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

Chunglim Mak¹, Philip James¹, and Miklas Scholz²

¹Ecosystems & Environment Research Centre, School of Environment & Life Sciences, Peel Building
²Civil Engineering Research Group, School of Computing, Science and Engineering, Newton Building
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Introduction – Urban Diffuse Pollution
Current Situation 1

Urban Runoff causing activities
- Drainage – Roads
- Drainage Housing
- Drainage – Mixed
Current Situation 2

North of England pollution source linked with DEFRA Diffuse Urban Pollution
(Surface Waters)
(count of waterbodies failing for issue)

- unknown: 1
- trading/industrial estates: 24
- sewage discharge (diffuse): 51
- drainage - road run-off: 33
- drainage - mixed: 111
- drainage - housing: 14

- Contaminated water body bed sediments: 4
- contaminated land: 65
- atmospheric deposition: 2
- amenity grassland: 2
- airports: 1
- active mine: 1
- abandoned mine: 67
Current Situation 3 – Key legislations

April 2014?
Current Situation 4 – SuDS

Diagram showing the relationship between solar energy, evapotranspiration, infiltration, and the receiving water body. The diagram includes labels for prevention, source control, site control, regional control, and various processes such as infiltration.
### Current Situation 5 – SuDS types

<table>
<thead>
<tr>
<th>Rainwater Harvesting</th>
<th>9</th>
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<tbody>
<tr>
<td>Pervious pavements</td>
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<td>Filter strips</td>
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<td>Infiltration devices</td>
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<td>Wetlands</td>
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<td>Underground storage</td>
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Current Situation 6 – Knowledge Gap
The Idea

• SuDS Planning Tool using the ecosystem services and disservices approach.
SuDS type

Rainwater Harvesting
Pervious pavements
Filter strips
Swales
Green roofs
Ponds
Infiltration devices
Wetlands
Underground storage
Bioretention

Ecosystem Disservice

Supporting
- Littering by animals foraging in bins
- Disease carrying animals
- Habitat competition with humans
- Accidents

Regulating
- Drainage failures
- Contaminant mobilization
- Maintenance
- VOC emissions
- Damage to infrastructures
- Plant pollen allergies

Cultural
- Land use conflicts
- Fear and stress
Explanation 1 - usage

- Web based user interface, with clickable links containing specific, detailed information to aid the following tasks:
  - Deciding on where to locate a new SuDS development.
  - Analysing an existing SuDS system.
  - Designing a new SuDS system.
  - Compiling public policy documents.
**The SuDS advice map**

- **< 5m above nominal river level.**
  - Underlain by unfavourable drift geology (till)
  - Within flood protection zones 2 or 3.
  - Storage based SuDS.

- **> 5m above nominal river level.**
  - Underlain by undifferentiated glacial deposits or alluvium
  - Outside all flood protection zones.
  - Infiltration and storage based SuDS.

- **> 5m above nominal river level.**
  - Underlain by sand/gravel drift deposits.
  - Outside flood protection zones 2 and 3.
  - Infiltration based SuDS.
**Rainwater Harvesting**

- Pervious pavements
- Filter strips
- Swales
- Green roofs
- Ponds
- Infiltration devices
- Wetlands
- Underground storage
- Bioretention

**Ecosystem Service**

- Supporting
  - Habitat for species
  - Provisioning
    - Food
    - Fresh water
    - Raw material
  - Cultural
    - Recreation
    - Education
    - Aesthetic
  - Regulating
    - Groundwater recharge
    - Flood mitigation
    - Water purification
    - Local climate and air quality
    - Global climate and greenhouse gas regulation
    - Pollination
    - Urban Heat Island Mitigation
    - Carbon sequestration

**Wetlands**

**Definition**

A storage type SuDS consisting of shallow ponds and marshes, covered almost entirely with aquatic vegetation. Six types of SuDS wetlands (shallow wetlands, extended detention shallow wetlands, pocket wetlands, pond/wetland systems, submerged gravel wetlands, and wetland channels). A positive water balance must be maintained in order to prevent the wetland from dying off. Most SuDS wetlands in Europe are soil or gravel-based horizontal-flow systems planted with T. Latifolia and/or P. Australis.

**Measurement Indicators**

- Habitat diversity
  - Aquatic: aquatic mesohabitats coverage
  - Terrestrial: terrestrial vegetation structure and coverage

- Landcover, Legal accessibility, Recreational structures

**Valuation Indicators**

- Travel Cost, Benefit Transfer
- Water Purification
- Wetlands are Excellent for Recreation.
SuDS type

Rainwater Harvesting

Pervious pavements

Filter strips

Swales

Green roofs

Ponds

Infiltration devices

Wetlands

Underground storage

Bioretention

Ecosystem Disservice

Supporting

Littering by animals foraging in bins

Habitat competition with humans

Disease carrying animals

Indicator

Habitats conducive to ticks and rats

Regulating

Drainage failures

Maintenance

VOC emissions

Costs of maintenance

Indicator

Land value, Profitability

Cultural

Landuse conflicts

Fear and stress

Indicator

Areas of non-illumination

Fear and stress
Pervious pavements

Definition
An infiltration based SuDS categorized into two types of surfaces: permeable and porous. Permeable surfaces are made up of materials that do not contain any voids in itself. However, through surfacing arrangements, they allow water to infiltrate through the gaps in-between. An example would be concrete block paving. Porous surfaces are made up of materials that are porous in itself. Water passing over these surfaces can infiltrate through them and into the aggregate sub-base below. Examples are grass, gravel, porous concrete, and porous asphalt. Typical construction materials are subgrade, geomembrane, aggregate, geotextile, and either impermeable pavement blocks or porous surfaces, depending on which two surface types is chosen to be used.

Measurement Indicators
Habitat diversity, Landcover, Biodiversity

Measurement Indicators
pH, Nitrates and Phosphates contents

Water Purification

Urban Heat Island Mitigation

Measurement Indicator
Colour of paving

Ecosystem Service
Habitat for species

Supporting Habitat for species

Provisioning Food

Fresh water

Raw material

Cultural
Recreation
Education
Aesthetic

Pollination

Local climate and air quality

Regulating Groundwater recharge

Flood mitigation

Water purification

Global climate and greenhouse gas regulation

UHI mitigation

Carbon sequestration
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Further Development

- SuDS type, ecosystem service and disservices linkages validation.
- Research on the strength class definitions.
- Ecosystem services and disservices valuation indicators and methods.
- Web site development.
- SuDS sites to trial planning tool.
Chunglim Mak

C.mak@edu.salford.ac.uk
Reference 1


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