

# IWRA's XVII WORLD WATER CONGRESS

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# Using a mixed method approach to determine the multiple benefits provided by Sustainable Drainage Systems



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# Introduction

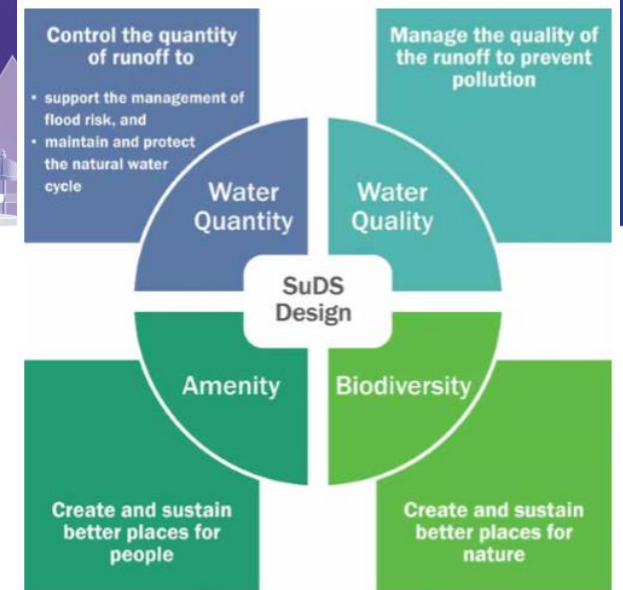
- **Sustainable Drainage Systems (SuDS)**

- SuDS are the urban drainage systems that are constructed with the aim of managing surface water in a natural way

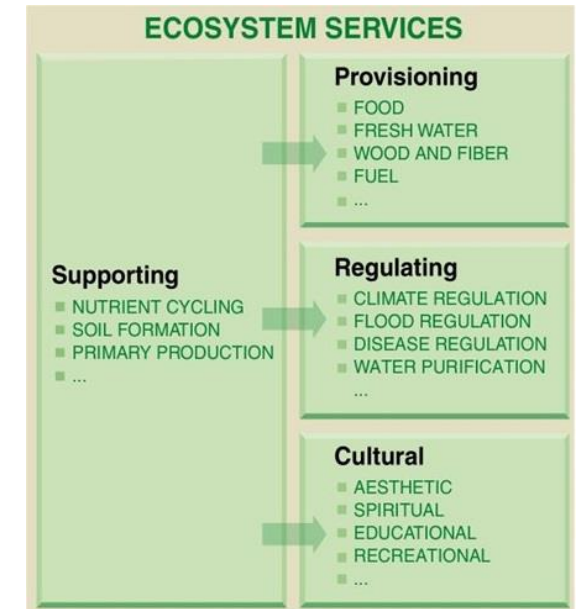
- **Ecosystem Services (ES)**

- Ecosystem services are the benefits that people receive directly or indirectly from the environment

A mixed method approach can help to determine the ecosystem services provided by SuDS



Woods-Ballard et al 2015



UKNEA 2011

# Aim and Objectives



- **Aim:** To assess the natural and societal value of SuDS by determining the Ecosystem Services provided by them and to develop a valuation approach
- **Objectives:**
  - Identify the multiple benefits provided by SuDS
  - Use mixed method approach to determine the social and cultural goods and benefits provided by SuDS
  - Develop a communication tool

# Methodology



- A mixed method approach – social and physical science methods
- Quantitative and qualitative analysis
- Methods:
  - Visual inspection
  - Public perception survey
  - Public participatory geographical information systems (PPGIS) method

# Case Study Sites



- Ardler, Dundee, Scotland, UK – pilot case study
- Dunfermline Eastern Expansion (DEX), Scotland, UK – main case study
- Waterlooville, England, UK – communication tool test site



# Ardler Case Study



- Located at North of Dundee, Scotland
- Ardler village – redeveloped multiple times
- The SuDS were established in early 2000
- Well established and well designed SuDS
- SuDS at Ardler include ponds, detention basin and swales

# SuDS at Ardler



a) Swale



b) Detention basin



c) Pond



# Results from Ardler



- Visual Inspection:
  - Regulating services identified at Ardler were climate regulation, water regulation, erosion control, and water purification
  - Cultural services identified at Ardler were educational value, spiritual value, aesthetics, recreation, and biodiversity

# Ardler results contd.



- Public Perception Survey:
  - Greenspace visit – everyday (50%), 2-3 times a week (28%), once in fortnight or less (26%)
  - Greenspace preference – Grassed area (47%), planted areas (25%), ponds(34%)
  - No flood risk – 63%
  - Willingness to Pay – 50%
  - Reason to choose the location – Commuting to work (3%), greenspace (8%), Neighbourhood (5%), school (6%), family ties (8%) other (15%)

<b>Cultural Benefits at Ardler</b>	
Aesthetics	H
Biodiversity	H
Recreation	H
Health	H
Educational value	H
Sense of wellbeing	H
Security	H
Tourism	H
Heritage	M
Cultural value	M
Religious wellbeing	L
Social Value	L

# Ardler results contd.

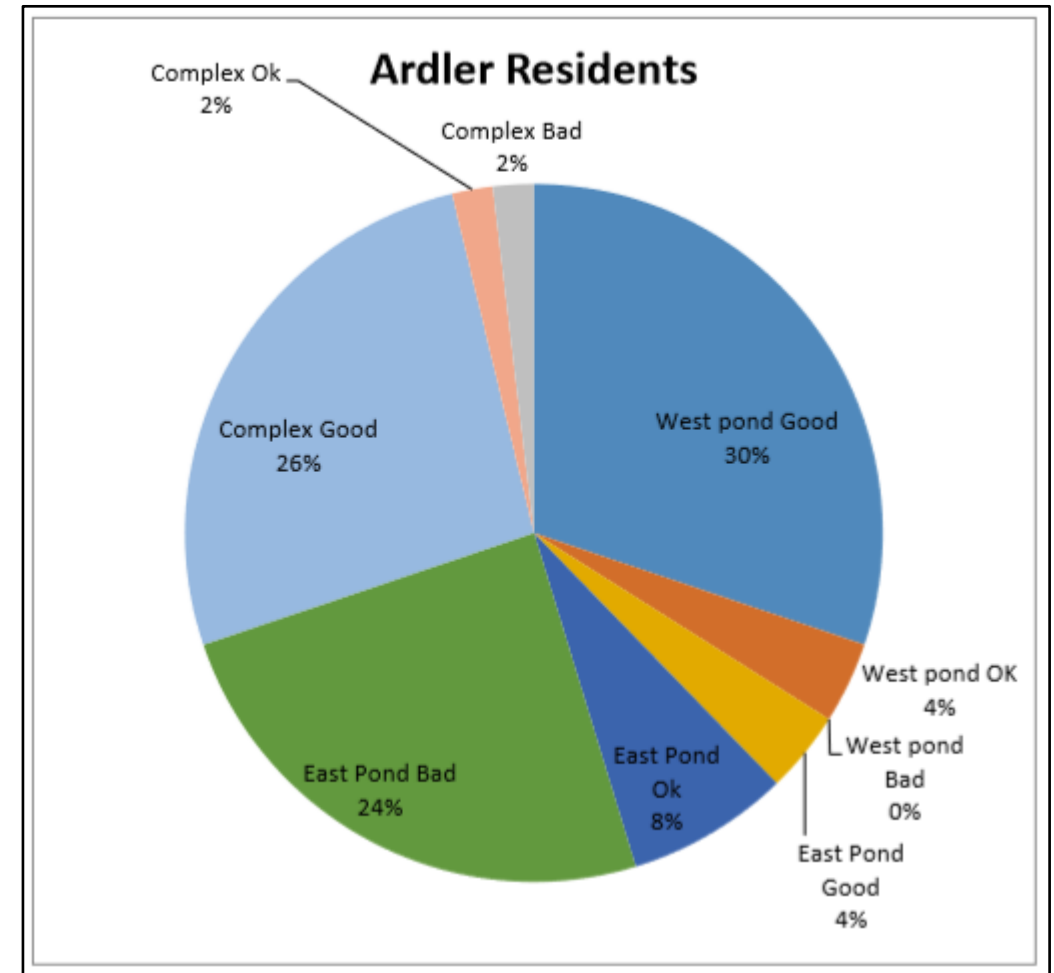


- Public Participatory GIS study



Public participatory GIS map at Ardler

Most favourite area – Ardler West Pond (83%)  
Least favourite area – Ardler East pond (60%)



# DEX, Dunfermline Case Study



- Dunfermline Eastern Expansion (DEX), Dunfermline, Scotland
- DEX is a 550 hectare site
- Previously agricultural development
- Commercial and residential developments
- SuDS development started in 1994
- SuDS at DEX include wetland, ponds, detention basins, swales, permeable paving and filter drains

# SuDS at DEX



a) Wetland



c) Pond



b) Basin



d) Swale

# Results from DEX, Dunfermline



- Visual Inspection:
  - Regulating services identified at DEX SuDS systems were climate regulation, water regulation, erosion control and water purification
  - Cultural services identified at DEX SuDS systems were educational value, spiritual value, recreation, aesthetics and biodiversity

# DEX results contd.

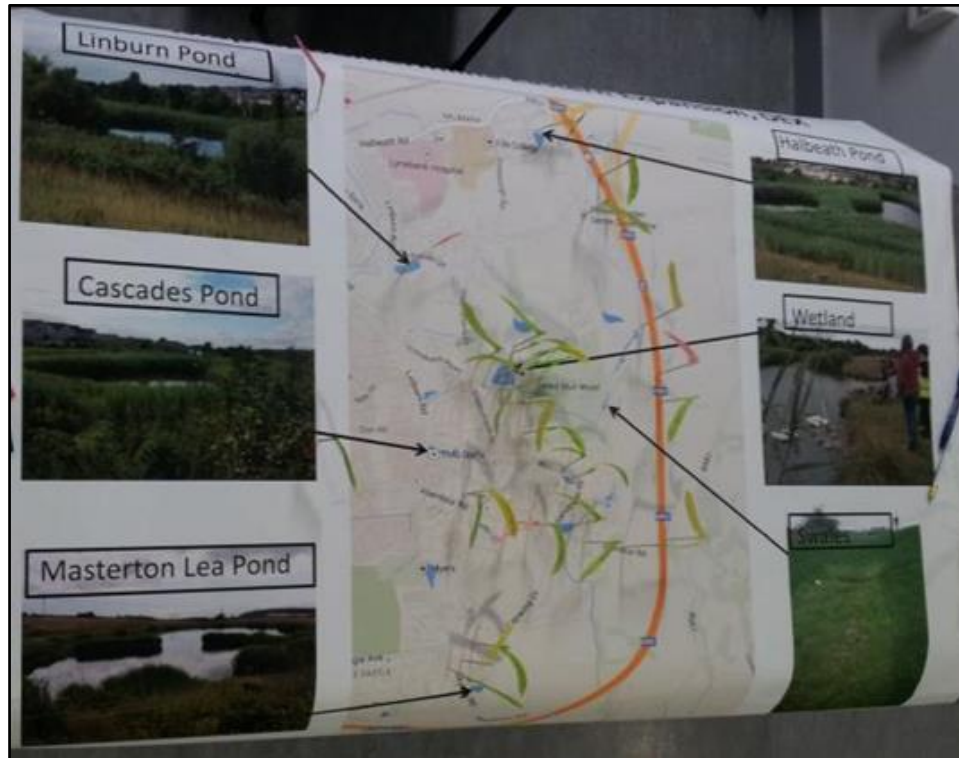


- Public Perception Survey:
  - Greenspace visit – everyday (28%), 2-3 times a week (33%), every two weeks or less (33%)
  - Greenspace preference – grassed area (21%), shrubs and trees (25%), ponds(10%)
  - House prices – high near SuDS systems (56%), not high near SUDS systems (34%)
  - SuDS knowledge - aware of SuDS (62% ), not aware of SuDS (36%)
  - Reason to choose the location – commuting to work (41%), greenspace (36%), neighbourhood (35%), school (18%), family ties (15%) and other (19%)

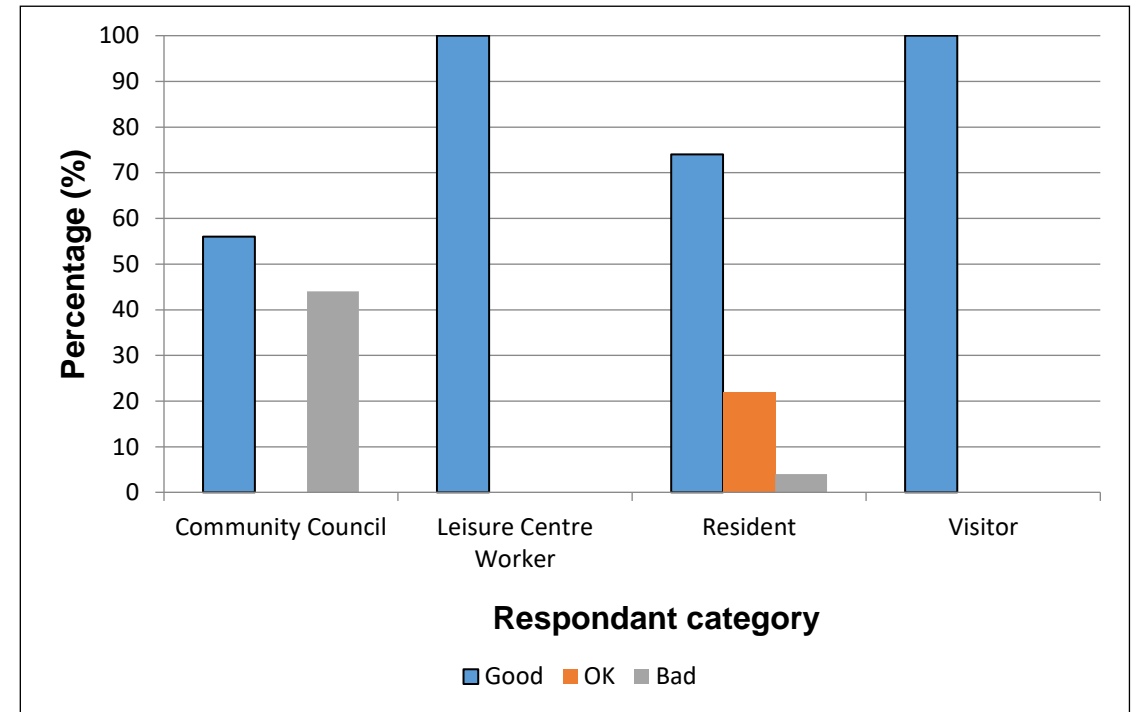
# DEX results contd.



- Public Participatory GIS study



PPGIS Map at DEX  
Most Favourite place: Wetland (27%)  
Least Favourite place: Linburn Basin (10%)



Wetland at DEX:  
Residents perception – Good (74%), OK (22%)  
and Bad (4%)



# DEX results contd.



Cultural Benefits	Vegetated SUDS (where, H-High, M-medium, L-Low)			
	Wetland	Pond	Basin	Swale
Education	H	M	L	L
Health	L	L	M	M
Aesthetics	M	H	M	M
Biodiversity	M	H	H	H
Recreation	H	M	H	H
Well-being	M	H	H	M
Pet walking	H	M	H	H
Community Activities	L	L	L	L
Other	L	L	L	L

These results were combined from

- Literature review
- Visual inspection
- Public perception survey
- Public participatory GIS study

# DEX results contd.



Regulating Service Benefits: where H (Green) = High, M (Yellow) = medium, L (Red) = Low

	Water Quality	Water Quantity	Erosion Control	Climate Regulation
Wetland	H	M	L	M
Pond	H	H	M	M
Basin	H	H	L	L
Swale	M	H	M	M

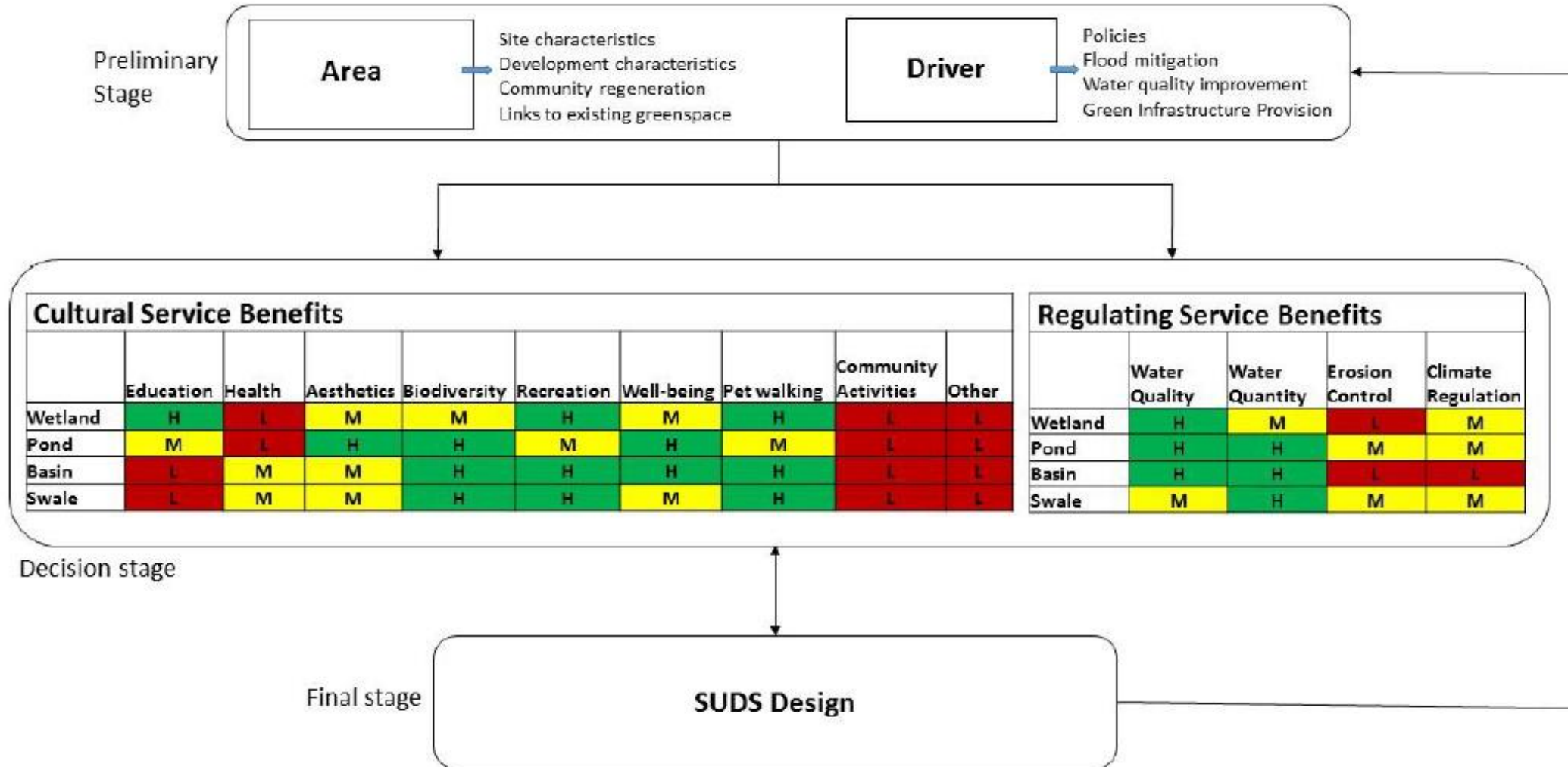
These results were combined from

- Literature review
- Visual inspection
- Pond and wetland survey

# Communication Tool



## Communication Tool for ecosystem services associated with SUDS



# Waterlooville Case Study



- Berewood Homes at the west of Waterlooville, Hampshire, England
- 247 hectare, Waterlooville Major Development Area (MDA)
- The SuDS construction started in 2008
- Well-established SuDS site
- SuDS at Waterlooville include swales, ponds, lagoons and ditches

# SuDS at Waterloooville



a) Pond



b) Swale

# Results from Waterloooville



- Professional survey - 20/36 responses
- Landscape architects (45%), researchers (15%), engineers (10%), policy officer (10%), designer (5%), drainage officer (5%)
- Swales image –35% agree to the scores given in communication tool, 15% did not agree and 40% partially agreed
- Ponds image - 20% agree to the scores given in communication tool, 10% did not agree and 55% partially agreed
- Ecosystem services got high value in SuDS design (85%)
- Communication tool got high usefulness in SuDS design (30%)

# Conclusion



- SuDS provides multiple benefits
- Vegetated SuDS contribute to ecosystems services
- Non-monetary evaluation of the multifunctional benefits provided by SuDS
- The communication tool helps landscape architects, engineers, planners and policy makers with respect to decision making
- A mixed method approach helps to collect the evidence base for cultural and regulating services



Thank you!

Any Questions?

References:

- UKNEA 2011. The UK National Ecosystem Assessment: Technical Report. UNEP-WCMC. Cambridge.
- Woods-Ballard, B. et al. 2015. The SuDS Manual. CIRIA. C753. London. ISBN: 978-0-86017-760-9