Blue-Green Cities
Delivering and Evaluating Multiple Flood Risk Benefits

bluegreencities.ac.uk

EPSRC Pioneering research and skills

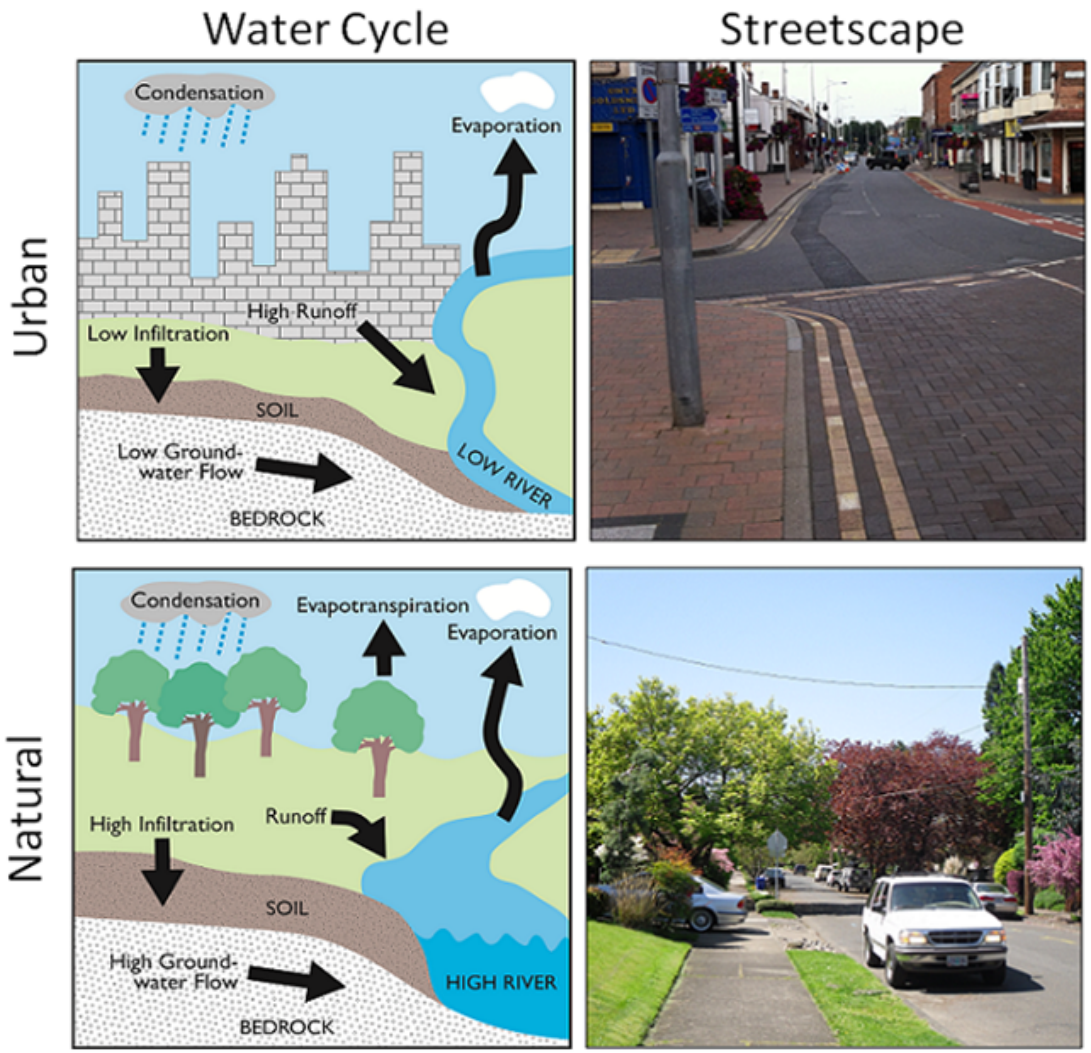
Environment Agency

RIVERS Agency

NATIONAL SCIENCE FOUNDATION

EPSRC Grant EP/K013661/1

Hydrologic and environmental attributes in



Grey

and Blue-Green Cities

BLUE- **GREEN**

blue green CITIES

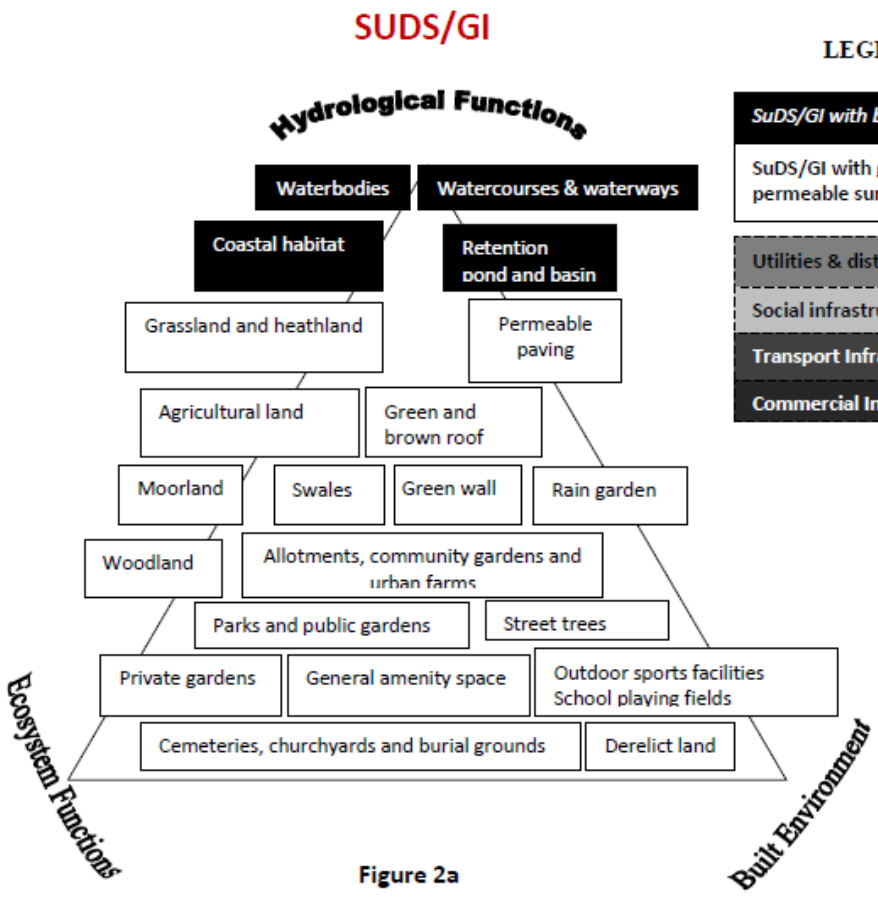


Figure 2a

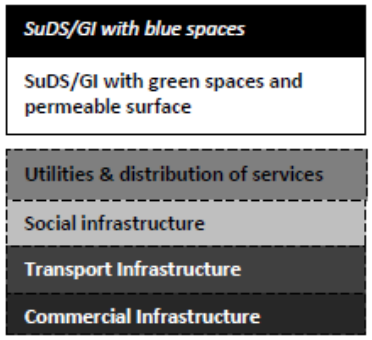


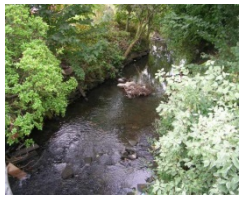
Figure 2b

Blue-Green Research Aim

Develop and rigorously evaluate strategies for managing flood risk that deliver multiple benefits as part of urban planning and renewal

J4M8, Edinburgh

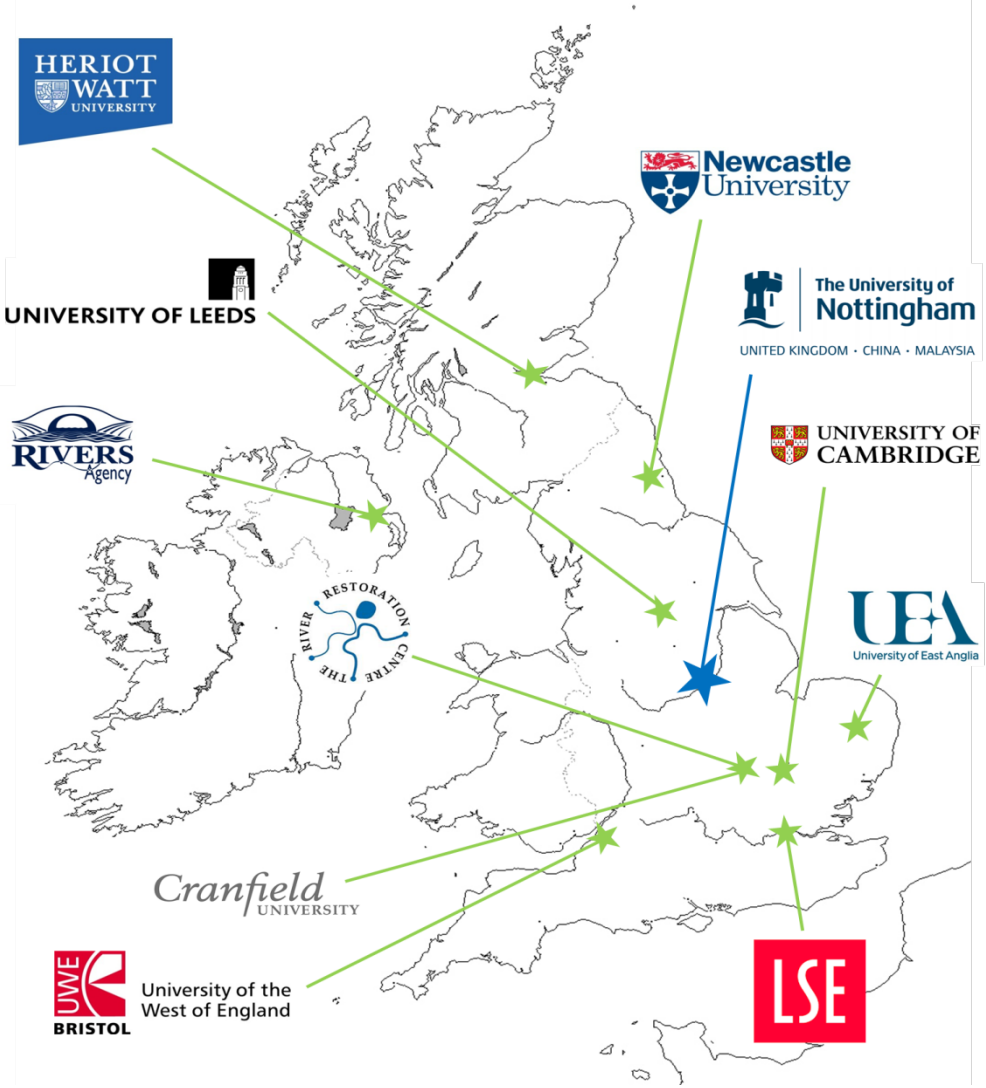
Hebden Bridge



Wortley Beck, Leeds

The Dings, Bristol

UK Partner Institutions



Case Study City: Newcastle

International Collaborations

Portland, Oregon

Blue-Green Cities are working with:

OSU Oregon State University

City of Portland, Oregon 1851

Reed College

Environmental Services City of Portland

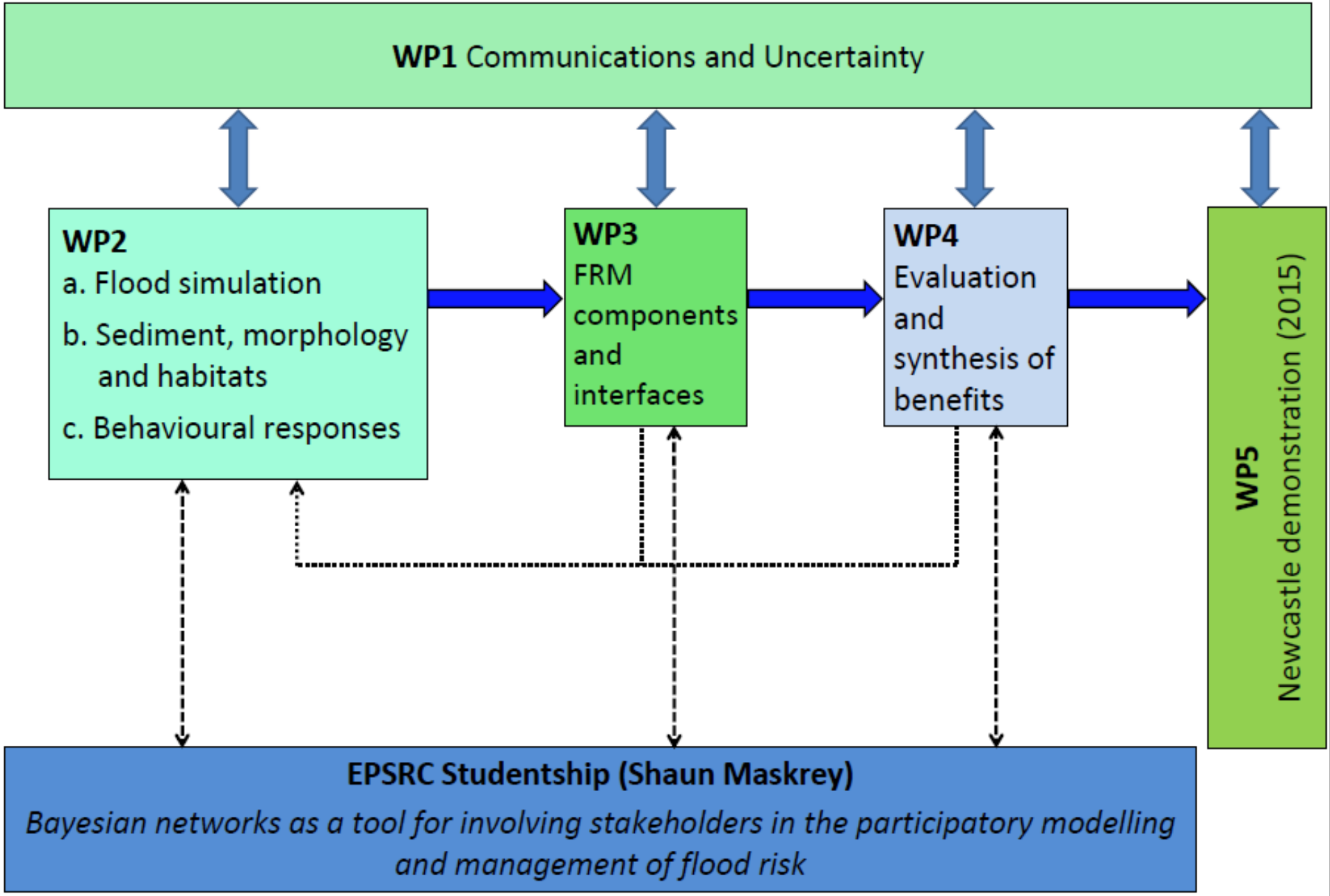
Washington State University

Portland State University

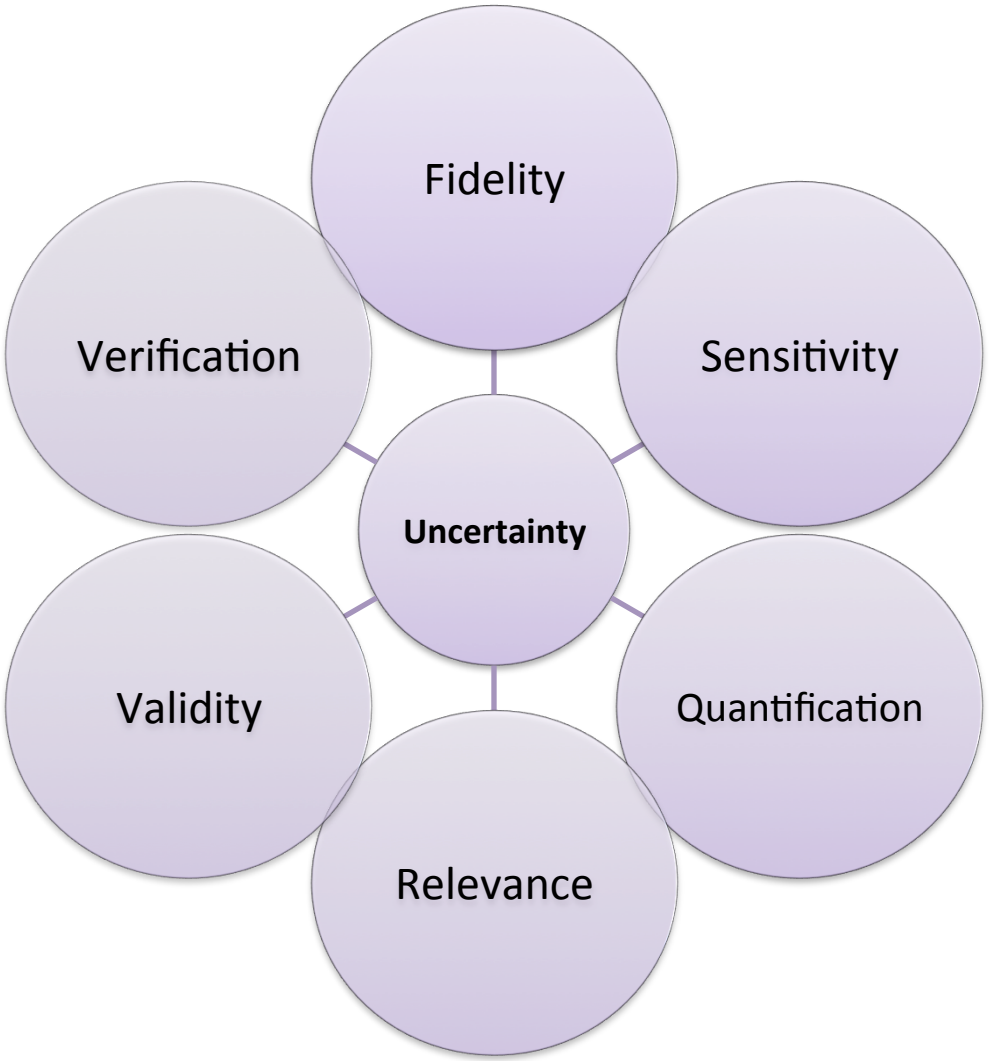
CleanWater Services

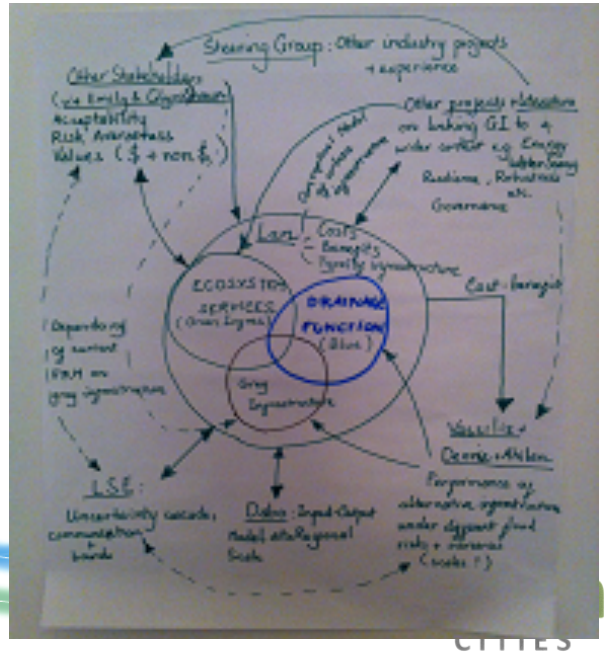
Ningbo, China

Blue-Green Cities are working with Ningbo academics
James Griffiths, David Higgitt, Faith Chan and Odette Paramor

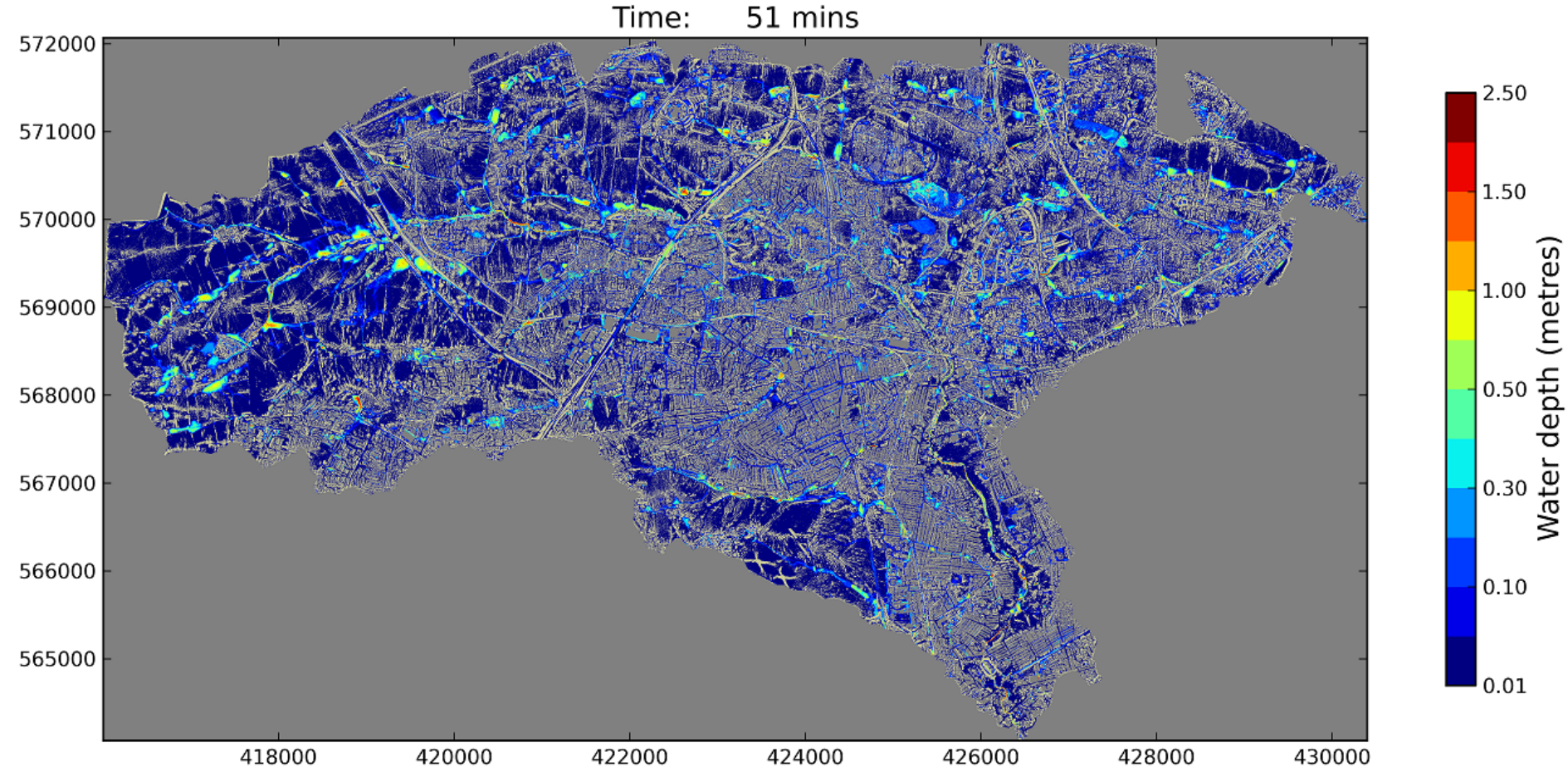

WP1 Communications and Uncertainty
WP2
a. Flood simulation
b. Sediment, morphology and habitats
c. Behavioural responses
WP3
FRM components and interfaces
WP4
Evaluation and synthesis of benefits
WP5
Newcastle demonstration (2015)
EPSRC Studentship (Shaun Maskrey)
Bayesian networks as a tool for involving stakeholders in the participatory modelling and management of flood risk

1. Uncertainty





2a. Flood Inundation – CityCAT



Water depth map of **Ouseburn catchment** (area = 120km^2 , cell size = 2m, cells = 30million). Storm event = 60 minutes, 100-year return period

2b. Sediment, morphology, habitats

AIM: assess sediment transport and debris dynamics within Blue-Green urban drainage networks and develop improved approaches to accounting for the risks and benefits associated with Blue-Green infrastructure.

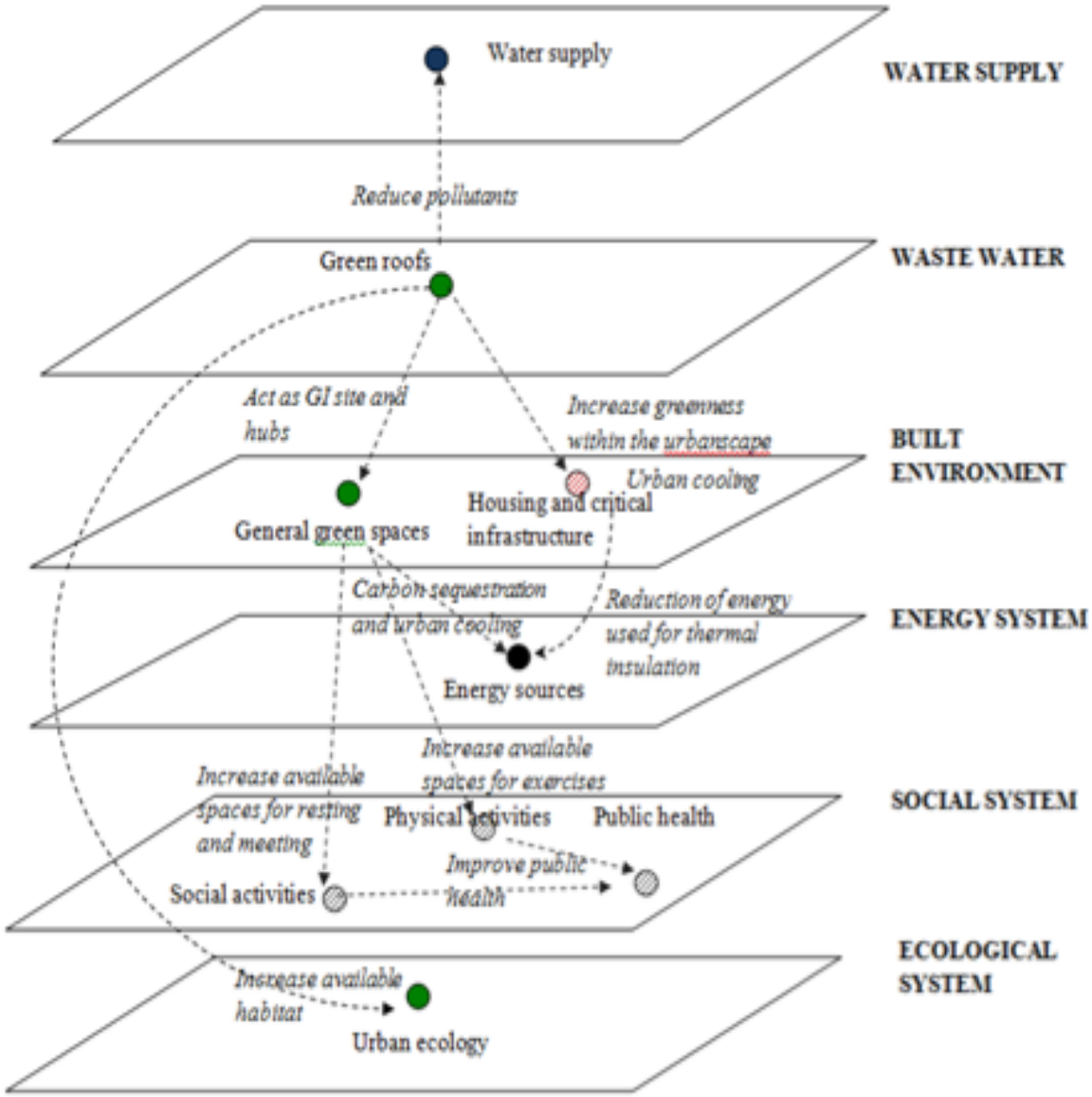
PIT technology

2c. Retrofit SuDS – attitudes/behaviours

The Dings, Bristol (above), @Bristol (top-right), St Nicholas House, Bristol (bottom right)

3. FRM components and interfaces

- Develop tools and methodologies to represent urban FRM and Blue-Green networks within a single urban environment
- "System of systems" approach
- Examining interdependencies with wider urban infrastructure

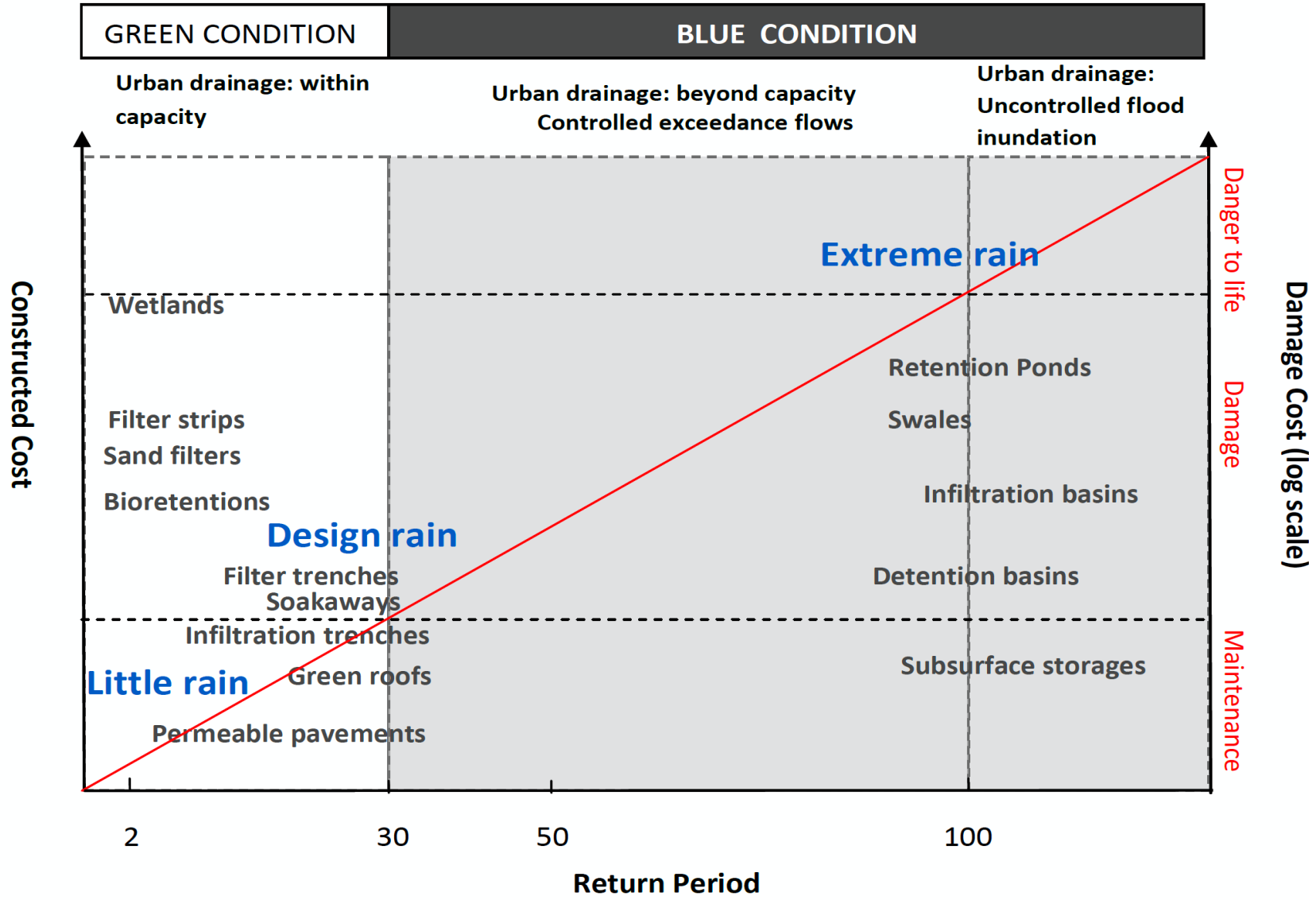


Hoang & Fenner, 2014 *submitted*

4. Evaluation and synthesis of benefits

Aim: Develop procedures for the robust evaluation of the multiple functionalities of Blue-Green infrastructure components within FRM strategies

- Blue (flood) and non-flood (Green)
- Evaluate the **relative significance of benefits** in context specific locations
- Establish preference ratings
- Review current design procedures and make **recommendations to the design guidance** to enhance the most significant non-flood benefits



Hoang and Fenner (Submitted), modified after Fratini et al. (2012) and CIRIA's SUDS manual (2007)

CWFA Research Objectives

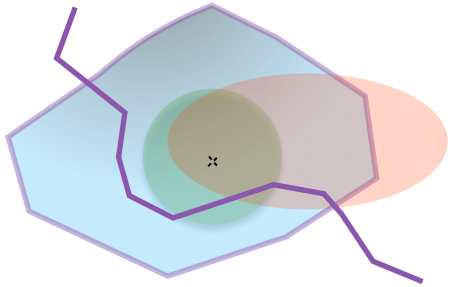
Investigate wider system interactions and multiple benefits of Blue-Green infrastructure

3 step-approach

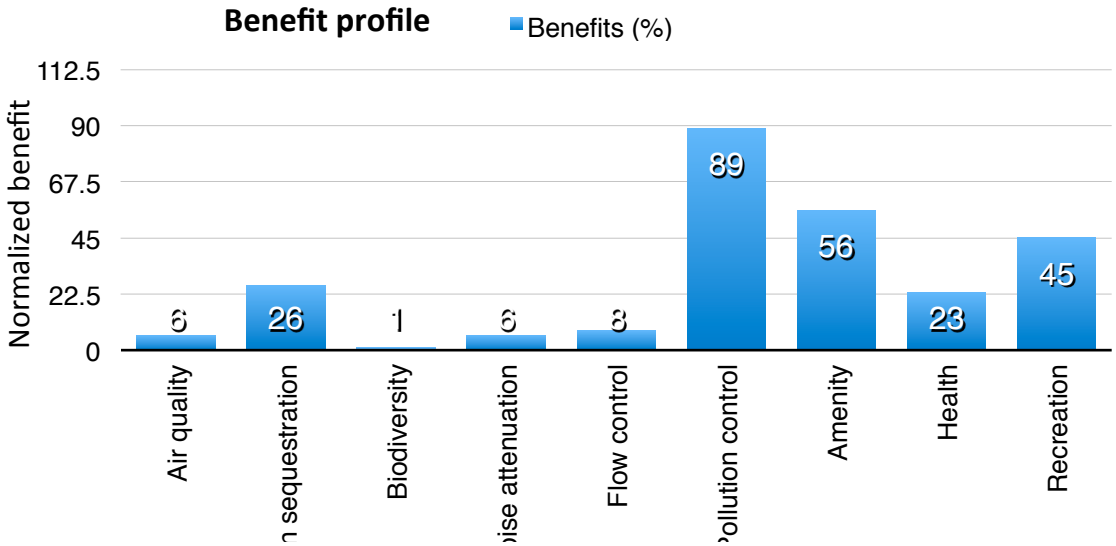
1.Benefit evaluation

2. Benefit significance:
incremental value added in a location-specific
context; can benefits in discreet installation be leveraged by enhanced
connectivity? (GIS-based)

3. Benefit preference



Benefit intensity- based on the cumulative spatial distribution of benefits



5. Demo Study

Newcastle

Identified flood risk (pluvial/ fluvial)?

Change flood risk management strategies?

Is Blue-Green infrastructure viable?

Buy-in from all local stakeholders

Data availability

Newcastle City Council
EA
Northumbrian Water
Natural England
Universities
Wildlife and Rivers Trusts
Estates
Natural History Society

Developing a Blue-Green vision for Newcastle - Learning and Action Alliance (LAA)

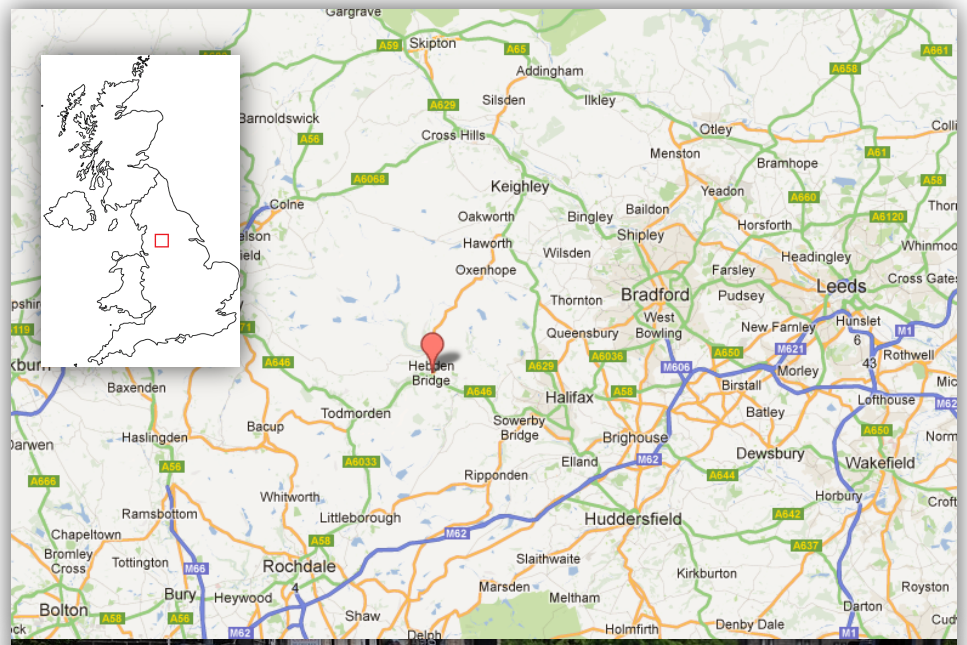
A LAA is usually an **open arrangement** where participants create a **Joint understanding** of a problem and its **possible solutions** based on rational criticism and coherence through **discussion.** It facilitates the identification of **innovative ideas** for the solution of complex (wicked) problems **outside the constraints of existing formal institutional settings.**

Solutions or ideas are afterwards presented in formal inter-organisational **decision-making processes**.

- **June 12th meeting**: "stock-take" of Newcastle BG initiatives

PhD Studentship

Participatory modelling using Bayesian networks



Location:

Hebden Bridge, West Yorkshire

Objectives:

Ensure local stakeholder knowledge, particularly about social processes, is utilised in flood risk modelling

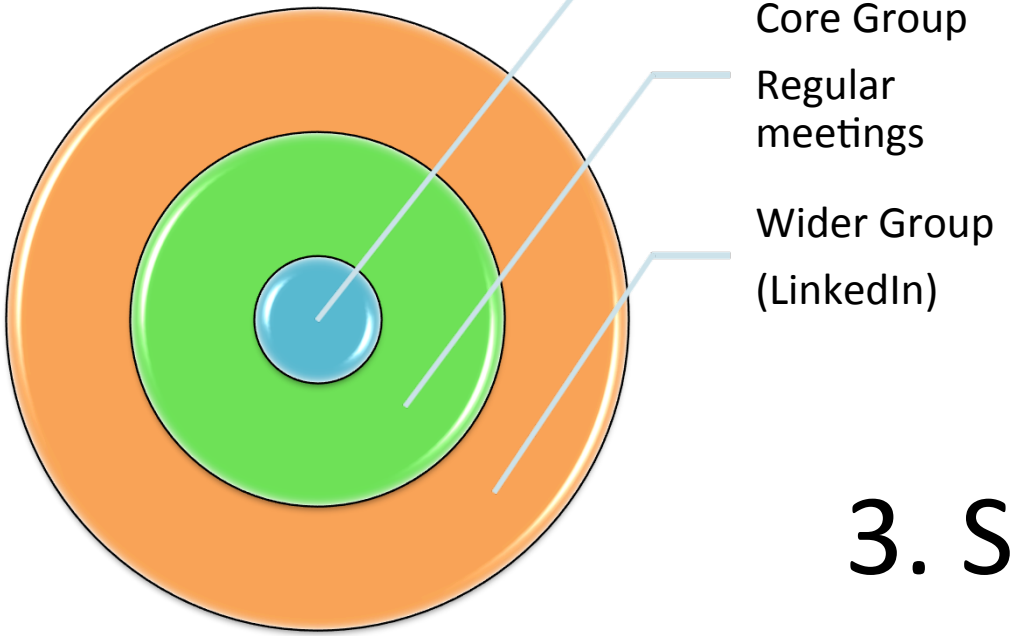
To achieve this through a participatory approach that harnesses the utility of the Bayesian network technique

Acknowledgement

The research reported in this presentation is being conducted as part of the Blue-Green Cities Research Consortium with support from the:

- **Engineering and Physical Sciences Research Council**
- **Northern Ireland Rivers Agency**
- **Environment Agency**
- **National Science Foundation**
- **City of Portland Bureau of Environmental Services**
- **Johnson Creek Watershed Council**

1. Establishment



Aim, vision, context, stakeholders, focus, culture

2. Functioning

- Legitimacy
- Trust
- Innovation
- Leadership
- Decision makers

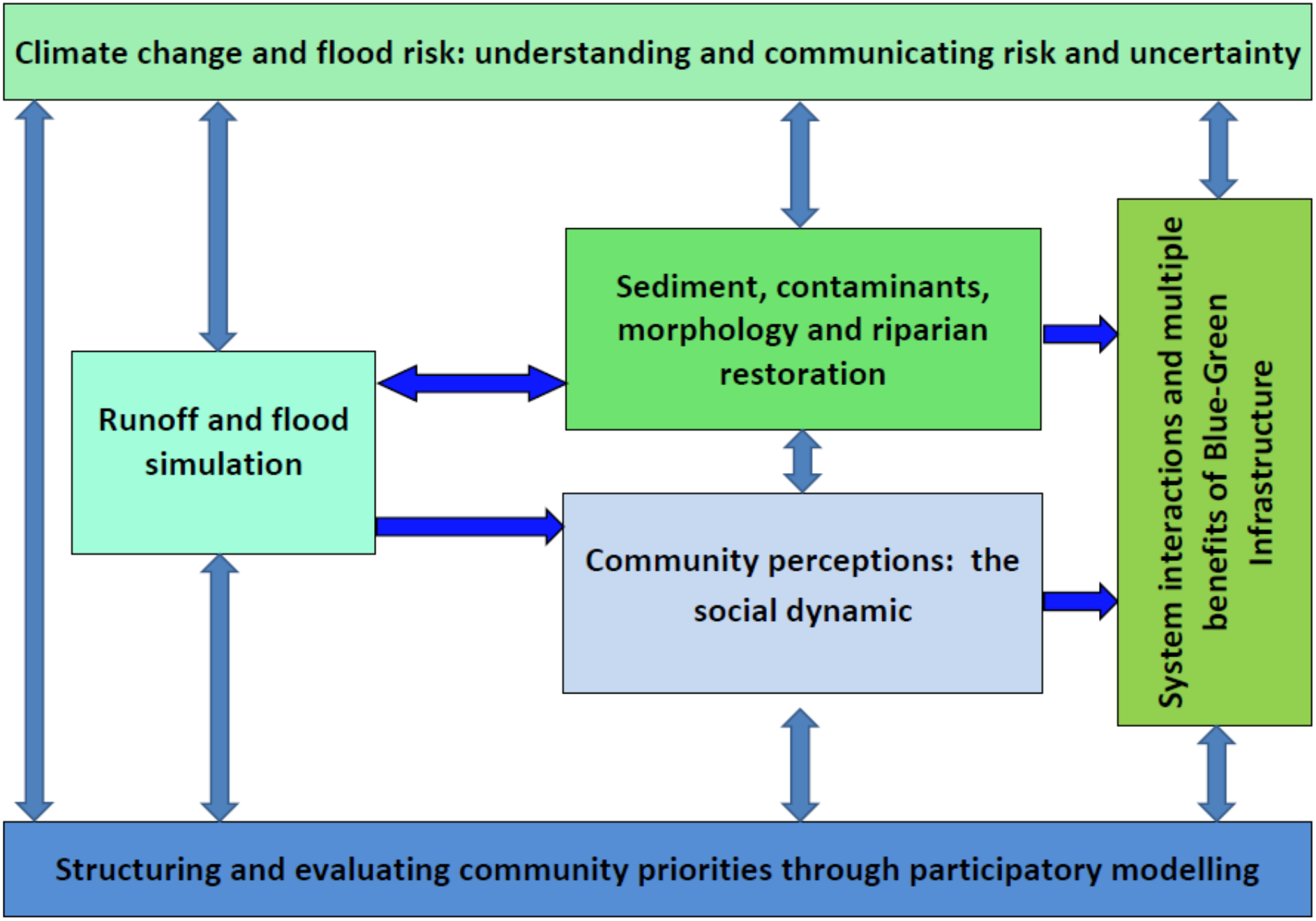
Terms of Reference - purpose, structure, rules

3. Sustainability

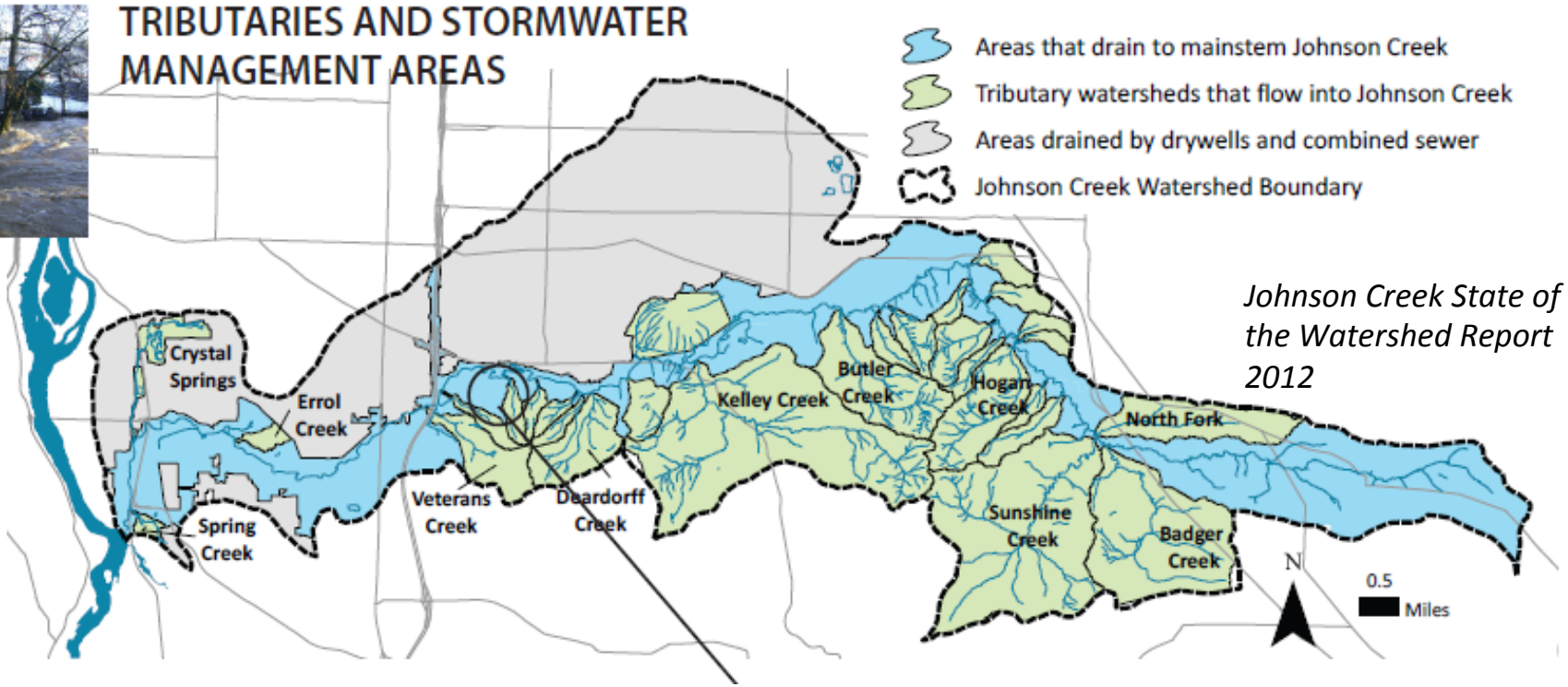
Active learning, communication, facilitation, characteristics, clear rewards

Clean Water For All (CWFA) 2014
A UK+US collaboration

Portland State
UNIVERSITY


Climate change and flood risk: understanding and communicating risk and uncertainty
Runoff and flood simulation
Sediment, contaminants, morphology and riparian restoration
Community perceptions: the social dynamic
System interactions and multiple benefits of Blue-Green Infrastructure
Structuring and evaluating community priorities through participatory modelling

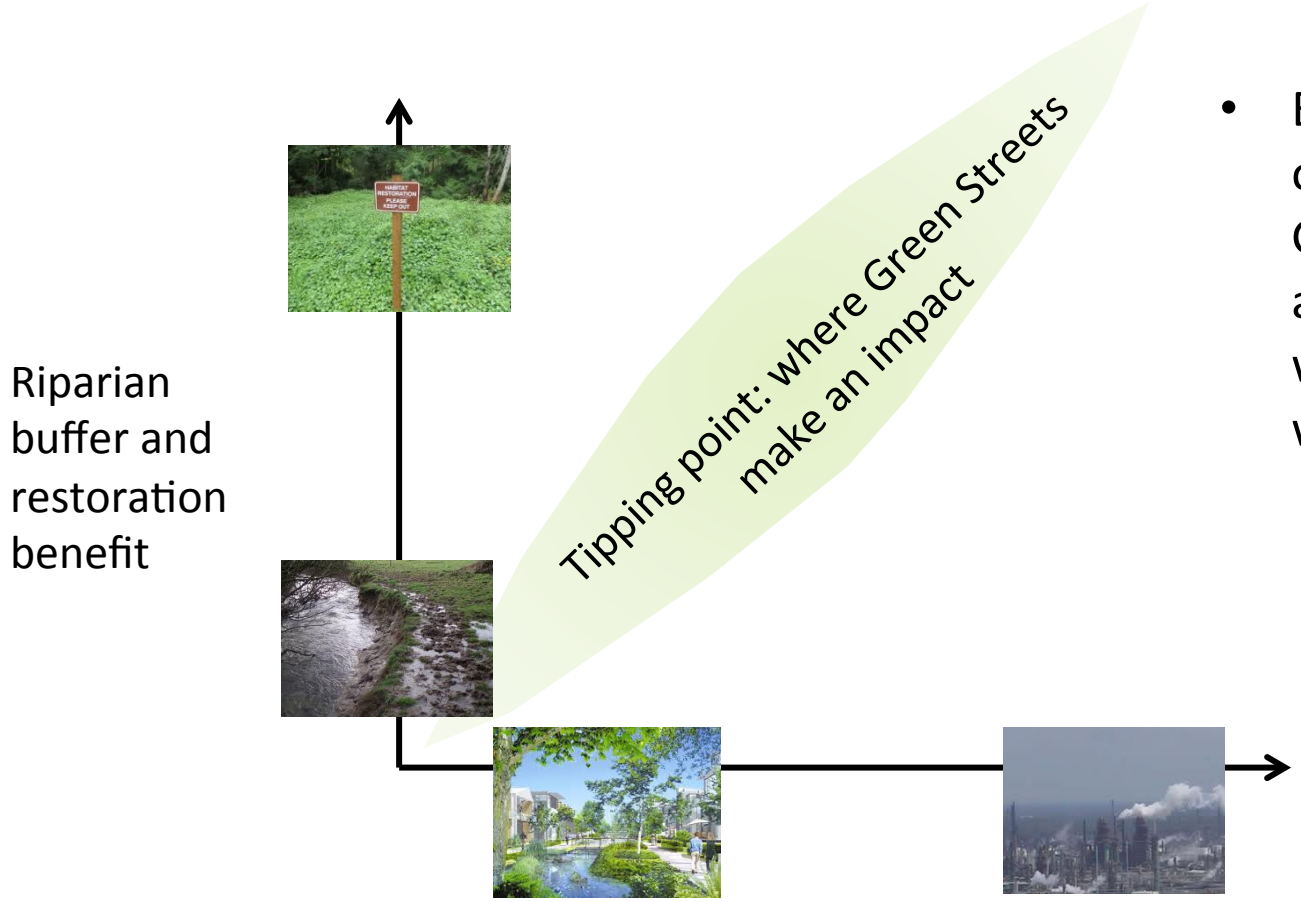
Case Study: Johnson Creek, Portland, OR



Johnson Creek State of the Watershed Report 2012

CWFA Research Objectives

- To develop a method for identifying the **Relevant Dominant Uncertainties** and the capacity for FRM strategies to be effective under different future scenarios
- To model Johnson Creek (with and without green streets) to understand the impacts of stormwater run-off on sediment and water quality



- Examine the influence of Green Streets, Blue-Green Infrastructure and river restoration on waterway health and water quality.

CWFA Research Objectives

- To explore the multiple perceived benefits of adopting a 'Blue-Green' approach to FRM, considering temporal changes in perceptions and behaviour
- Participatory modelling; where and when is it appropriate to use ***Bayesian networks*** to be used as a tool to support the participatory process?