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| Title | Linking sustainable urban drainage systems (SuDS) and ecosystem services: New connections in urban ecology |
| Authors | Mak, C, James, P and Scholz, M |
| Type | Conference or Workshop Item |
| URL | This version is available at: http://usir.salford.ac.uk/27427/ |
| Published Date | 2012 |

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Linking Sustainable urban Drainage Systems (SuDS) and ecosystem services: new connections in urban ecology

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Current Situation
My experience - A2B Blackridge Station Car park
Gap in current research
Research Approach

To critically evaluate Sustainable urban Drainage Systems in terms of the emerging ecosystem services paradigm.

A new way to link SuDS and ecosystem services.

Collect data to verify the links between SuDS and ecosystem services.

Data analysis to quantify the SuDS techniques and sites examined.

Extrapolate the findings for the analysis of land use changes in a city scale.
<table>
<thead>
<tr>
<th>SuDS type</th>
<th>Ecosystem Service</th>
<th>Indicator</th>
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<tbody>
<tr>
<td>Rainwater Harvesting</td>
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<td>Habitat diversity</td>
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<td>Aesthetic</td>
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Key drivers for sustainability in urban drainage 1

- The impacts of urbanisation on hydrological processes.
  - Impermeable surfaces result in increased runoff and earlier arrival of stormwater to river.
  - Rapid rise and fall of peak discharge – sudden flooding of river.

[Diagrams showing pre-urbanisation and post-urbanisation processes]

Butler and Davies, 2011

(CIRIA, 2011)
Key drivers for sustainability in urban drainage 2

- Water quality deterioration due to urban diffuse pollution.
- Climate change increases risk of flooding.
Key legislations for sustainability in urban drainage

• 2000 – Water Framework Directive
  o All urban surface runoffs has to be controlled so that their impact to the receiving environment is mitigated.
  o Transposed into UK National legislation in Dec 2003.

• 2004 – Making space for water (England)
  o Government consultation on future flood risk management.

  o Flood risk management hierarchy: assess, avoid, substitute, control (SuDS), mitigate.
## SuDS types

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- Rainwater Harvesting
- Pervious pavements
- Filter strips
- Swales
- Green roofs
- Ponds
- Infiltration basins and trenches
- Wetlands
- Underground storage
- Bioretention

**Ecosystem Service**

**Supporting**

- Habitat for species

**Provisioning**

- Food
- Fresh water
- Raw material

**Regulating**

- Groundwater recharge
- Flood mitigation
- Water purification
- Local climate and air quality regulation (including Urban Heat Island Mitigation)
- Global climate and greenhouse gas regulation (including carbon sequestration)
- Pollination

**Cultural**

- Recreation
- Education
- Aesthetic

**Indicator**

- Habitat diversity
- Availability of pollinators
- Land cover
- Biodiversity
- Harvest / Yield
- Stock availability
- Groundwater recharge rates
- Number of floods causing damages
- Defensive expenditures
- Nitrate and Phosphate contents
- Turbidity
- pH
- Cool air production
- Leaf area index
- Green volume
- Carbon stocked
- Carbon content and rate of accumulation
- Legal accessibility
- Recreational structures
- Location
- History of educational use
- Educational Infrastructure
- Number of visitors
- Scenic beauty and visual quality
Ecosystem Services 1

Provisions from the natural environment that are beneficial to human beings.

• 1997 – Gretchen C. Daily et. al.
  o Introduction to ecosystem services

• 1997 – Robert Costanza et. al.
  o A table listing 17 major categories of ecosystem services and functions.

• 2002 – Rudolf S. de Groot et. al.
  o A framework diagram and a table distinguishing between ecosystem functions, processes, goods and services.

• 2005 – Millennium Ecosystem Assessment (MEA)
  o Four categories: supporting, provisioning, regulating, and cultural.
Ecosystem Services 2

• 2007 – Boyd and Banzhaf
  o Started to distinguish ecosystem services and ecosystem processes.

• 2010 – The Economics of Ecosystems and Biodiversity (TEEB)
  o Four categories: habitat or supporting, provisioning, regulating, and cultural.
  o Excluded ecosystem processes such as primary production and water cycle.

• 2011 – UK National Ecosystem Assessment (UK NEA)
  o Three categories: provisioning, regulating, and cultural.
  o Excluded supporting services.

• 2011 – Bastiana et. al.
  o Further divide ecosystem services as properties, potentials and services.
For this research

- **Supporting**
  - Habitat for species

- **Provisioning**
  - Food, fresh water, raw material

- **Regulating**
  - Groundwater recharge, flood mitigation, water purification, local climate and air quality regulation, global climate and greenhouse gas regulation, pollination

- **Cultural**
  - Recreation, education, aesthetics

(Costanza et al., 1997; Daily, 1997; Groot et al., 2002; MEA, 2005; TEEB, 2010; World Resources Institute, 2010; UK NEA, 2011)
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Ecosystem services indicators – 1

Habitat for species

Pollination

- Biodiversity
- Landcover
- Habitat diversity
- Availability of pollinators
Ecosystem services indicators – 3

Global climate and greenhouse gas regulation

- Landcover
- Carbon content and rate of accumulation
- Carbon stocked
- Leaf area index
- Green volume
- Cool air production

Local climate and air quality regulation
SuDS type

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Any questions?