions from the natural environment that are beneficial to human beings. Therefore, this model highlights the services each SuDS types can generate that are beneficial to us (see appendix 2, fig. 1). Eventually, the ecosystem services can be measured using the indicators illustrated in the model, and the results will highlight values of each ecosystem services SuDS generate. The SuDS communication and planning tool (see appendix 2, fig. 1) has three columns: first, different SuDS types; second, ecosystem services each SuDS type can generate; third, indicators for measuring the ecosystem services. Each SuDS type is shown in different colour, for illustration and clarification, with matching colour lines projecting from each SuDS types to link with the ecosystem services they can generate. The ecosystem services are split into four categories – supporting, provisioning, regulating and cultural. For illustration and clarification, each ecosystem services categories are highlighted in different shades of green. In order to show which indicators can be used to measure which ecosystem services, matching green coloured lines were drawn so that they project from the ecosystem services towards their relevant indicators. Key SuDS literatures, including CIRIA materials, were referred to and the functions of different SuDS types were analysed in order to construct the list of SuDS types in the first column of the SuDS communication and planning tool. In the second column, the	

	categories and services represent the urban "natural" environment, such as urban parks and Green Infrastructures, and what these environments can generate that are beneficial to human beings . Ecosystem processes such as primary productivity and water cycle were not included because they will exist whether or not they offer any benefits to us. The ecosystem services chosen for the second column were based on key ecosystem services literatures (see Task 3) and the ease of quantification using the cost/benefit approach. The links between SuDS types and ecosystem services were based on empirical and implied evidences gathered through systematic and critical literature reviews (see Task 3 for some key literatures used to justify the links). In the third column, methods and empirical measurement data from a wide range of literatures were analysed in order to, firstly, identify the indicators for measuring ecosystem services, and secondly, link the ecosystems services with their relevant indicators together. The SuDS communication and planning tool is currently being tested within the River Irwell Catchment Plan. Currently, there is a serious problem with regards to diffuse pollution in urban areas of the river catchment which is preventing many rivers and lakes from achieving the legally required standard of water quality. Urban diffuse pollution mostly contain within storm water runoff. Impervious surfaces from urban areas contribute to large volume of storm water runoff into natural water bodies, causing flooding and distribution of diffuse pollutants. Therefore, reducing and managing storm water runoff is the key to tackle urban diffuse pollution. The planning tool will be used to investigate the multi-functional benefits that SuDS can provide in addition to the control of storm water runoff and tackling urban diffuse pollution by purifying the storm water before they enter the rivers.

Task 2: Use of the tool

Position / Use
*If you can, please indicate which **stage(s) of the decision / policy making process** your tool is / could be used in (these stages were identified in the specification document)*

Stage	Currently used	Could be used
Ideas	Yes	Yes – developers
Survey		Yes – engineers, planners
Assess		Yes – engineers
Policy / decision		Yes – flooding management policies
Implement		Yes – engineers
Evaluate		Yes - engineers

Please add any further comments here:

Task 3: Existing literature about the tool

Are you aware of any KEY policy and / or academic literature evaluating your tool? *(e.g. reports, journal articles, books)*

Please add any further comments here:

Author & Date	Title Vol pages	Web link (if available)
B. Woods-Ballard; R. Kellagher; P. Martin, C. Jefferies; R. Bray; P. Shaffer, (2007).	C697 The SUDS Manual. CIRIA, 1-607.	www.susdrain.org/resources/ciria-guidance.html#cgsuds
Costanza, Robert; d'Arge, Ralph; de Groot, Rudolf; Farber, Stephen; Grasso, Monica; Hannon, Bruce; Limburg, Karin; Naeen, Shahid; O'Neill, Robert V.; Paruelo, Jose; Raskin, Robert G.; Sutton, Paul; van den Belt, Marjan, (1997).	The value of the world's ecosystem services and natural capital. Nature, 387, 253-260.	
Rudolf S. de Groot; Matthew A. Wilson; Roelof M.J. Boumans, (2002).	A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics, 41, 393-408.	
TEEB - The Economics of Ecosystems and Biodiversity, (2011).	TEEB Manual for Cities: Ecosystem Services in Urban Management.	www.teebweb.org
Hanson, C.; Ranganathan, J.; Iceland, C.; Finisdore, J., (2012).	The Corporate Ecosystem Services Review: Guidelines for Identifying Business Risks and Opportunities Arising from Ecosystem Change	www.wri.org/publication/corporate-ecosystem-services-review
Gretchen C. Daily, (1997).	Introduction: What are ecosystem services? Nature's Services: Societal Dependence on Natural Ecosystems, Island Press, 1-10.	
Smith, R. M.; Thompson, K.; Hodgson, J. G.; Warren, P. H. & Gaston, K. J., (2006).	Urban domestic gardens (IX): Composition and richness of the vascular plant flora, and implications for native biodiversity. Biological Conservation, 129, 312-322.	
R. Céréghino; A. Ruggiero; P. Marty; S. Angélibert, (2008).	Influence of vegetation cover on the biological traits of pond invertebrate	

		communities. Ann. Limnol. - Int. J. Lim., 44, 267-274.	
	UK National Ecosystem Assessment, (2011).	UK National Ecosystem Assessment: Technical Report, chapter 10 – Urban.	
	Benjamin Burkhard; Franziska Kroll; Stoyan Nedkov; Felix Müller, (2012).	Mapping ecosystem service supply, demand and budgets. Ecological Indicators, 21, 17-29.	
	Trisha L.C. Moore; William F. Hunt, (2012).	Ecosystem service provision by stormwater wetlands and ponds - A means for evaluation? Water Research, 46, 20, 6811-6823.	

Task 4: Your experience of working on the tool	
Have you done any research/consultancy work on this tool in terms of its development, testing and/or evaluation? *If so, please provide an outline.*	This SuDS communication and planning tool was created and is in the process of being further developed during a PhD research programme.
Guidance	For Tasks 5-7, please also try to consider the **future** development and application of this tool in the TABLES project in your answers.
Task 5: Incorporating the ecosystem approach (EA) and ecosystem services (ES) ***Please refer to the summary text about ES for concept clarification at the end of this template (appendix)***	
Using examples (from practice, research or consultancy), explain how EA and/or ES are currently incorporated in/by the tool *If neither approach is currently incorporated, please move to the next question*	The incorporation of EA and ES can be seen through applying the tool in the River Irwell Catchment Plan. Through EA and ES incorporation, the environmental and social benefits SuDS can provide are as follows: 1. Enhance flood protection and alleviate drought, by providing extra water storage capacity, of an area. Therefore, SuDS can be used as an alternative to the culverts, weirs, locks and dams that are currently being used for flood mitigation in the River Irwell[1]. 2. Provide wildlife habitats, link different habitats together, and provide refuge for different wildlife species. Therefore, SuDS can be incorporated into the planned River Irwell brownfield sites regeneration[1]. 3. Support a variety of wildlife habitats, which enhance biodiversity. Therefore,

[1] JAMES, P., ATKINSON, S., BARLOW, D., BATES, A., COMYN, F., DUDDY, M., DUTTON, D., FRASER, J., HORSFALL, W., HOTHERSALL, A., LOWRY, K., MOORE, A., ROTHWELL, J., SCHOFIELD, M., SMITH, A., SURTEES, A., TAYLOR, D., TOLLITT, B., TOWERS, C., TZOULAS, K., WHITAKER, G. & CAUSER, K. 2012. The Irwell Catchment Pilot: The Rivers Return. *In:* THE ENVIRONMENT AGENCY (ed.). Warrington.

	SuDS can be made accessible to local people in the Irwell Catchment for recreational purposes[1]. 4. Provide multi-functionality of green infrastructure[1]. 5. Act as an alternative source of water supply, by turning grey water into usable water. 6. Maximise intervention performance, such as using Green Roofs for temporary water storage, in order to manage storm water. Aside from the above services, the SuDS communication and planning tool can be used as evidence to encourage utility companies, such as United Utilities, to invest in SuDS, by showing them the possibility of SuDS replacing Combined Sewerage Systems[1]. The planning tool can also be used to encourage schools to adopt SuDS, such as the Primrose Primary School in Ordsall, Greater Manchester, and to show the possibility of SuDS in providing job opportunities, such as in designing the scheme, construction, and maintenance.
How could the ecosystem approach and/or ecosystem services be (further) incorporated within the existing tool?	EA and ES can be further incorporated within the SuDS communication and planning tool through examinations of trade-offs and synergies. The trade-offs between ecosystem services happen when a driver changes an ecosystem service for the better, which in turn worsen another ecosystem service. Land use alteration is a major driver of changes in ecosystem services[2]. Trade-offs of different services can therefore be observed through changes in land use. In urbanization through densification, land use alteration occurred through the increase in impermeable surface coverage, which made flood mitigation worse but did not affect carbon storage[2]. In urbanization through urban sprawl, land use alteration occurred through the increase in the size of the urban area, which replaces previous green field areas[2]. In this case, changes in land use made carbon storage worse but did not affect flood mitigation[2]. Multiple ecosystem services can be improved or worsen at the same time either due to their interactions with the shared driver, or with each others. This situation is termed synergies. For example, diving to see coral reefs is a human recreational activity. Algae, however, can outcompete and outgrow the reefs, which leads to their deaths. Fish,

[2] EIGENBROD, F., BELL, V. A., DAVIES, H. N., HEINEMEYER, A., ARMSWORTH, P. R. & GASTON, K. J. 2011. The impact of projected increases in urbanization on ecosystem services. *Proc Biol Sci,* 278**,** 3201-8.

making coral reefs their habitats, eats algae as part of their diet. This offers protection to the reefs, which in turn secure the recreational activity of diving for human beings[3].

SuDS produce many different ecosystem services. Each of these ecosystem services are either interlinked with drivers or are directly linked with each others. In a retention pond, Habitat for Species is a key ecosystem service. This service can be improved or worsened via the improvement of water retention volume of the pond. Water retention capacity of the pond affects its flood mitigation capacity, another key ecosystem service, of the retention pond. Therefore, water retention is the driver that links Habitats for Species and Flood Mitigation together when analysing a retention pond's ecosystem services.

Complex plant structures can also change the flow of storm water from laminar to turbulent[4]. Turbulent water flow disrupts processes such as attenuation and inflitration[4], which has a negative effect on Flood Mitigation and Water Purification ecosystem services.

The economic analysis of ecosystem services can also be incorporated into the SuDS communication and planning tool. For example with regards to Fresh Water Provision, the data collected for the generation of clean, usable water per annum can be compared with the cost of using mains water per annum[5, 6, 7, 8], in order to get a value for the clean water generation capability of a SuDS site. Overall, SuDS can either be represented as cost saving schemes or systems that can generate actual profits if they produce or support the production of products that have market values.

Task 6: Situating the tool within priority questions/criteria arising from the scoping interviews		
Explain how the tool can be	**Priority question/criteria**	**Does your tool address/implement this question/criteria? Or does it have the potential if it**

[3] HUGHES, T. P., RODRIGUES, M. J., BELLWOOD, D. R., CECCARELLI, D., HOEGH-GULDBERG, O., MCCOOK, L., MOLTSCHANIWSKYJ, N., PRATCHETT, M. S., STENECK, R. S. & WILLIS, B. 2007. Phase shifts, herbivory, and the resilience of coral reefs to climate change. *Curr Biol,* 17**,** 360-5.

[4] B. WOODS-BALLARD, R. KELLAGHER, P. MARTIN, C. JEFFERIES, R. BRAY & P. SHAFFER 2007. C697 The SUDS Manual. *C697.* London: CIRIA.

[5] HEIN, L., VAN KOPPEN, K., DE GROOT, R. S. & VAN IERLAND, E. C. 2006. Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics,* 57**,** 209-228.

[6] PASCUAL, U. & MURADIAN, R. 2010. The economics of valuing ecosystem services and biodiversity. The Economics of Ecosystems and Biodiversity (TEEB).

[7] RUTH ASHTON, RICHARD BAKER, JAMIE DEAN, GILES GOLSHETTI, ANNE JALUZOT, NERYS JONES, MARTIN MOSS, MALCOLM STEELE, WILL WILLIAMS & WILMERS, P. 2010. Building natural value for sustainable economic development: The green infrastructure valuation toolkit user guide. Green Infrastructure North West.

[8] MALTE BUSCH, ALESSANDRA LA NOTTE, VALÉRIE LAPORTE & MARKUS ERHARD 2012. Potentials of quantitative and qualitative approaches to assessing ecosystem services. *Ecological Indicators,* 21**,** 89-103.

situated within the priority questions/criteria that arose in the scoping interviews *Complete as many boxes as required*		**was better integrated with an EA/ES approach?** *Please explain how.*
	Language and communication	
	1. Contribution to aiding the development of shared vocabulary within which principles of EA and ES can be shared with multiple stakeholders across built and/or natural environment	Yes, as through visualization, one can clearly see the links between the different SuDS types and the ecosystem services each one can generate, therefore, encouraging developers, engineers, and planners to incorporate EA and ES into their work.
	2. Capacity of the tool to develop shared understandings of the many identities and values of places from the perspectives of multiple visitors, residents and businesses	Yes. The SuDS communication and planning tool has the potential to help residents and businesses to understand the benefits of retrofitting SuDS in their areas.
	3. Capacity of the tool to improve or enable engagement across different publics so avoiding the usual suspect problem	Yes. Utility companies, environmental organisations, planners, engineers and ecologists can use this tool as a base for engagement and meaningful conversations.
	Learning from experience/pedagogy	
	4. Capacity of the tool to help reveal and value 'hidden' assets that are not recognised by communities or publics that use them	Yes. The tool can reveal ecosystem services SuDS can generate that are previously not thought of such as recreation and education, therefore, encouraging the adoption of SuDS by communities and the general public.
	5. Extent to which tool is building on other tools or EA/ES progress	Yes. The tool uses the ecosystem services identified by MEA, TEED, UK NEA, and other key publications, and link them with different SuDS types.
	6. Extent to which tool is locally derived or grounded or can be adjusted to closely reflect 'local' context. Is the tool suitable for an open source approach?	The tool is currently being used in the River Irwell Catchment Plan, but the aim is to make the tool generically applicable.
	7. Extent to which the tool is open to interpretation and application in a variety of forms (that reflect 'cultural' differences)	The aim is to make the tool generically applicable, therefore, the application of it can potentially reflect any cultural differences.
	Developing and selecting tools	
	8. Is the tool dependent on a specific funding source? How onerous is the application procedure? What are the chances of success?	This tool is being developed during a PhD research programme, which is funded by the UK Engineering Council.
	9. Does skills development (essential or optional?) and support exist for the tool or is there a body to ensure the	The aim is to make the tool usable by non-experts, therefore, no special training is required.

optimal and correct use of it?	
10. Extent to which current statutory hooks can be exploited by the tool or will benefit the quality or application of the tool (e.g. NNPF's duty to cooperate, SUDS, ecol. networks)	The Flood and Water Management Act 2010 and the Water Framework Directive can be exploited by the tool.
Informing resultant policies effectively	
11. Extent to which the tool informs or improves policies/decisions. What does the tool cover? (full range of positive and negative economic, social and environment impacts / tradeoffs?)	The planning tool can be used as evidence to encourage utility companies, such as United Utilities, to invest in SuDS, by showing them the possibility of SuDS replacing Combined Sewerage Systems. The planning tool can also be used to encourage schools to adopt SuDS, such as the Primrose Primary School in Ordsall, Greater Manchester, and to show the possibility of SuDS in providing job opportunities, such as in designing the scheme, construction, and maintenance.
12. How does the tool link into the planning system (applications and processes). At what cost / extra burden?	The tool can be used to justify decisions with regards to the following: first, the location of a SuDS scheme; second, the type of SuDS to use for either new development or retrofitting. The tool can also be used for scoping and screening to find the most suitable SuDS type for a particular site.
Delivering management objectives	
13. Suitability or capacity of the tool to assist with managing visitor needs and pressures within protected areas / the considered area? How?	N/A
Local ownership/new governance	
14. To what extent can the tool assist in developing statutory plans (local and management plans) and improve ownership and use by publics?	The tool can assist in developing statutory plans by highlighting the benefits SuDS can provide to the local communities and the environment.
15. To what extent does/could the tool contribute to a new form of community governance in management of the environment?	The tool highlights the services SuDS can provide to the local communities, therefore, they can be encouraged to adopt and manage SuDS sites for the benefits of the local environment.
Improved tools: understanding flows, interconnections and spatial issues	
16. Capacity to improve spatial understandings of the flows and interactions of various ecosystem services between sectors and at different scales	Potentially.
17. Capacity of the tool to reconcile assessments of options and	Potentially.

benefits across different scales (and sectors)	
18. Extent to which the tools is capable or can be manipulated to work across sectoral and administrative boundaries	The tool is generically applicable.
19. Extent to which the tool can handle data shortages and gaps (or is effectiveness considerably compromised?)	Few data is required to operate this tool.
20. To what extent has/could the tool put landscape/nature conservation and designated species/sites on the radar (positively or resulting in resentment?)	No.

Please add any further comments here:

Task 7: A SWOT analysis of the tool

Referring back to the relevant policy and academic literature (listed in Task 3), plus your own expertise (listed in Task 4) and the way in which the tool is situated within the priority questions/criteria (listed in Task 6), please complete a summary SWOT analysis ensuring that each point is well justified

Where possible, this analysis should reflect the tool's past and current application, as well as its effectiveness in policy and decision making processes

Strengths *(of the tool in delivering intended outcomes)*

- Easy to use
- Simple concept
- Little training is required
- The links between SuDS types and ecosystem services are clearly laid out
- Critically researched and analysed
- Room for further enhancement

Weaknesses *(factors that detract from the tool's ability to deliver intended outcomes)*

- Little empirical evidence to back up linkages at the moment
- Unable to show potential ecosystem disservices SuDS can generate
- Currently no indications of values of ecosystem services that can be generated by SuDS

Opportunities *(consider opportunities for application of the ecosystem approach and services)*

- Urban planning
- Justify decision for retrofitting SuDS
- Assist in developing statutory plans for the use of SuDS
- Encourage SuDS adoption and management by local communities.
- Assist in statutory plans development.
- Encourage the investments of SuDS schemes.

Threats *(factors which negatively affect the tool and its outcomes)*

Classify these by their "seriousness" and "probability of occurrence" in the table below, and pay particular attention to the threats associated with potential use of ecosystem approach/ecosystem services.

Threat	Seriousness (high, medium, low)	Probability of occurrence (high, medium, low)
Lack of empirical data to justify the links between SuDS types and ecosystem services they can generate.		low
Unable to show potential ecosystem disservices SuDS can generate.		low
Indicators for determining the values of ecosystem services that can be generated by SuDS are to be confirmed.		low

Please add further comments here:

Guidance	*Please now use the remainder of the document (box below) to make any general comments, observations or analyses of the tool*
Further comments	

Appendix 2 – The SuDS communication and planning tool

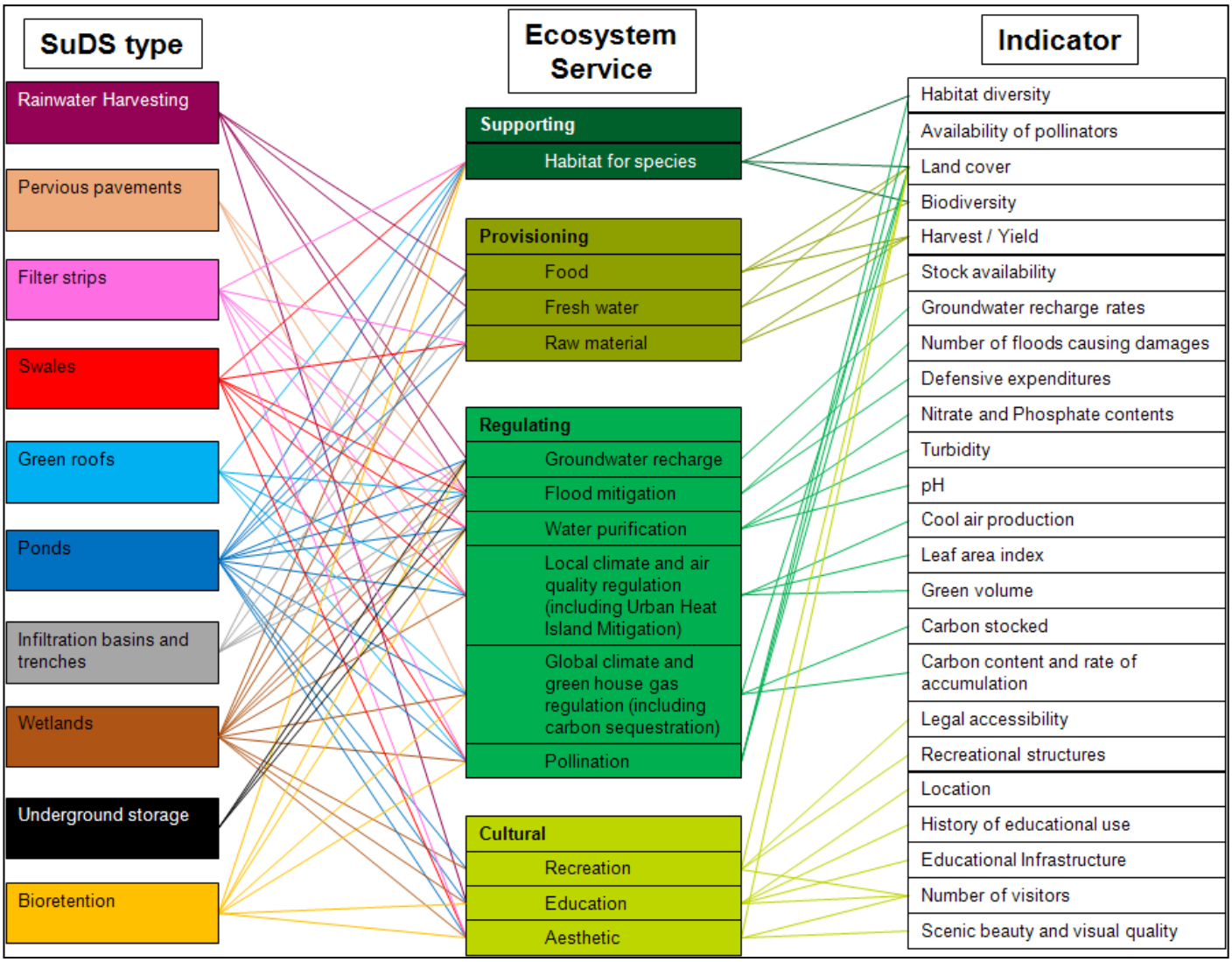

Figure 1 – The SuDS communication and planning tool[9, 10]

[9] MAK, C., JAMES, P. & SCHOLZ, M. Resilient Ecosystem Service Assessments for Sustainable Drainage Systems (SuDS). College of Science and Technology Research Showcase, 2012a MediaCityUK, University of Salford, Salford, UK.

[10] MAK, C., JAMES, P. & SCHOLZ, M. Linking Sustainable urban Drainage Systems (SuDS) and ecosystem services: new connections in urban ecology. British Ecological Society Annual Meeting and AGM, 2012b University of Birmingham, UK. neat.ecosystemsknowledge.net