University of Salford MANCHESTER

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

Chunglim Mak[1], Philip James[1], and Miklas Scholz[2]

[1]Ecosystems & Environment Research Centre, School of Environment & Life Sciences, Peel Building

[2]Civil Engineering Research Group, School of Computing, Science and Engineering, Newton Building

Content

- Introduction – Urban Diffuse Pollution
- Current Situation
- The Idea
- Explanations and demonstration – River Irwell Catchment
- Further Research

Introduction – Urban Diffuse Pollution

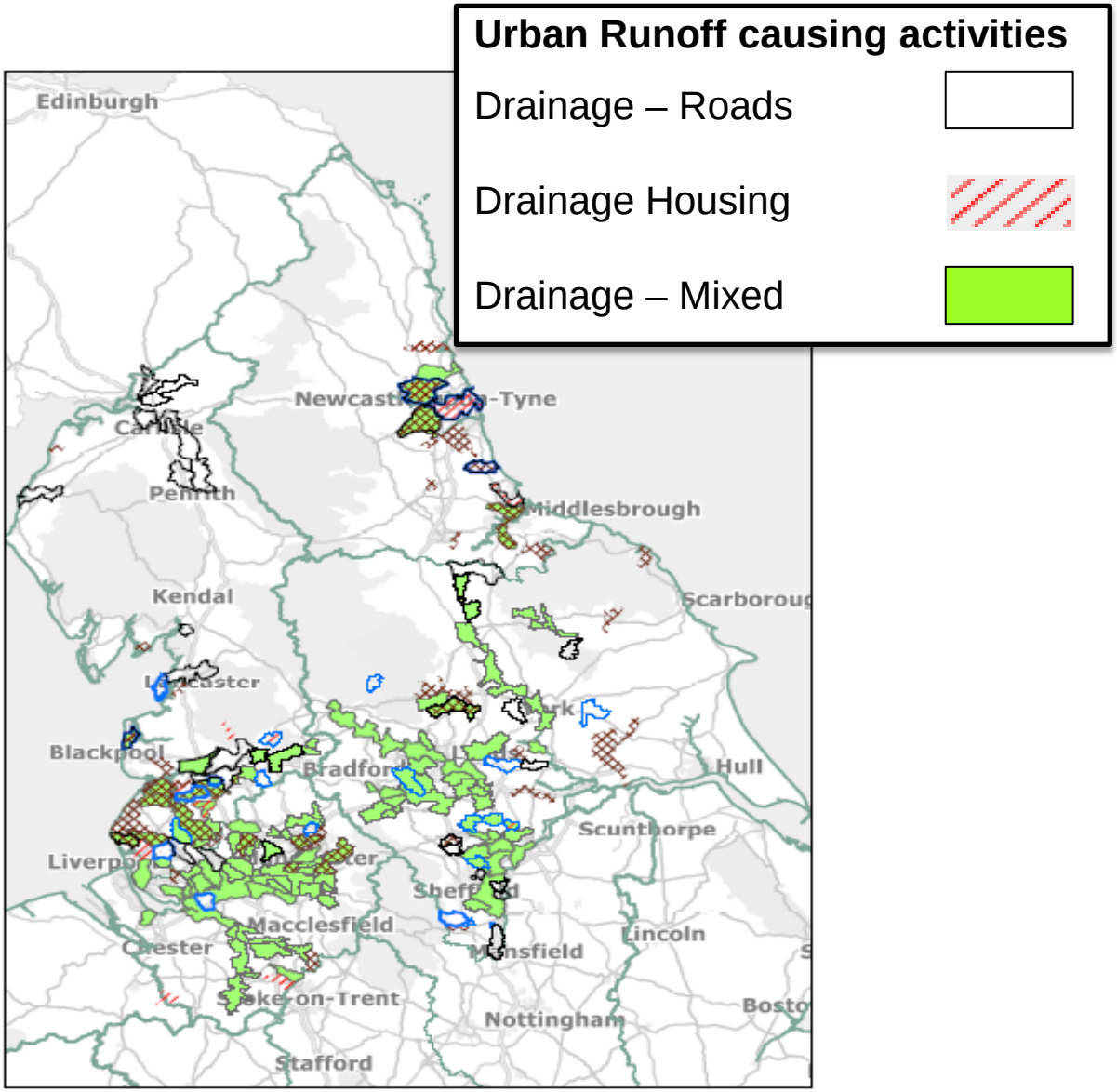
1

2

3

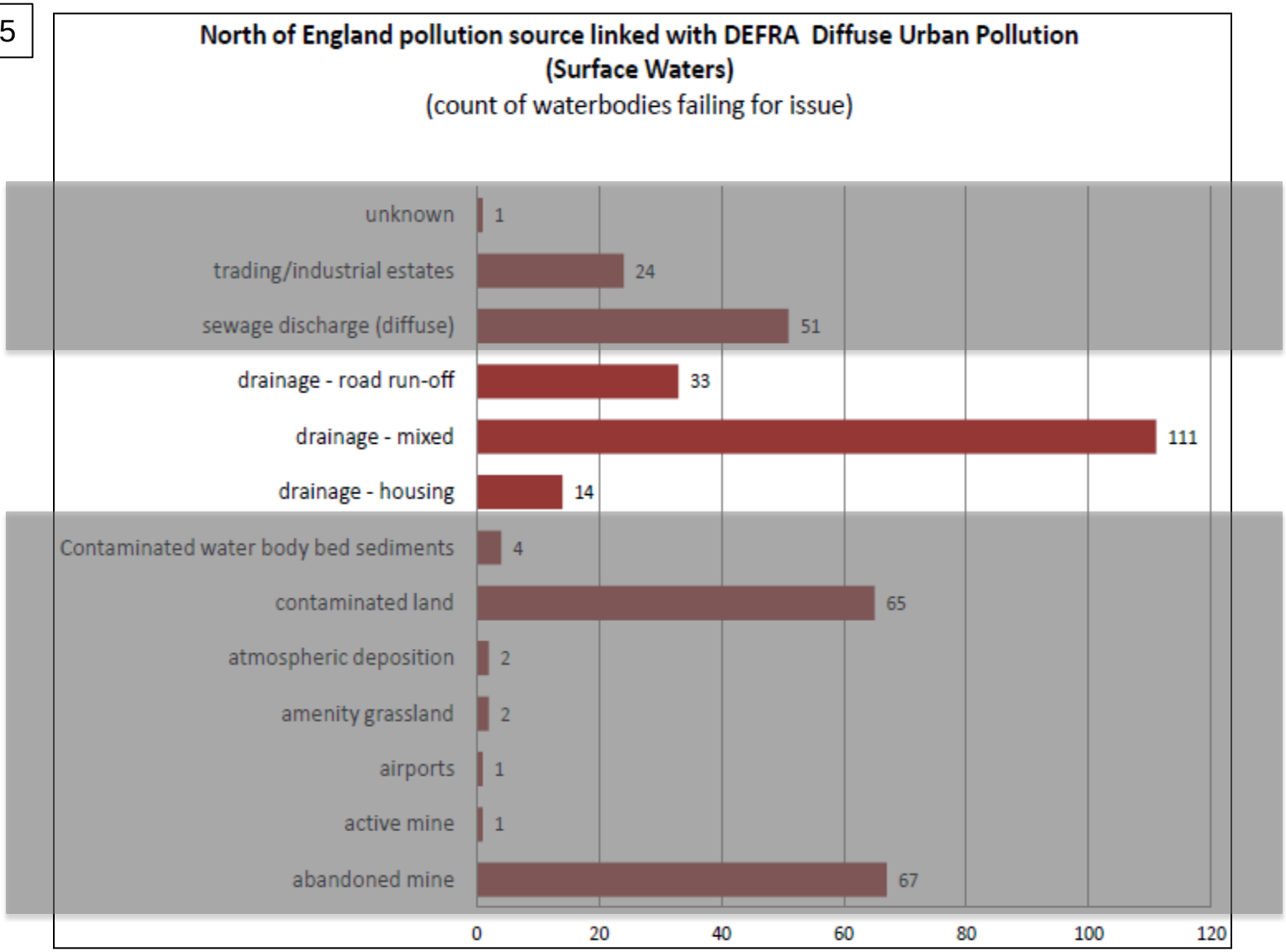
Current Situation 1

4

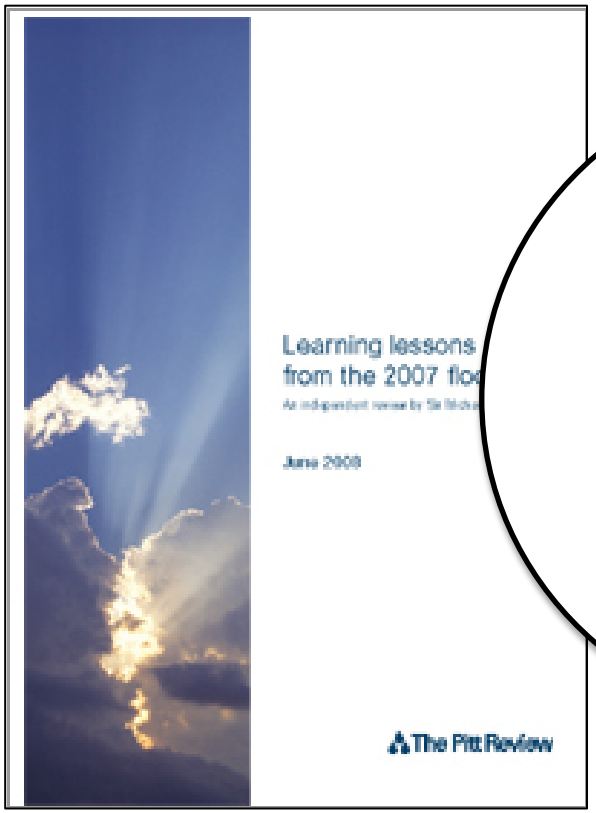


Current Situation 2

5

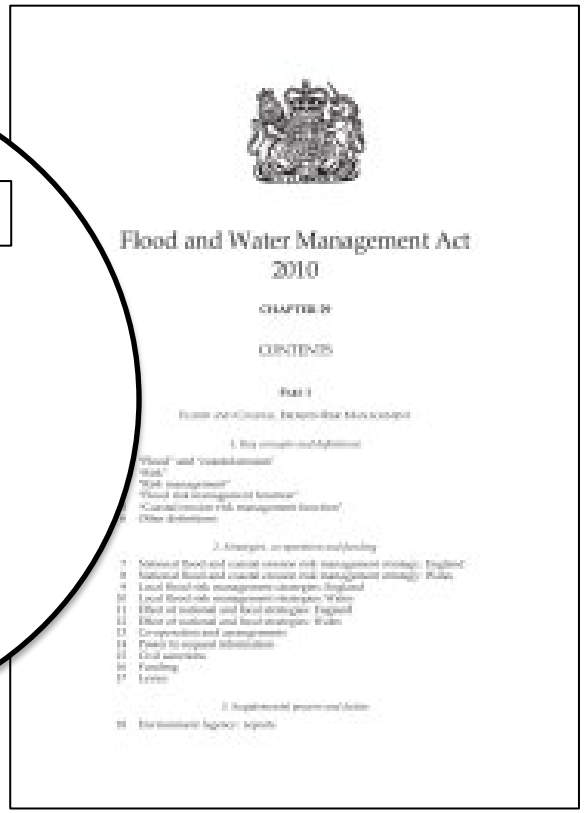


Current Situation 3 – Key legislations

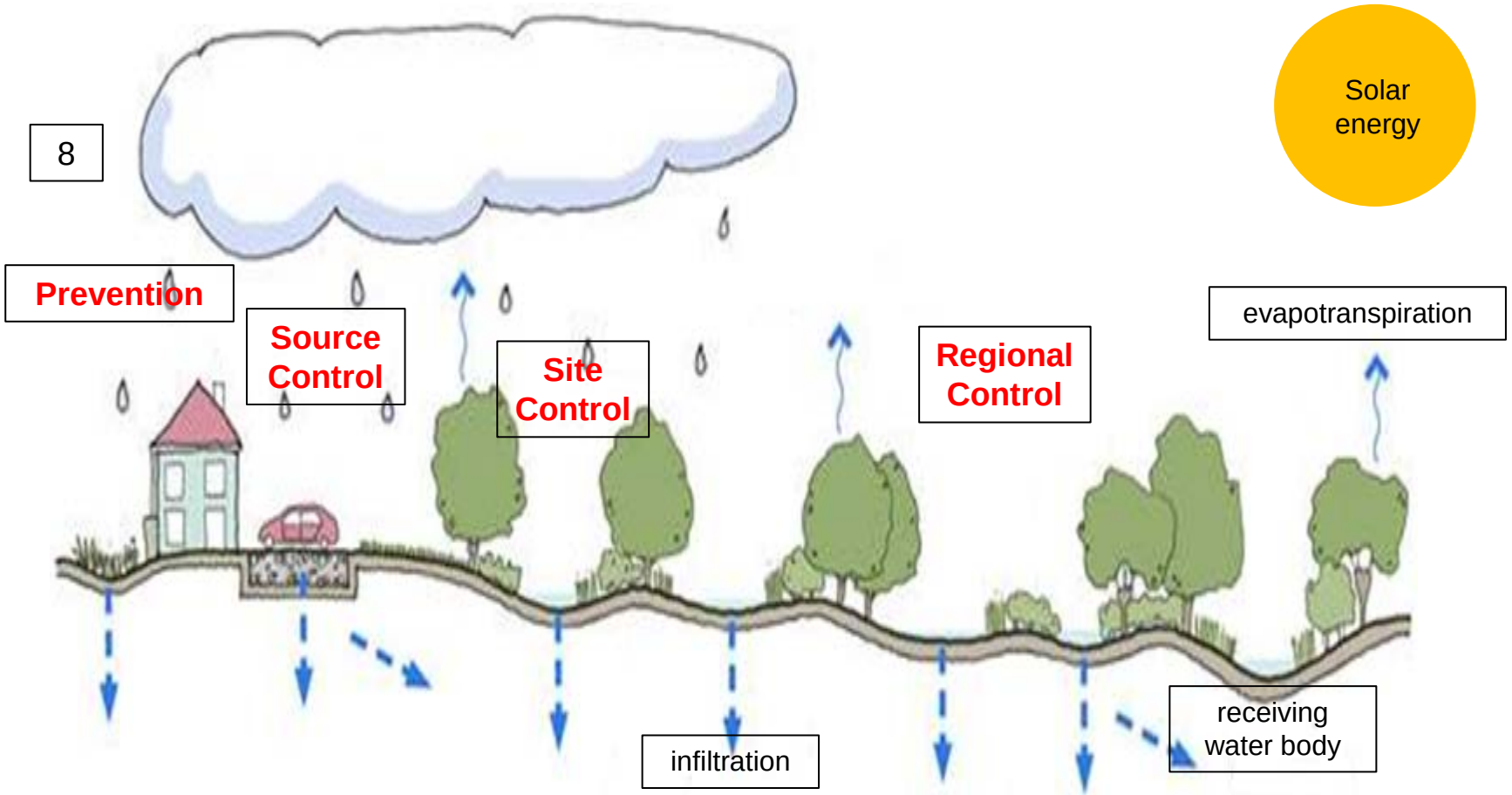


6

April 2014?



Current Situation 4 – SuDS



Current Situation 5 – SuDS types

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

9

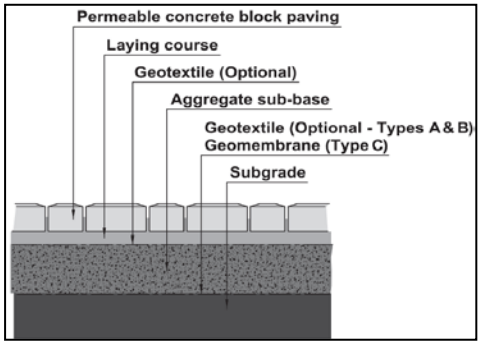
10

11

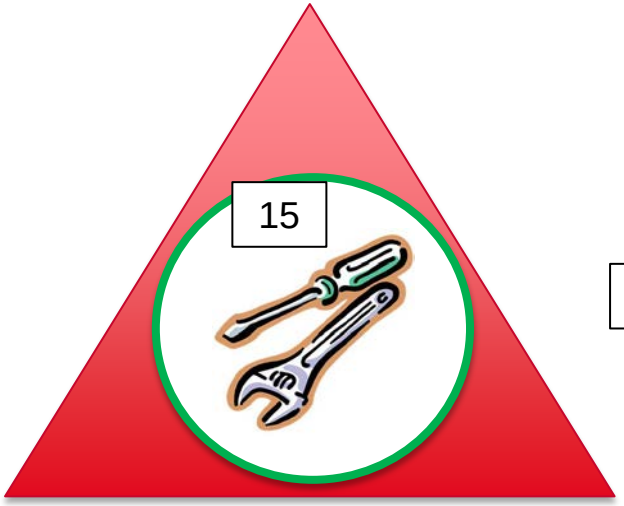
12

Current Situation 6 – Knowledge Gap

13



15

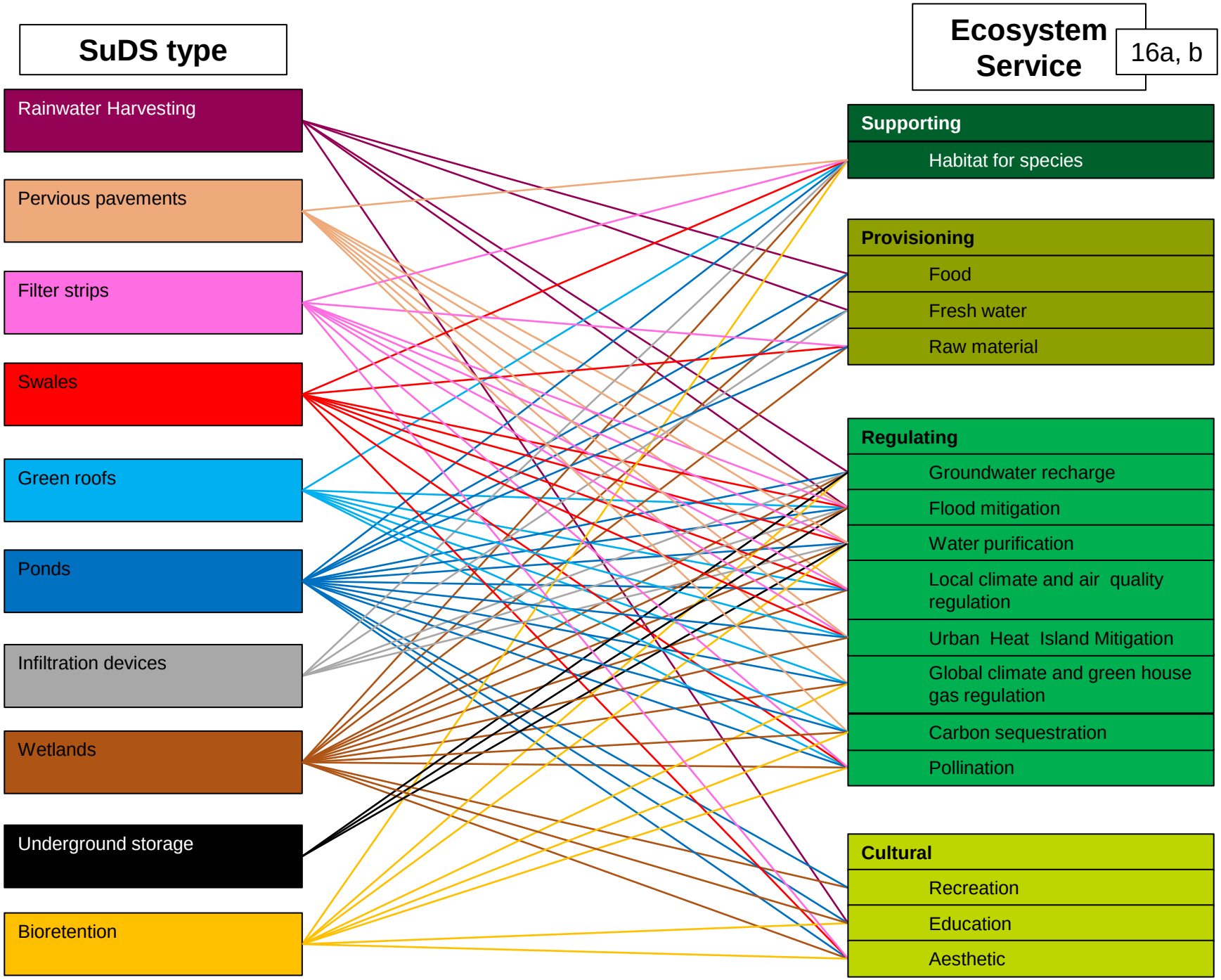


14a

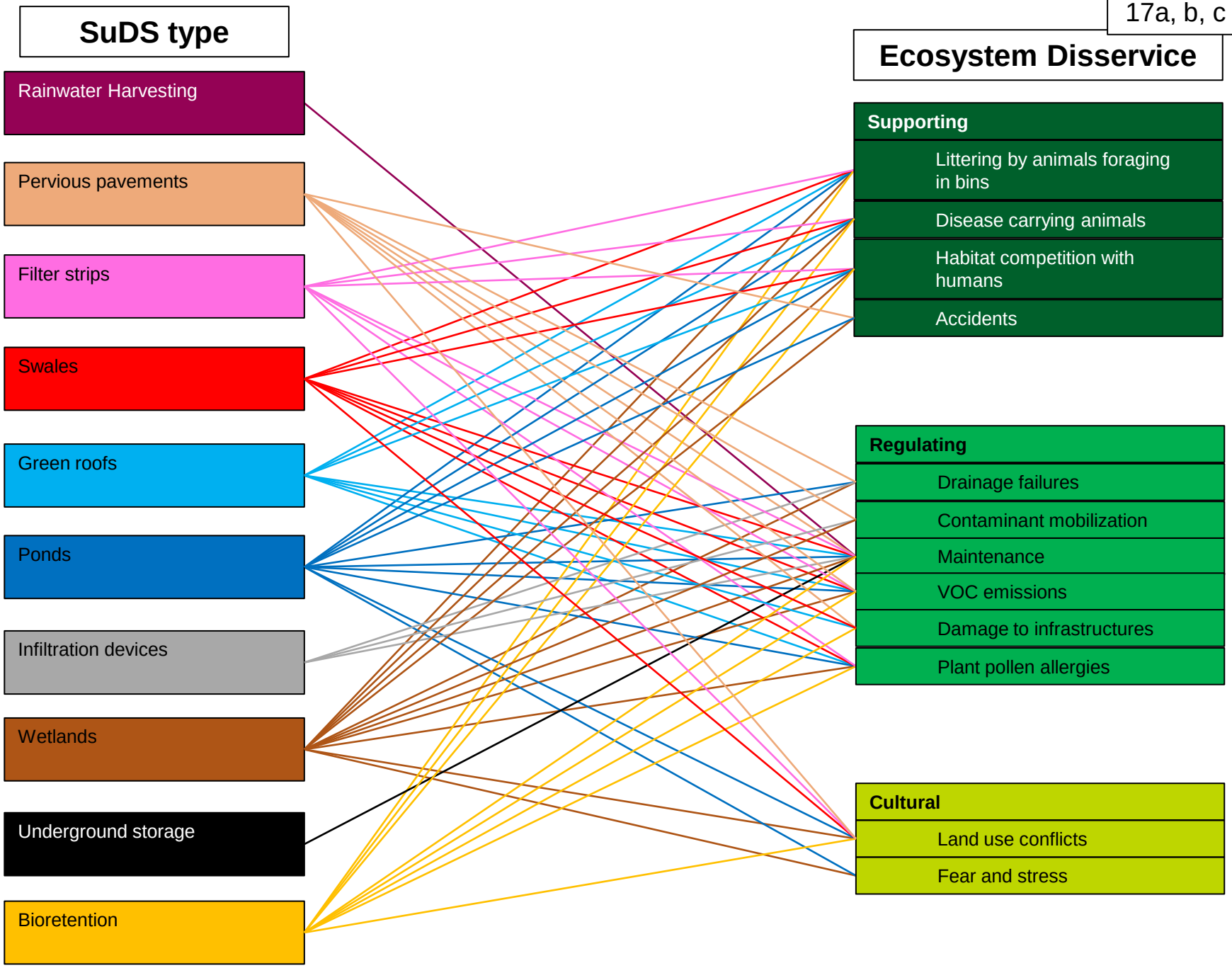
14b

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 Service
16a, b
Supporting
Habitat for species
Provisioning
Food
Fresh water
Raw material
Regulating
Groundwater recharge
Flood mitigation
Water purification
Local climate and air quality regulation
Urban Heat Island Mitigation
Global climate and green house gas regulation
Carbon sequestration
Pollination
Cultural
Recreation
Education
Aesthetic

17a, b, c


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

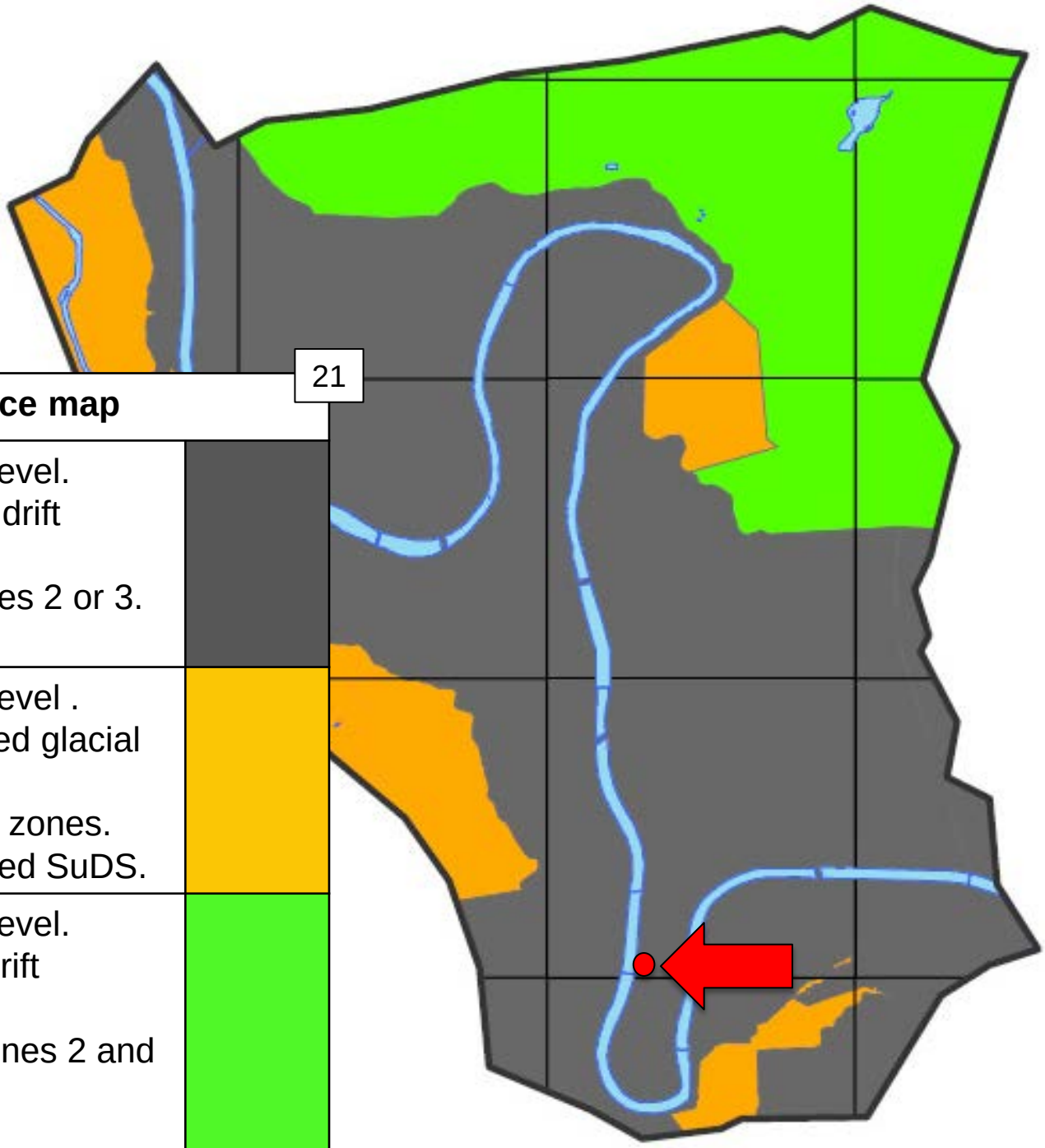
Explanation 1 - usage

- Web based user interface, with clickable links containing specific, detailed information to aid the following tasks:

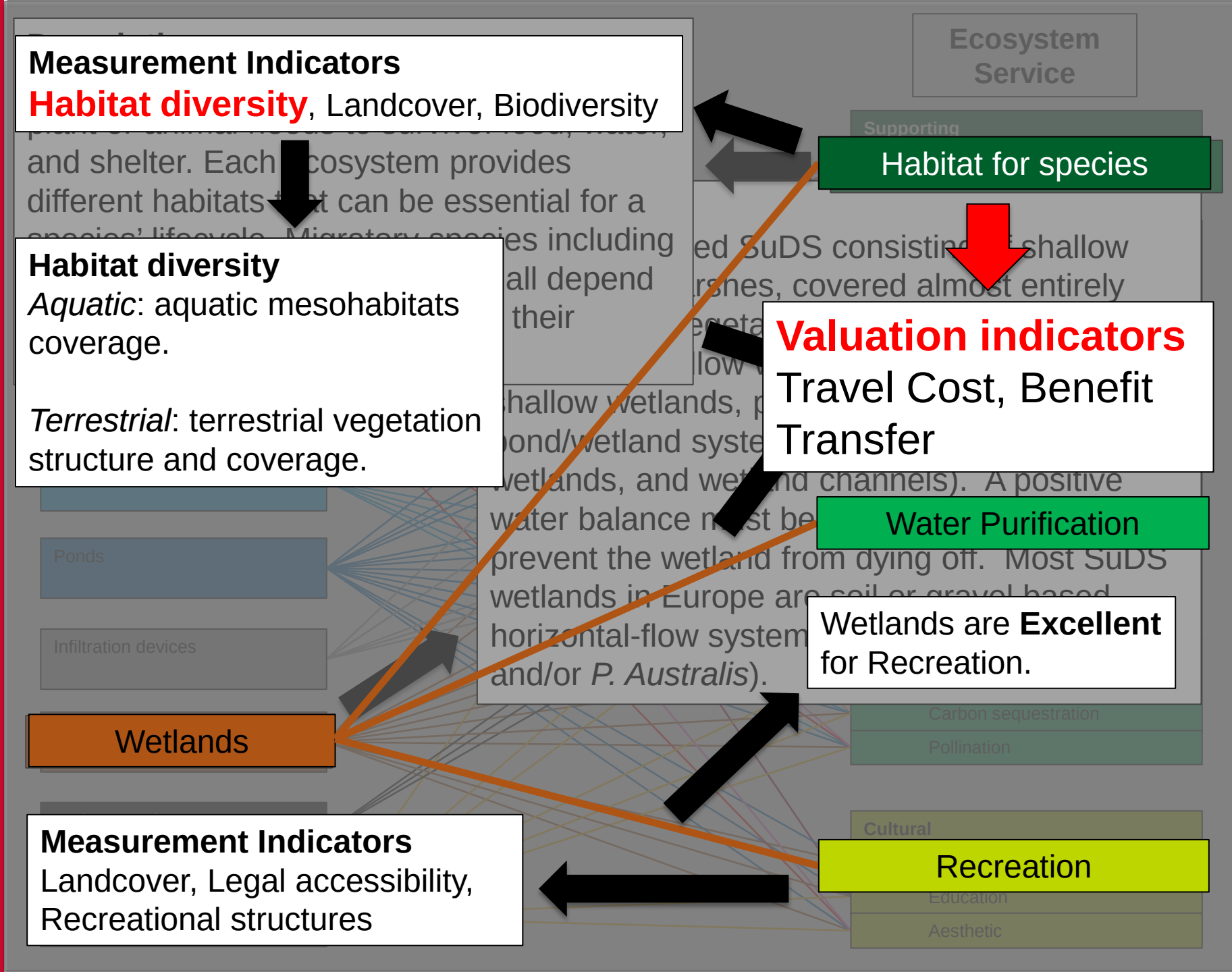
  - Deciding on where to locate a new SuDS development.
  - Analysing an existing SuDS system.
  - Designing a new SuDS system.
  - Compiling public policy documents.

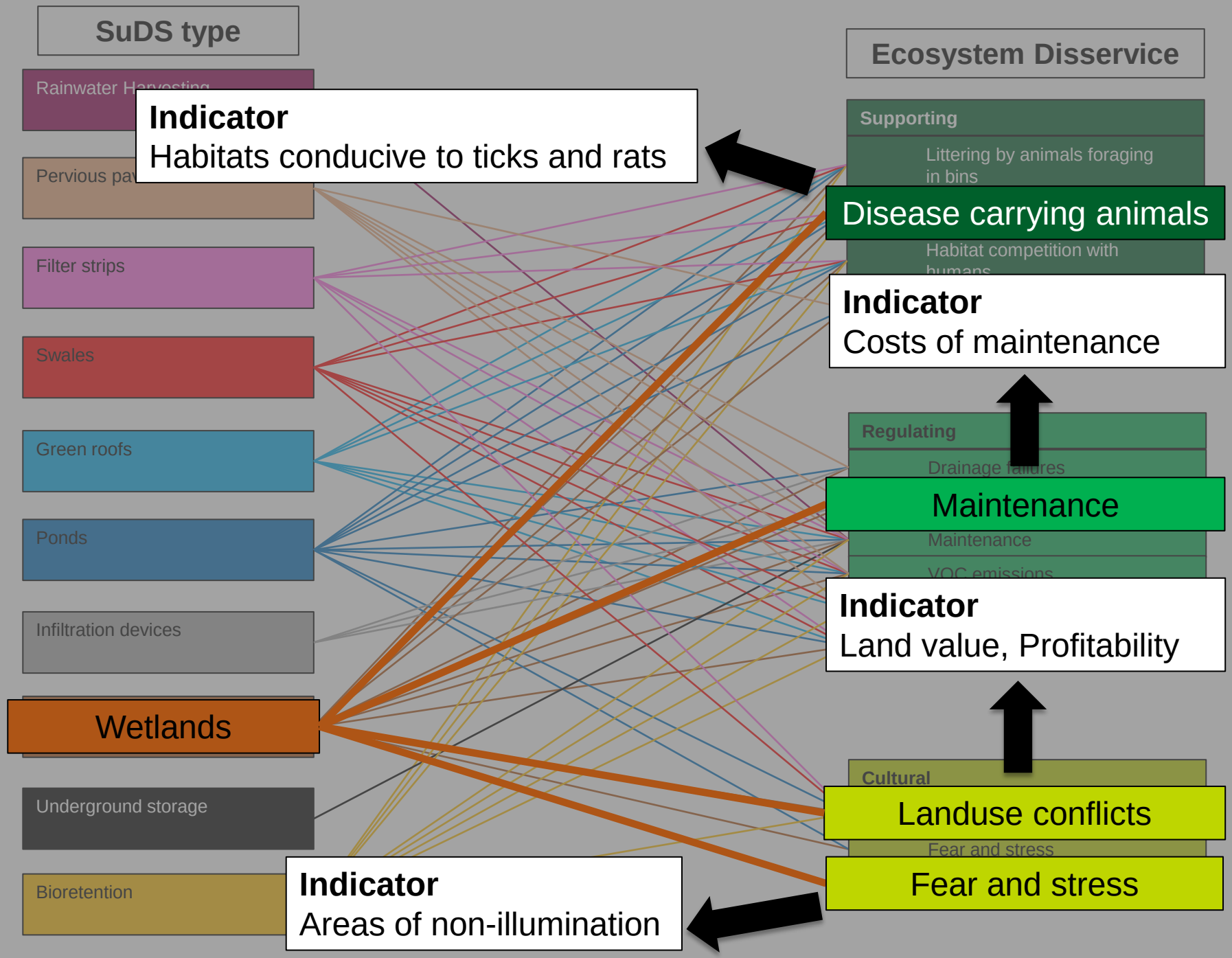

Optical & Hearing Services
David Lewis Sports Ground
Lower Broughton Rd
Riverside
Hydra Close
Cygnus Ave
Meadow Walk
University Rd
Wainwright Ln
University of Salford Students Union
Peel Park
Meadow Rd
Chiffon Way
Angora Dr
Flax St
Silk St
A5066
Blackburn St
Calico Close
Cannon St
Adelphi St
Peru St
Cockcroft Rd
Salford University
Crescent
Imagery ©2013 DigitalGlobe, Infoterra Ltd & Bluesky, The GeoInformation Group, Map data ©2013 Google
Edit in Google Map Maker

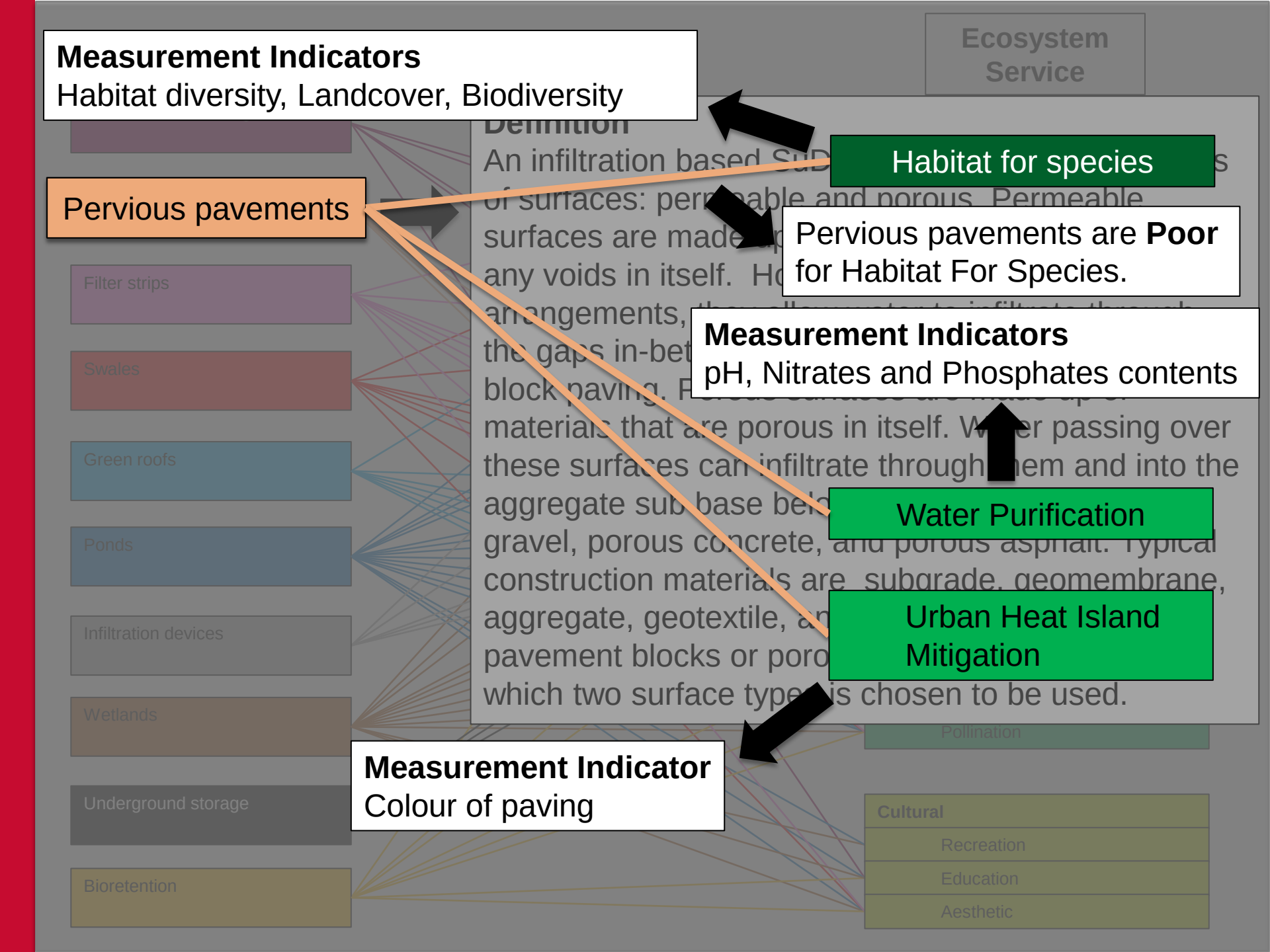
Lower Irv
advice m

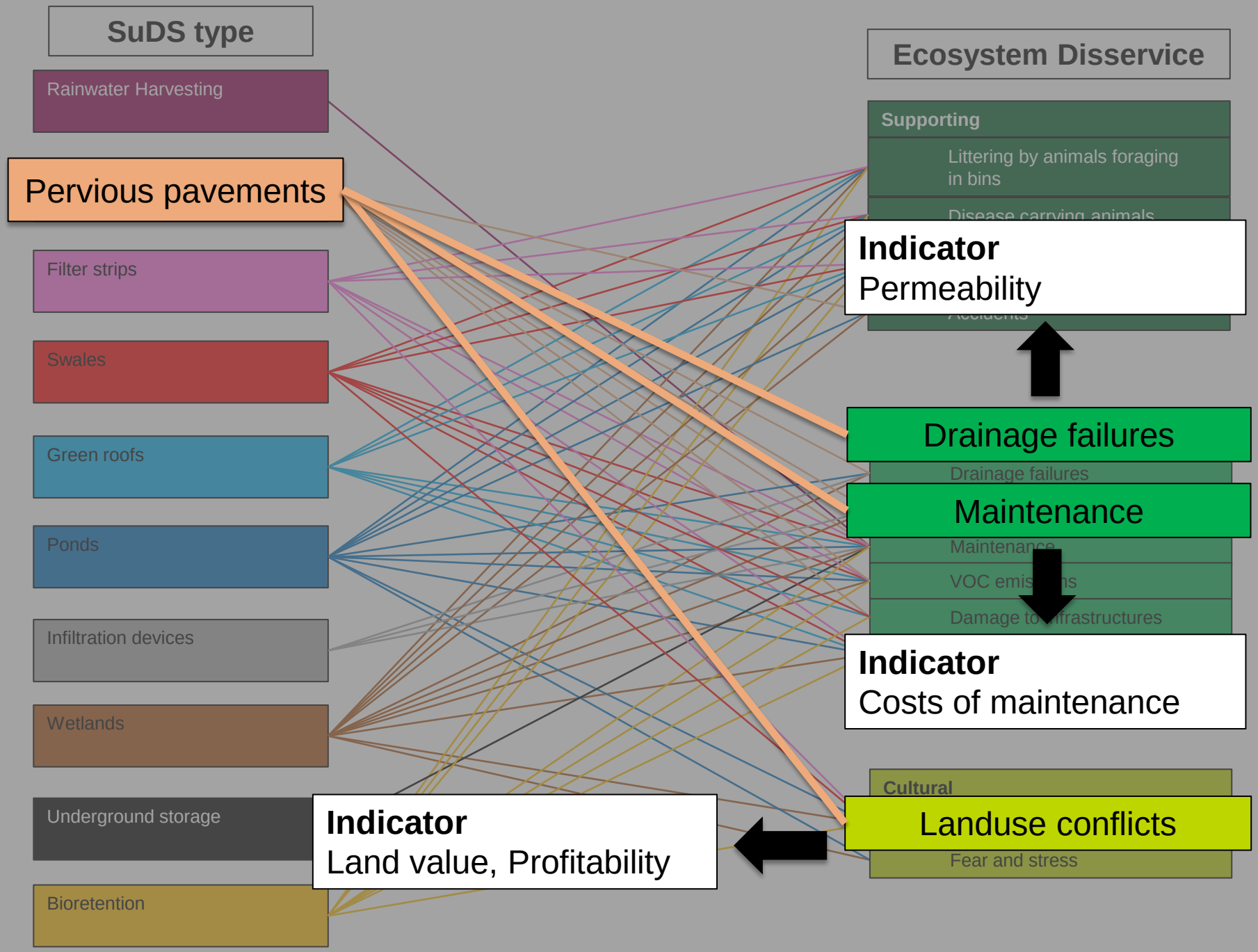


The SuDS advice map	
• < 5m above nominal river level. • Underlain by unfavourable drift geology (till) • Within flood protection zones 2 or 3. • Storage based SuDS.	
• > 5m above nominal river level . • Underlain by undifferentiated glacial deposits or alluvium • Outside all flood protection zones. • 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.	


Measurement Indicators
Habitat diversity, Landcover, Biodiversity
Habitat diversity
Aquatic: aquatic mesohabitats coverage.
Terrestrial: terrestrial vegetation structure and coverage.
Ecosystem Service
Supporting
Habitat for species
Valuation indicators
Travel Cost, Benefit Transfer
Water Purification
Wetlands are **Excellent** for Recreation.
Ponds
Infiltration devices
Wetlands
Carbon sequestration
Pollination
Cultural
Recreation
Education
Aesthetic
Measurement Indicators
Landcover, Legal accessibility, Recreational structures


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
Regulating
Drainage failures
Maintenance
Maintenance
VOC emissions
Cultural
Landuse conflicts
Fear and stress
Fear and stress
Indicator
Habitats conducive to ticks and rats
Indicator
Costs of maintenance
Indicator
Land value, Profitability
Indicator
Areas of non-illumination


Measurement Indicators
Habitat diversity, Landcover, Biodiversity
Ecosystem Service
Habitat for species
Pervious pavements
Pervious pavements are Poor for Habitat For Species.
Measurement Indicators
pH, Nitrates and Phosphates contents
Water Purification
Urban Heat Island Mitigation
Measurement Indicator
Colour of paving
Filter strips
Swales
Green roofs
Ponds
Infiltration devices
Wetlands
Underground storage
Bioretention
Pollination
Cultural
Recreation
Education
Aesthetic


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
Indicator
Permeability
Drainage failures
Drainage failures
Maintenance
Maintenance
VOC emissions
Damage to infrastructures
Indicator
Costs of maintenance
Cultural
Landuse conflicts
Fear and stress
Indicator
Land value, Profitability

SuDS techniques comparisons

SuDS techniques	E.S for comparisons	E.DS for comparisons	Additional E.S	Additional E.DS
Wetlands	• Habitat For Species • Water Purification	• Maintenance • Landuse Conflicts	• Recreation	• Disease Carrying Animals • Fear and Stress
Pervious Pavements			• Urban Heat Island Mitigation	• Drainage Failures

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

1, 2, and 3. 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.James, P., et al. (2012). The Irwell Catchment Pilot: The Rivers Return. The Environment Agency. Warrington.

4. ENVIRONMENT AGENCY 2013. Urban Diffuse Pollution Challenge - Evidence Pack. *In:* APPENDIX 2 - URBAN DIFFUSE POLLUTION SOURCES 2 (ed.).

5. ENVIRONMENT AGENCY 2013. Urban Diffuse Pollution Challenge - Evidence Pack. *In:* NORTH OF ENGLAND POLLUTION SOURCE LINKED WITH DEFRA DIFFUSE URBAN POLLUTION (SURFACE WATERS) - COUNT OF WATERBODIES FAILING FOR ISSUE (ed.).

6. ANNE MCINTOSH MP 2012. Flooding. *In*: DEFRA (ed.).

7, 9, 13, 18. B. WOODS-BALLARD, R. KELLAGHER, P. MARTIN, C. JEFFERIES, R. BRAY & P. SHAFFER 2007. C697 The SUDS Manual. *C697.* London: CIRIA.

8. CIRIA 2012. SuDS management train. *In:* SUDS MANAGEMENT TRAIN (ed.).

Reference 2

10. SUDSNET 2008. Permeable paving. *In:* PERMEABLE PAVING AND FILTER DRAIN AT SUPERMARKET (ed.).

11. WAGNER, T. 2012. Troy's Green Roof. *In:* TROYS_GREENROOF10 (ed.).

12. FORBES, G., FOY, B. & MULHOLLAND, M. 2010. The role of Constructed Wetlands in treating farmyard dirty water. *In:* THE CONSTRUCTED WETLAND AT GREENMOUNT CAMPUS, C. (ed.). The Department of Agriculture and Rural Development - Northern Ireland.

14a. GOLDMAN, R. L. 2010. Ecosystem Services: How People Benefit from Nature. *In:* ECOSYSTEM SERVICES: HOW PEOPLE BENEFIT FROM NATURE (ed.). Environment - Science and Policy for Sustainable Development.

14b. SNOW, S. 2008. *Green Eyes On: Bee Pollen Cures Allergies*. www.treehugger.com/green-food/green-eyes-on-bee-pollen-cures-allergies.html.

15. Microsoft. 2013.

16a. MILLENIUM ECOSYSTEM ASSESSMENT. 2005. Chapter 2: Ecosystems and their services. *Ecosystems and Human Well-being: A Framework for Assessment.*

Reference 3

16b, 19. TEEB. 2010. TEEB Manual for Cities: Ecosystem Services in Urban Management. www.teebweb.org.

17a. LYYTIMAKI, J., PETERSEN, L. K., NORMANDER, B. & BEZAK, P. 2008. Nature as a nuisance? Ecosystem services and disservices to urban lifestyle. *Environmental Sciences*, 5, 161-172.

17b. GOMEZ-BAGGETHUM, E. & BARTON, N. D. 2013. Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, 86, 235-245.

17c. Antia, D. J. D. 2009. Formation and Control of Self-Sealing High Permeability Groundwater Mounds in Impermeable Sediment: Implications for SUDS and Sustainable Pressure Mound Management. *Sustainability*, 1, 855-923.

20. KSIAZEK, K., FANT, J. & SKOGEN, K. 2012. An assessment of pollen limitation on Chicago green roofs. *Landscape and Urban Planning*, 107, 401-408.

21. DONCASTER, S., STOVIN, V. & MORROW, B. 2008. Lower Irwell Valley, Salford Integrated Urban Drainage Pilot Project TRE344 Final Report.