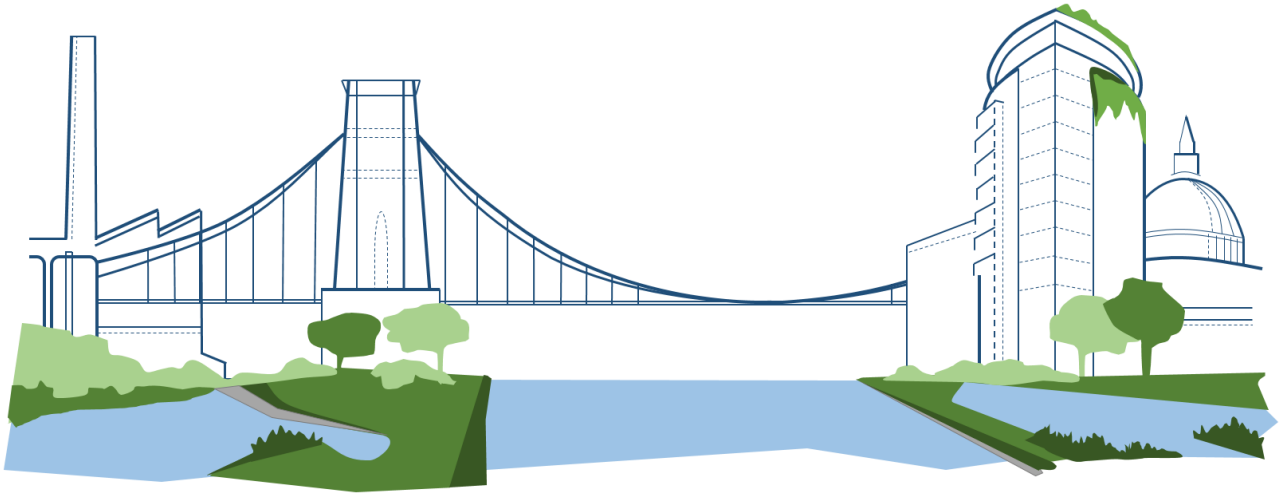
EPSRC
Pioneering research and skills

Urban flood resilience into practice

A Tale of Two Projects (and Cities)



EPSRC
Pioneering research and skills

Professor Nigel Wright

Pro Vice-Chancellor Research
De Montfort University, Leicester

"Urban Living" theme: water, energy, transport, local government, economics.

Seventh International Conference on Flood Management
Leeds, UK
September 5-7, 2017.

Keynotes:

- Haibin Wan, State Flood Control and Drought Relief Headquarters, China
- John Curtin, Director of Incident Management and Resilience, Environment Agency
- Professor Chris Zevenbergen, IHE Delft, the Netherlands

www.icfm7.org.uk

Two projects

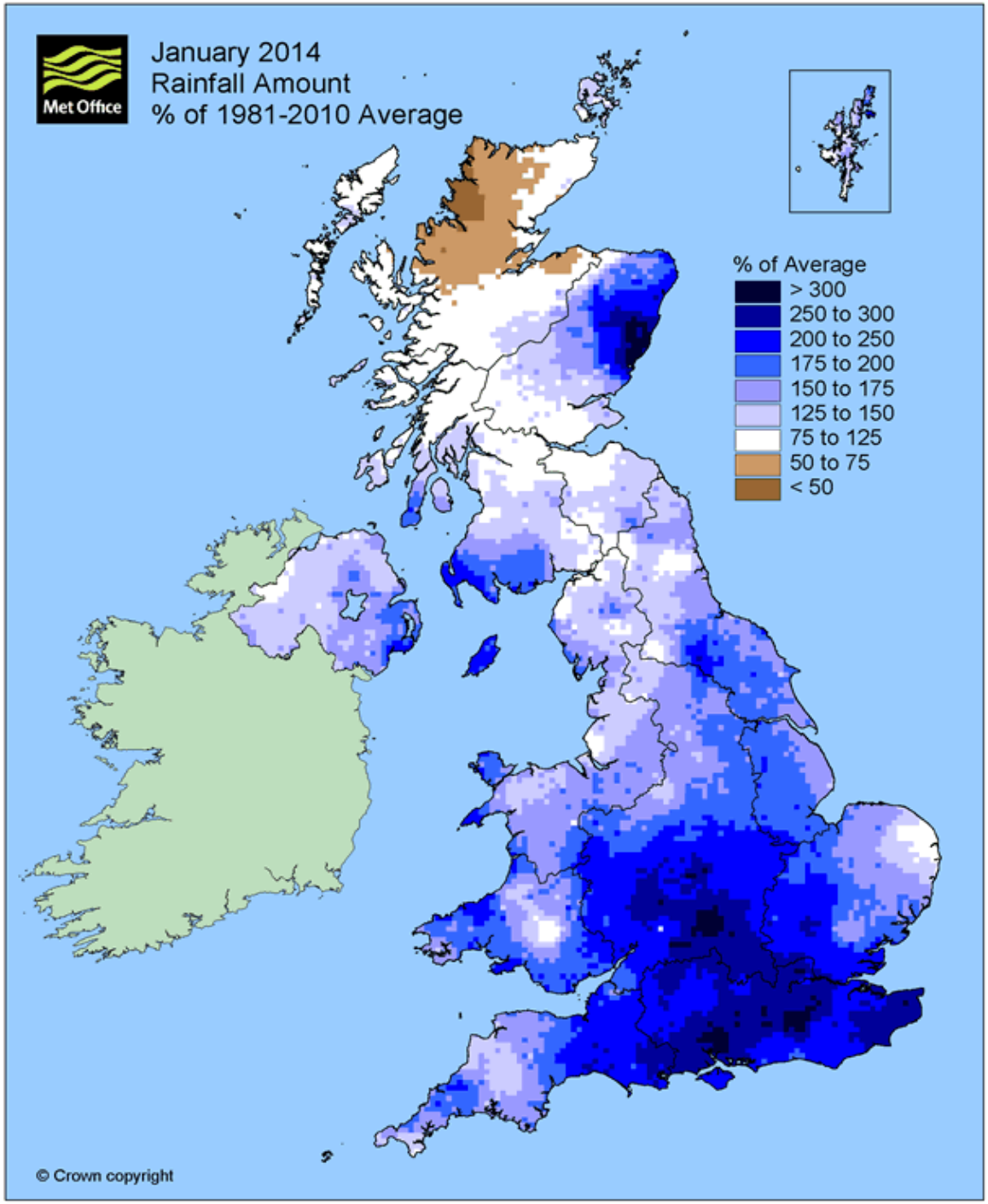
- Blue-green cities (BGC): 2012-2016
- Urban Flood Resilience (UFR): 2016-2020

- Core partners in common.
- UFR has new partners to reflect lessons from BGC.

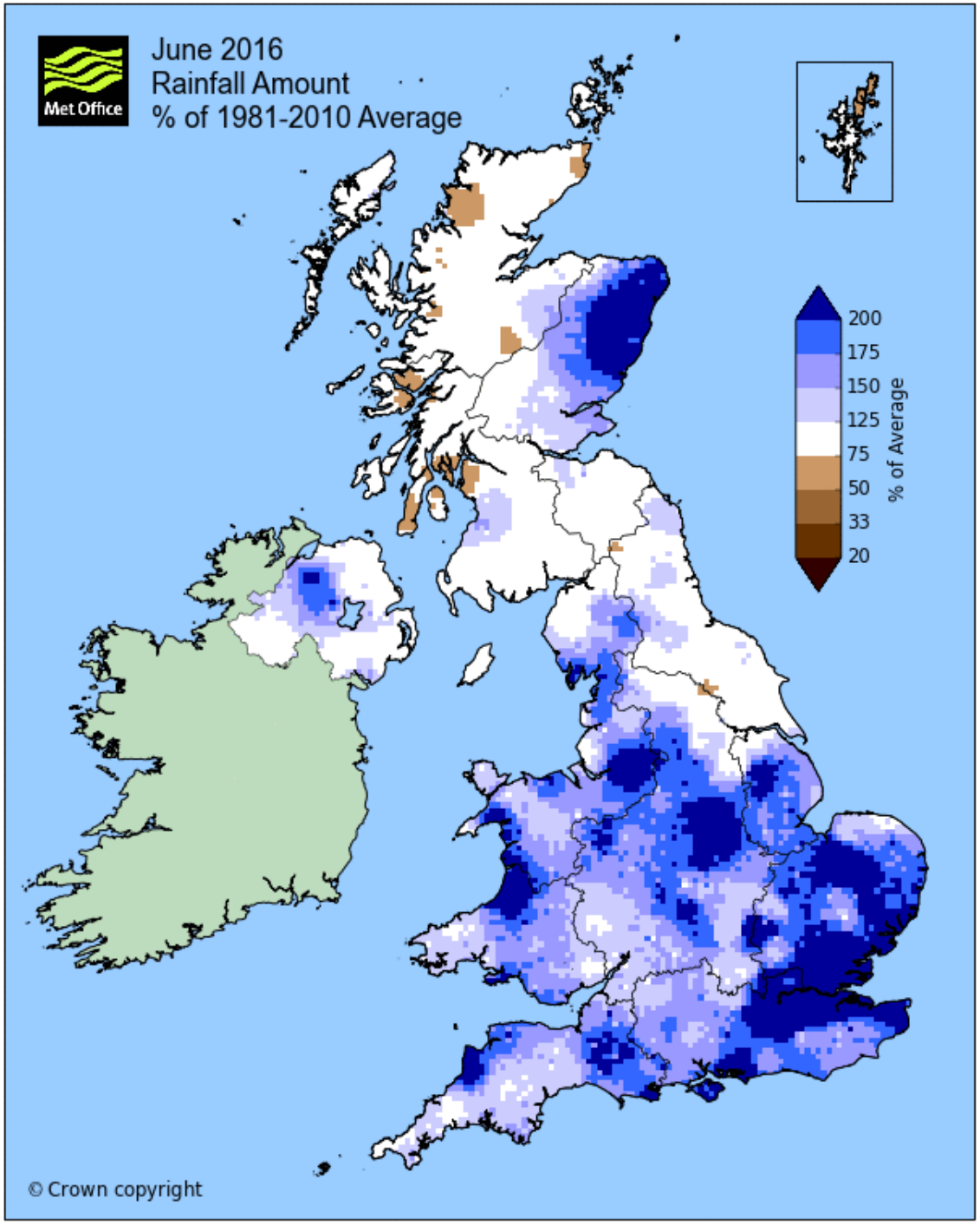
Delivering and Evaluating Multiple Benefits in Blue-Green Cities

bluegreencities.ac.uk

EPSRC Grant EP/K013661/1



January 2014 Rainfall Anomaly



June 2016 Rainfall Anomaly

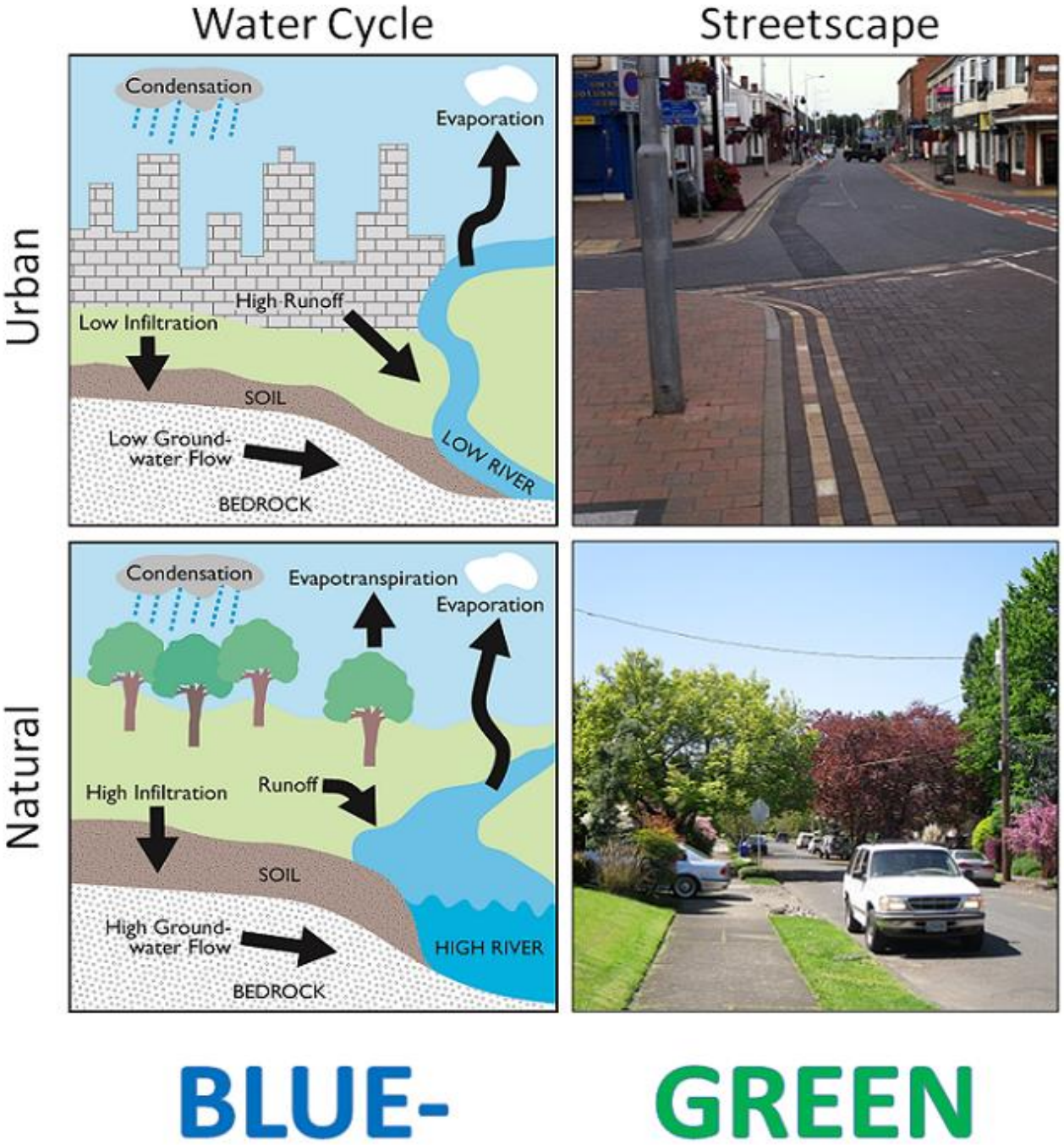
"what is required is a fundamental change in how we view flood management, from flood defence where we protect ourselves to one of resilience, living with and making space for water and the opportunity to get "more from less" by seeing all forms of water as providing multiple benefits."

Commission of Inquiry into flood resilience of the future titled 'Living with water', March 2015. All Party Group for Excellence in the Built Environment, House of Commons, London, p. 32.

Traditional drainage (grey infrastructure)

London without the Thames Barrier during the December 2013 tidal surge (Environment Agency simulation)

Source:
http://www.bbc.co.uk/news/magazine-26133660



Blue-Green Cities

- Working with nature to manage water and deliver a range of other benefits to society, the economy and the environment
- Multifunctional landscape
- Blue-Green space connectivity

Blue-Green infrastructure

Blue-Green Cities Research Aim

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

Learning and Action Alliances (LAAs)

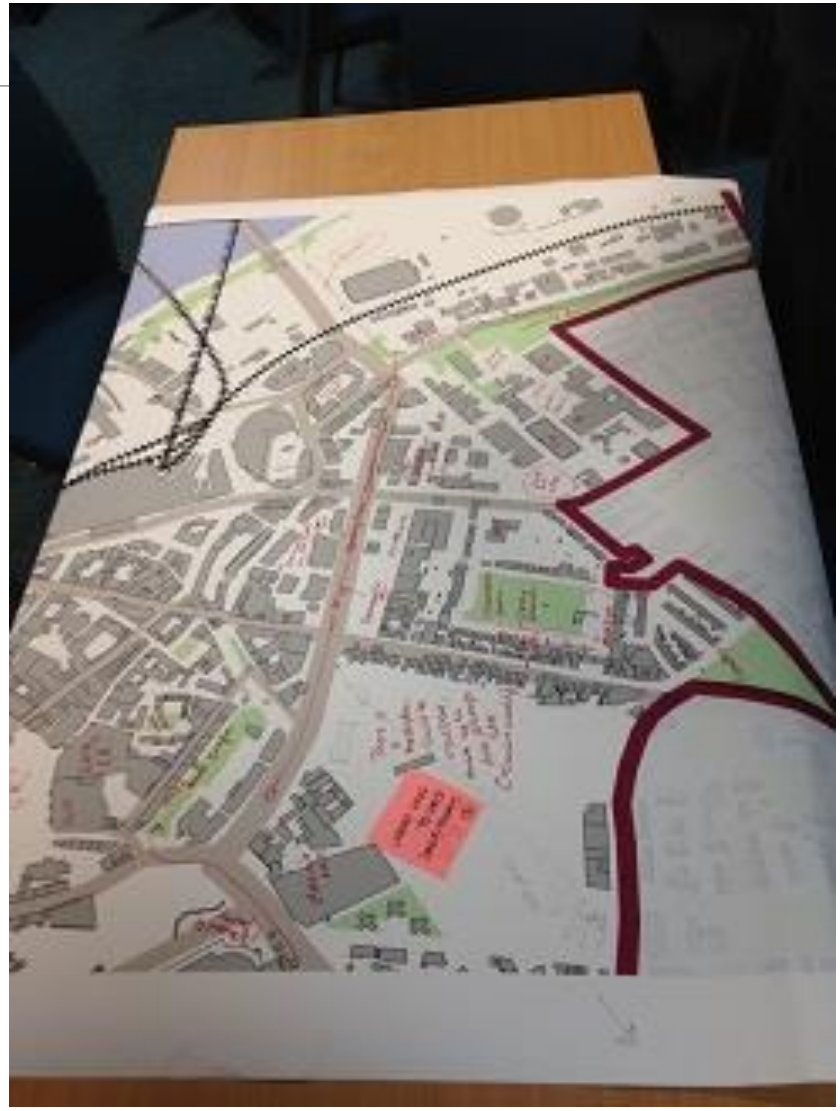
- A LAA is usually an **open arrangement** where participants create a **joint understanding** of a problem and its **possible solutions** based on rational criticism and coherence through **discussion**

- 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**

The Newcastle Learning and Action Alliance

'Blue-Greening' the urban core – a master-planning workshop



Newcastle helps lead the way in blue-green cities move to combat flood risk

15:30, 19 FEB 2016 | BY TONY HENDERSON

More water storage and greening spaces in Newcastle are the basis for the city conference pledge at the Life Science Centre

8 SHARES | COMMENTS

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Witherspoon Photography

Blue-Green Cities conference line up, left to right, Fula Ogunyoye, Haskoning DHV: David Wilkes, Arup: Marie Fallon, Environment Agency; Clare Rogers, Newcastle University; Richard Warneford, Northumbrian Water; Coun Ged Bell, Newcastle City Council

Blue and green could rival black and white as key colours in the Newcastle of the future.

Source: http://www.chroniclelive.co.uk/news/north-east-news/newcastle-helps-lead-way-blue-10914312

Blue-Green Cities Research Approach

Model Existing Flood Risk Management

Model Citizens' Behaviours

Evaluate Multiple Flood Risk Benefits

Stakeholder and Community Communications

Options for Hard/Soft Measures

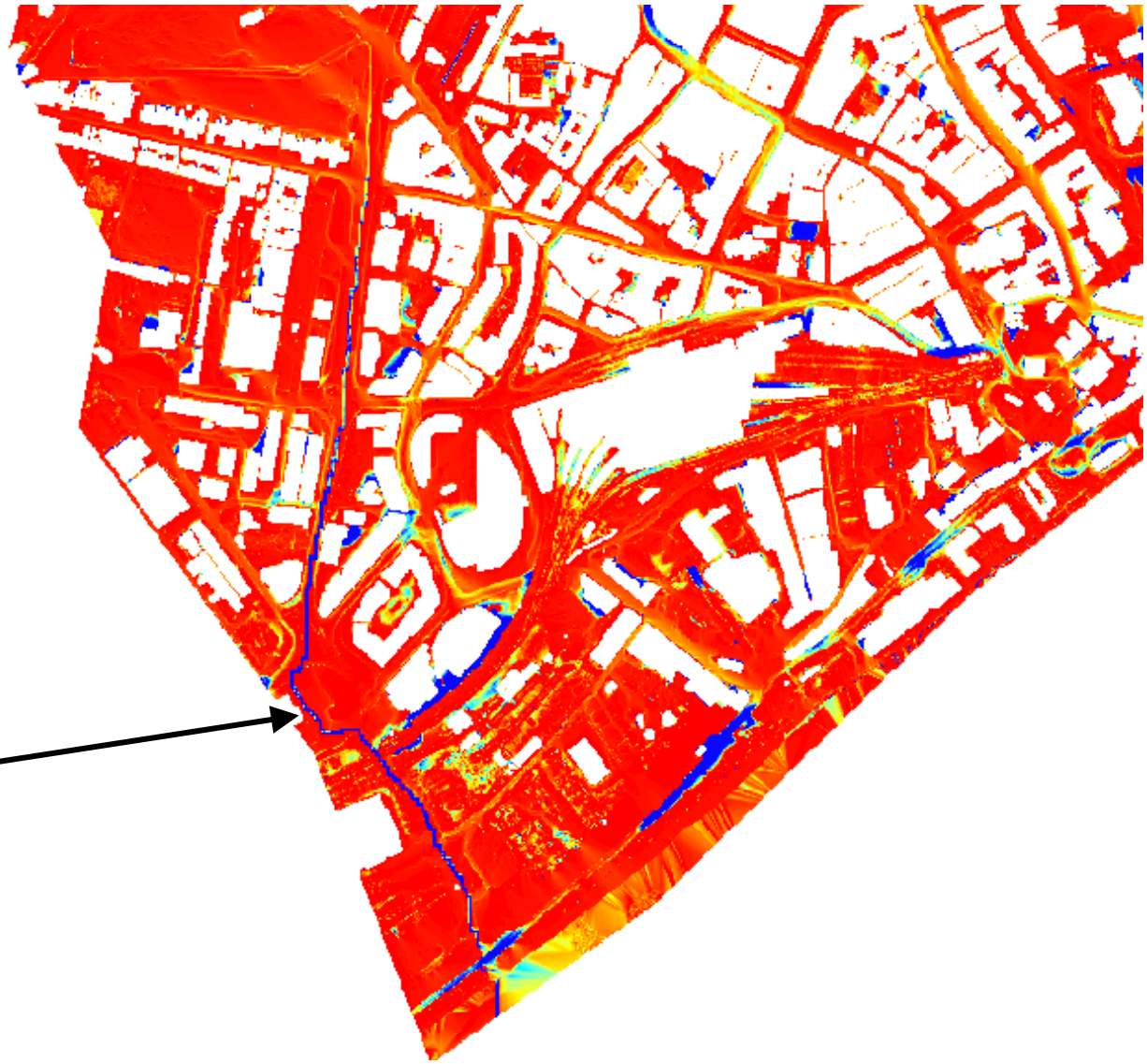
Demonstration Case Study

Modelling novel Blue-Green solutions

St James' Boulevard swale, Newcastle

RP= 50 years, 60 mins

Dimensions of swale:
Width = 2m
Depth < 1m



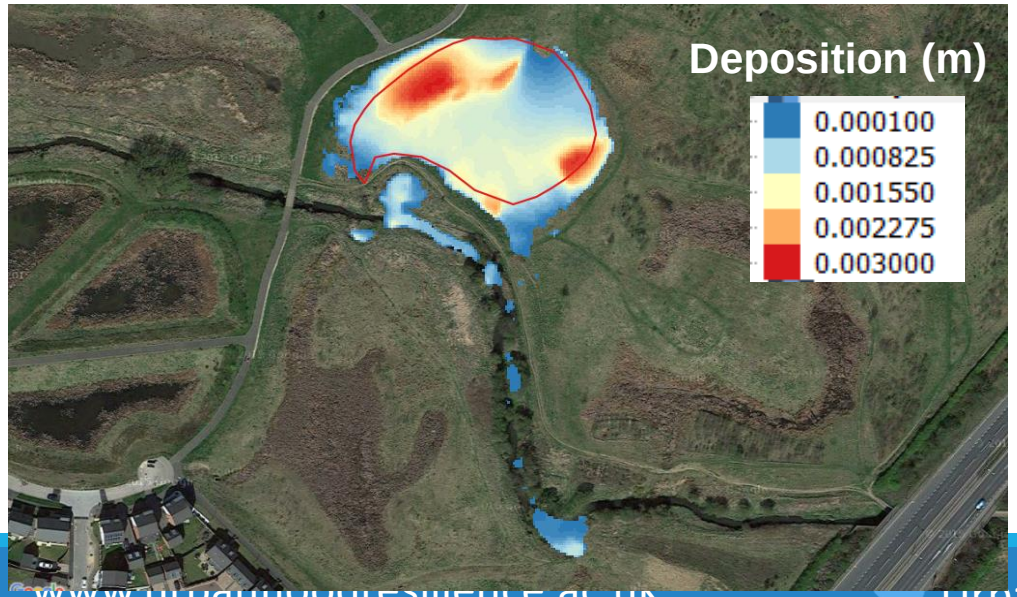
Flooding and sediment

Southwell (East Midlands)
2013 – after the floods

Source: Daily Mail

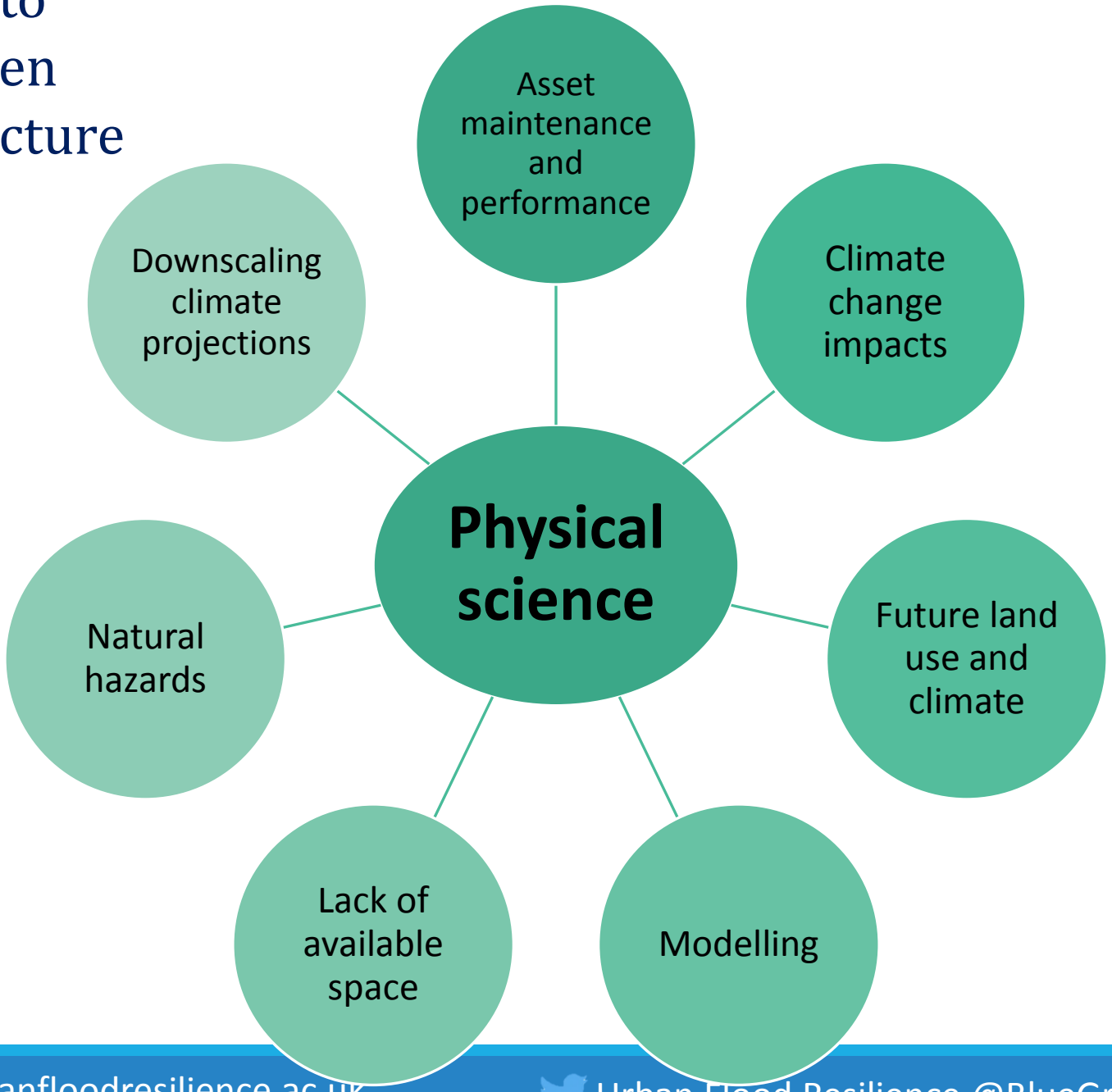
Water and sediment transport modelling

River flood routing simulations 100 yr event, 1 hr duration, with sustainable drainage pond

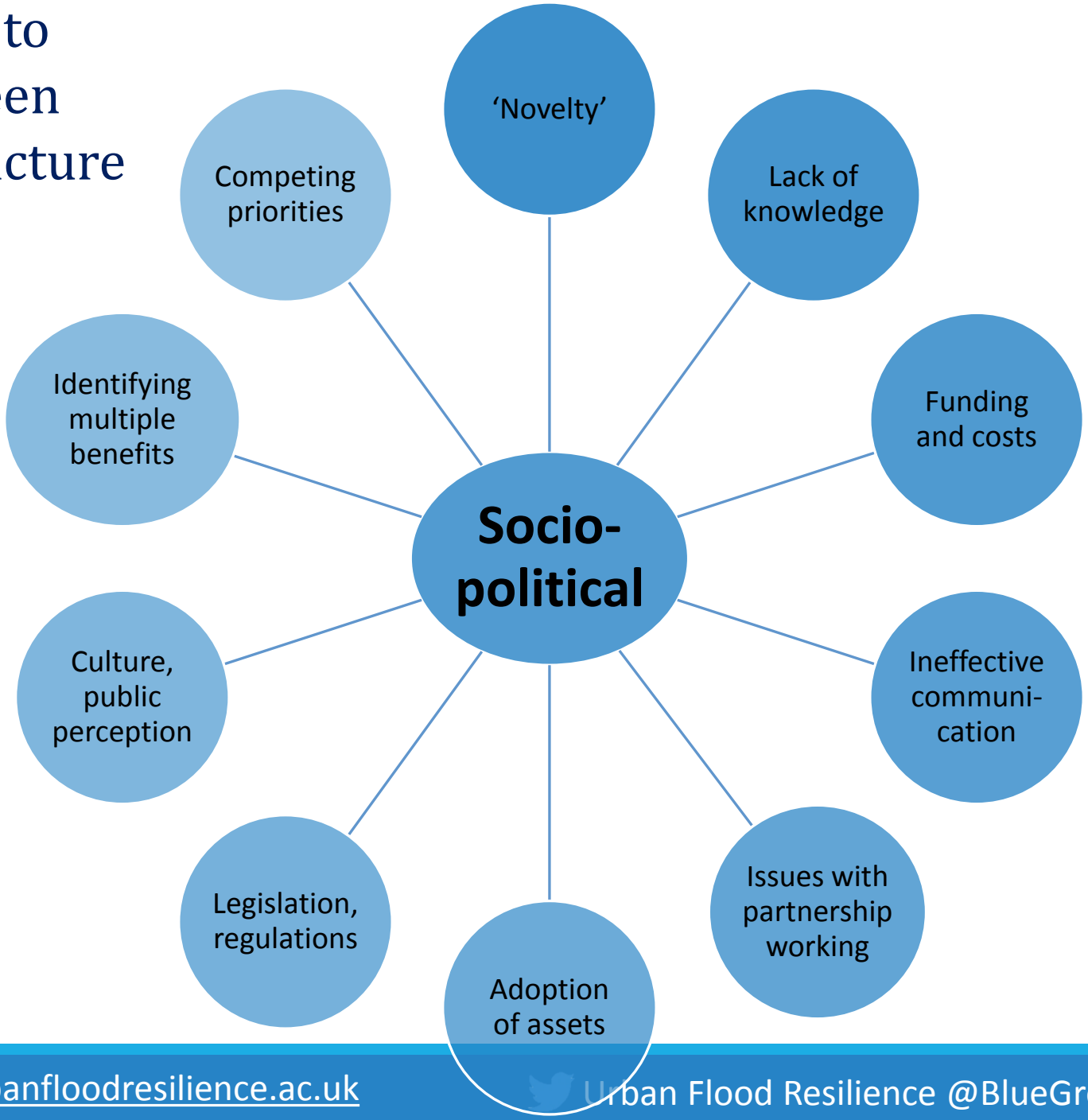


Sediment deposition in sustainable drainage pond (100 yr event, 1 hr)

Barriers to Blue-Green infrastructure



Barriers to Blue-Green infrastructure

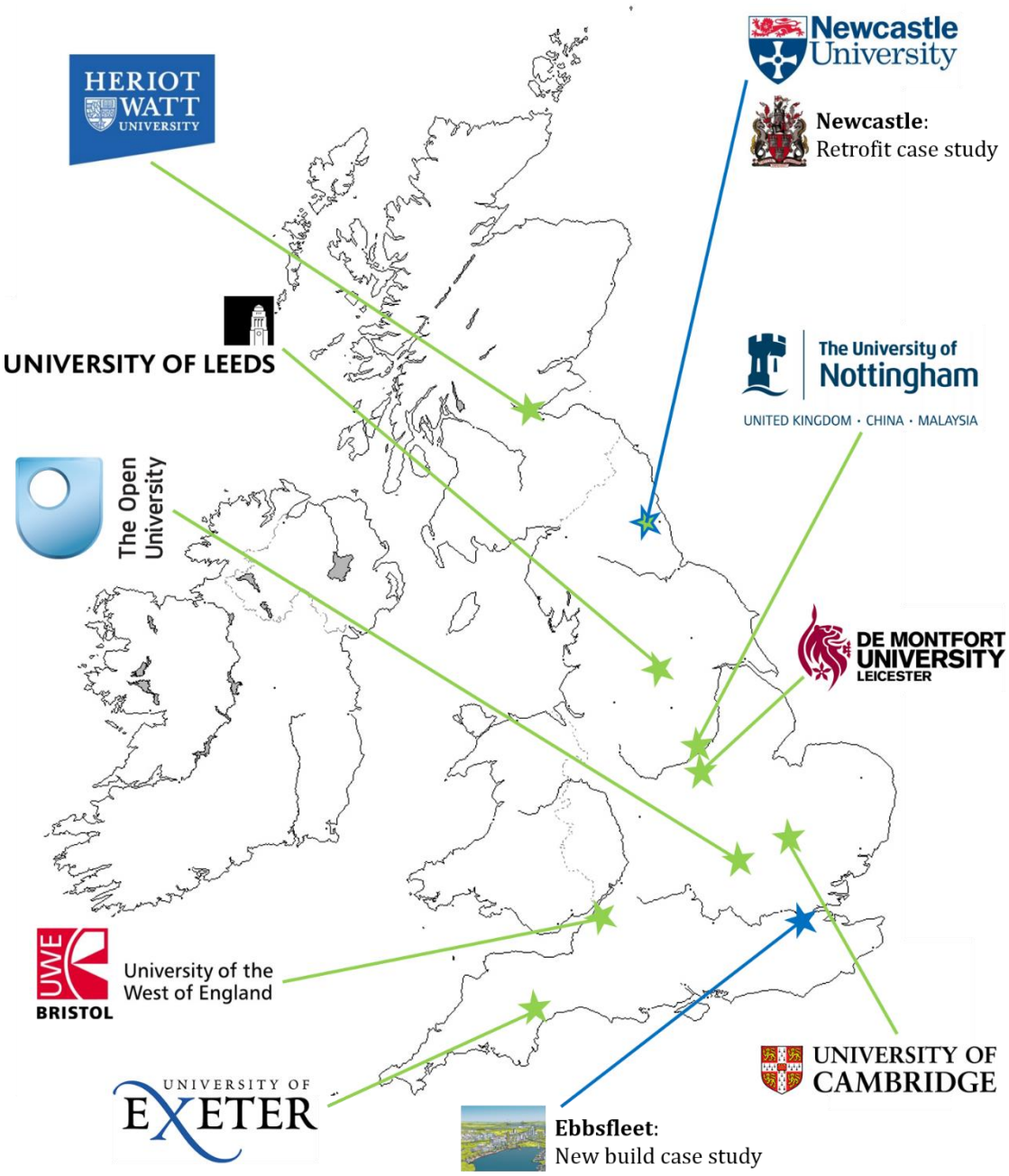


Overcoming the barriers – the top five

1. Promote multifunctional space and identify, quantify and monetise the multiple benefits
2. Improve education and communication, raise awareness, community engagement
2. Partnership working from the project outset
4. Changes in legislation, regulations, industry standards, planning guidelines
5. Exemplars (examples of best practice, local – international)

Project 2

UK Urban Flood Resilience Research Consortium



Aim

Make *urban flood resilience* achievable nationally, by making transformative change possible through adoption of the whole systems approach to urban flood and water management

Urban Flood Resilience

A city's capacity to maintain future flood risk at acceptable levels by:

1. preventing deaths and injuries,
2. minimising damage and disruption during floods,
3. recovering quickly afterwards,
4. ensuring social equity,
5. protecting the city's cultural identity and economic vitality

Resilient Blue-Green Cities

Image: https://www.contradodigital.com/wp-content/uploads/2014/06/Blue-Green-City.jpg

Changing the Water Narrative:
stormwater is not just a nuisance
but presents ***opportunities*** to make cities
Resilient, Attractive, Competitive and Liveable

Research Impact

- Potential to enable a step change in protecting UK cities and national economy from increased storminess, without constraining urban development and growth

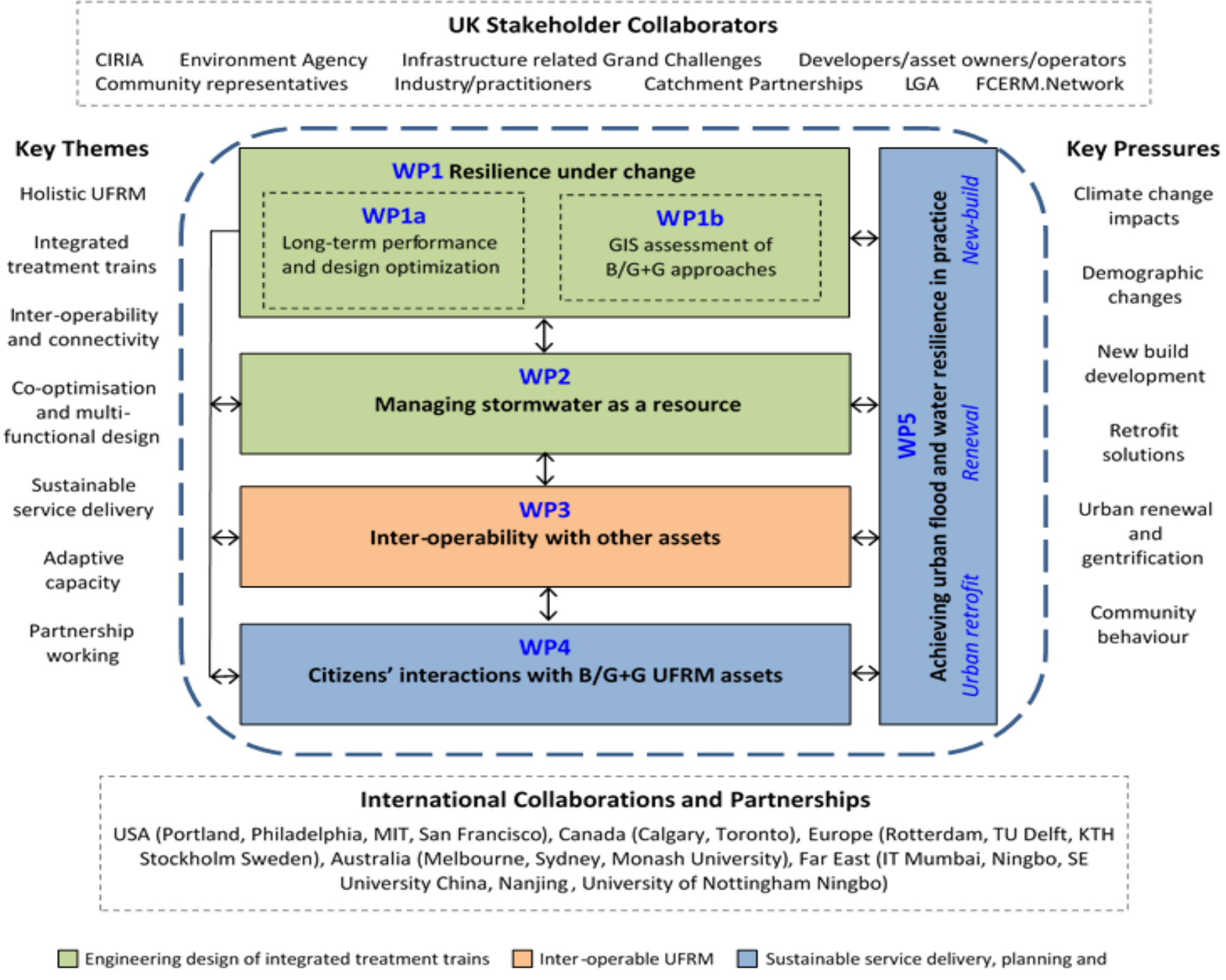
- Envisioning and delivering a ***different water future***: one based on resilient cities where flood and water management is planned, developed, designed and operated in ways that are truly sustainable

Urban Flood Resilience Research Themes

- **Engineering Design** of integrated Blue/Green and Grey **(B/G+G)** surface water treatment trains that support resilient management of both water quantity and quality

- **Planning** that puts urban flood risk management at the heart of urban planning & focuses on interfaces between planners, developers, engineers and communities

- **Development** of flood and water management assets that function inter-operably with other urban systems: transport, energy, land-use and natural systems


UK Stakeholder Collaborators
CIRIA
Environment Agency
Infrastructure related Grand Challenges
Developers/asset owners/operators
Community representatives
Industry/practitioners
Catchment Partnerships
LGA
FCERM.Network
Key Themes
Holistic UFRM
Integrated treatment trains
Inter-operability and connectivity
Co-optimisation and multi-functional design
Sustainable service delivery
Adaptive capacity
Partnership working
WP1 Resilience under change
WP1a
Long-term performance and design optimization
WP1b
GIS assessment of B/G+G approaches
WP2
Managing stormwater as a resource
WP3
Inter-operability with other assets
WP4
Citizens' interactions with B/G+G UFRM assets
WP5
Achieving urban flood and water resilience in practice
New-build
Renewal
Urban retrofit
Key Pressures
Climate change impacts
Demographic changes
New build development
Retrofit solutions
Urban renewal and gentrification
Community behaviour
International Collaborations and Partnerships
USA (Portland, Philadelphia, MIT, San Francisco), Canada (Calgary, Toronto), Europe (Rotterdam, TU Delft, KTH Stockholm Sweden), Australia (Melbourne, Sydney, Monash University), Far East (IT Mumbai, Ningbo, SE University China, Nanjing, University of Nottingham Ningbo)
Engineering design of integrated treatment trains
Inter-operable UFRM
Sustainable service delivery, planning and

Deliverables: Engineering Design

- **Next generation flood and water management models** that bridge the interfaces between urban/rural and engineered/natural hydrological systems: simulating urban floods, droughts and water cycles to deliver acceptable service provision 365 days a year (WP1a)

- **Recommendations on integrated B/G+G stormwater treatment trains** through development of adaptation designs and pathways appropriate to their location, community and scale (WP1a)

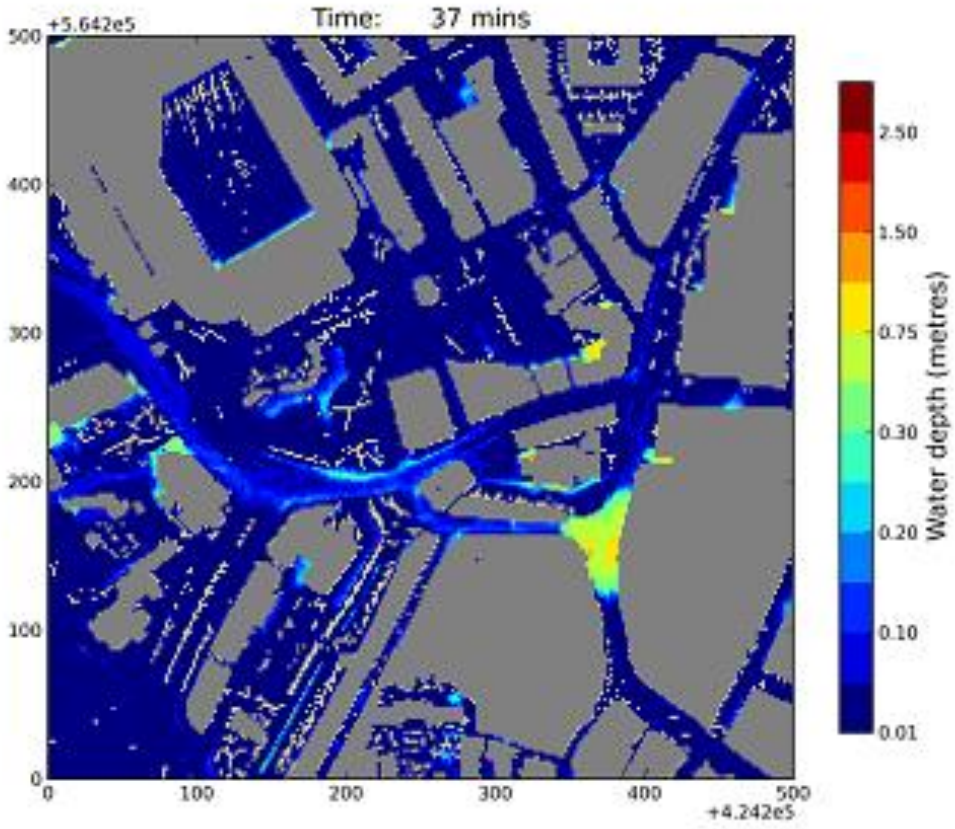
- **GIS toolbox for a National Assessment of urban flooding** using B/G+G combinations to handle increased flood risk, sewer capacity, and stormwater resource potential under present and future climates (WP1b)

WP1a. Long-term performance and design optimization

Optimise B/G+G and SuDS system performance under a range of future scenarios for climate and socio-economic change

Establish how integrated surface/sub-surface water management systems can deliver 24/7 service provision that is resilient to increased climatic variability

Replace single ‘design floods’ with a whole systems approach based on coordinated management of the ‘stormwater cascade’, making best possible use of urban water cycles and green spaces



WP1b. GIS assessment of B/G+G approaches

GIS-toolbox to support comparative evaluation of the costs and benefits of alternative urban flood risk management solutions

Integrated maps of flood risk reduction and wider benefits, e.g. carbon sequestration, habitat improvement, greenspace access

Future scenarios for climate change, socio-economic development, and damage & disruption reductions using integrated B/G+G systems

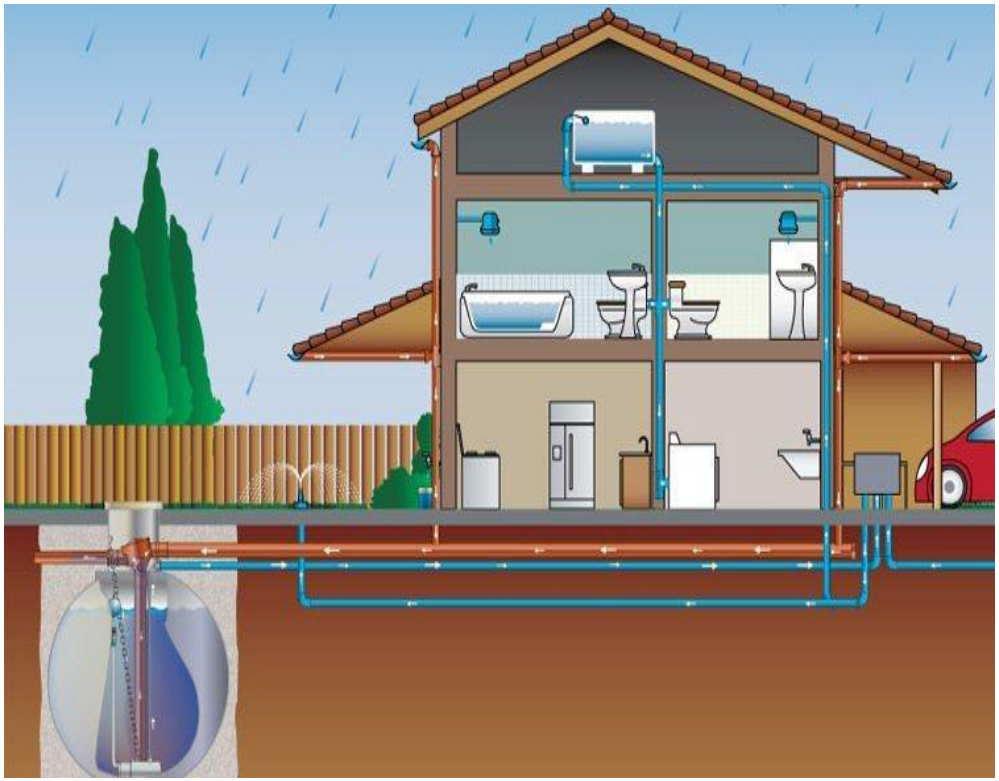
Deliverables: Engineering for urban water resource use across drought – flood spectrum

- **Enhanced design methods** that both mitigate flood hazards and treat stormwater as a resource - leading to stormwater capture, recycling and reuse (WP2)

- **Improved integration of urban flood risk management and water, energy and transport infrastructure** and expanded inter-operability of urban systems-of-systems (WP3)

WP2. Managing stormwater as a resource

Potential for stormwater use within buildings, irrigation, managing subsidence, groundwater recharge, micro-hydropower, enhancing recreation and ecosystems services



Rainwater harvesting under climate change

Stormwater development and resource potential

Stormwater retention for biodiversity in urban streams, green spaces and corridors

Cumulative effects of B/G+G treatment trains on urban stream forms and functions

WP3. Multi-functional systems

Investigate the potential for employing inter-operable B-G/G infrastructure to increase flood resilience across urban systems

Optimise use stormwater management solutions to interoperate with existing infrastructure assets;

- where and how have these solutions already been used?
- what are the overall benefits of multi-functional and interoperable systems to various agents?

Increase functionality of designs for greater efficiency and productivity while reducing overall costs

Deliverables: social and planning aspects of urban flood risk management

- **Characterise citizen's behaviours and decision making** on flooding and urban water use, and informing decisions through improved flood risk and water literacy (WP4)

- **New protocols for placing flood and water management decision making at the heart of urban planning** (WP5)

- **Case studies** demonstrating enhanced urban flood and water management in retrofit, renewal, new town applications (WP5)

WP4. Citizen's interactions with B/G+G infrastructure

Understand how to transform attitudes and change behaviours of flood professionals and urban residents

Co-develop new mechanisms for engaging communities, improving flood awareness and communicating benefits (e.g. social media)

Demonstrate how citizens' priorities and lifestyles, affect their understanding of and support for B/G+G

Use on-line communications to study perceptions and opinions, and shift citizens' and professionals' attitudes and behaviours with respect to B/G+G

WP5. Achieving urban flood and water resilience in practice

Inform, take-up and apply research in WPs1-4 to establish:
a) how resilient urban flood and water service delivery can be put at the heart of urban planning, and;
b) how barriers to innovation can be overcome

Establish Learning and Action Alliances in case study cities

Investigate barriers to flood and water innovation

Align research in WPs1-4 with the needs of practitioners and local government

Case Study Cities

Newcastle

Retrofit and urban renewal

Ebbsfleet

New build in a ‘garden city’

WP5: main tasks

1. Theory and Methodology - *Governmentality, Actor-Network and Complexity:* documentary analysis and field work underway
2. Establish Ebbsfleet Local Action Alliance (LAA)
3. Re-launch Newcastle LAA
4. Establish LAA agendas
5. With LAA stakeholders understand planning/development contexts

Ebbsfleet Summit

Eastgate Community Centre 10 May 2017 09.30 – 15.15

9.30 Participant arrival and networking over coffee

Session 1: Setting the context

10.00 Welcome and introductions
Simon Harrison (Ebbsfleet Development Corporation)

10.05 Urban Flood Resilience in an Uncertain Future
Colin Thorne (University of Nottingham)

10.30 The Ebbsfleet Garden City
Simon Harrison (Ebbsfleet Development Corporation)

10.50 Kent County Council flood risk management strategies
Bronwyn Brunton (Kent County Council)

11.05 Q&A

11.30 Refreshments

Session 2: Opportunities and barriers in Ebbsfleet

11.45 Developer's vision for Ebbsfleet (TBC)

12.00 Rivers, nature and greenspace (TBC)

12.15 Group discussion: what are current barriers and opportunities in Ebbsfleet?

13.00 Lunch and networking

Session 3: Developing a collaborative vision for Ebbsfleet

13.45 Briefing on the Learning and Action Alliance and membership options
Emily O'Donnell (University of Nottingham)

14.05 Workshop exercise: developing a vision for a resilient, sustainable Ebbsfleet

14.55 Feedback to main group

15.15 Closing remarks and end of meeting

EPSRC Environment Agency ATKINS UKWIR water industry forum Ebbsfleet Newcastle

WP5: Activities this quarter

Ebbsfleet Summit (10th May)

Attended by key stakeholders

- Thames Water, Southern Water
- Gravesham and Dartford Councils (Planning Officers + Councillor)
- Kent Wildlife Trust
- Tarmac Lafarge
- UFR consortium members

Outputs/achievements

- Need to better understand hydrogeology
- Opportunities for BG during all planning and design phases
- Opportunities for BG: River Ebbsfleet, Green Corridors, City Parks
- Potential quick wins – community SuDS stewards, pocket parks
- Challenge of engaging developers and understanding motivations

Next steps

- acquire data and understanding of hydrogeology
- programme of 'themed' meetings on specific issues

WP5: Activities this quarter

Newcastle LAA re-launch (7th June)

Attendees: 27 stakeholders including;

Members of Blue-Green Cities LAA

- Newcastle City Council
- Environment Agency
- Arup
- UFR research team
- Northumbrian Water
- Newcastle University Estates
- Royal Haskoning DHV

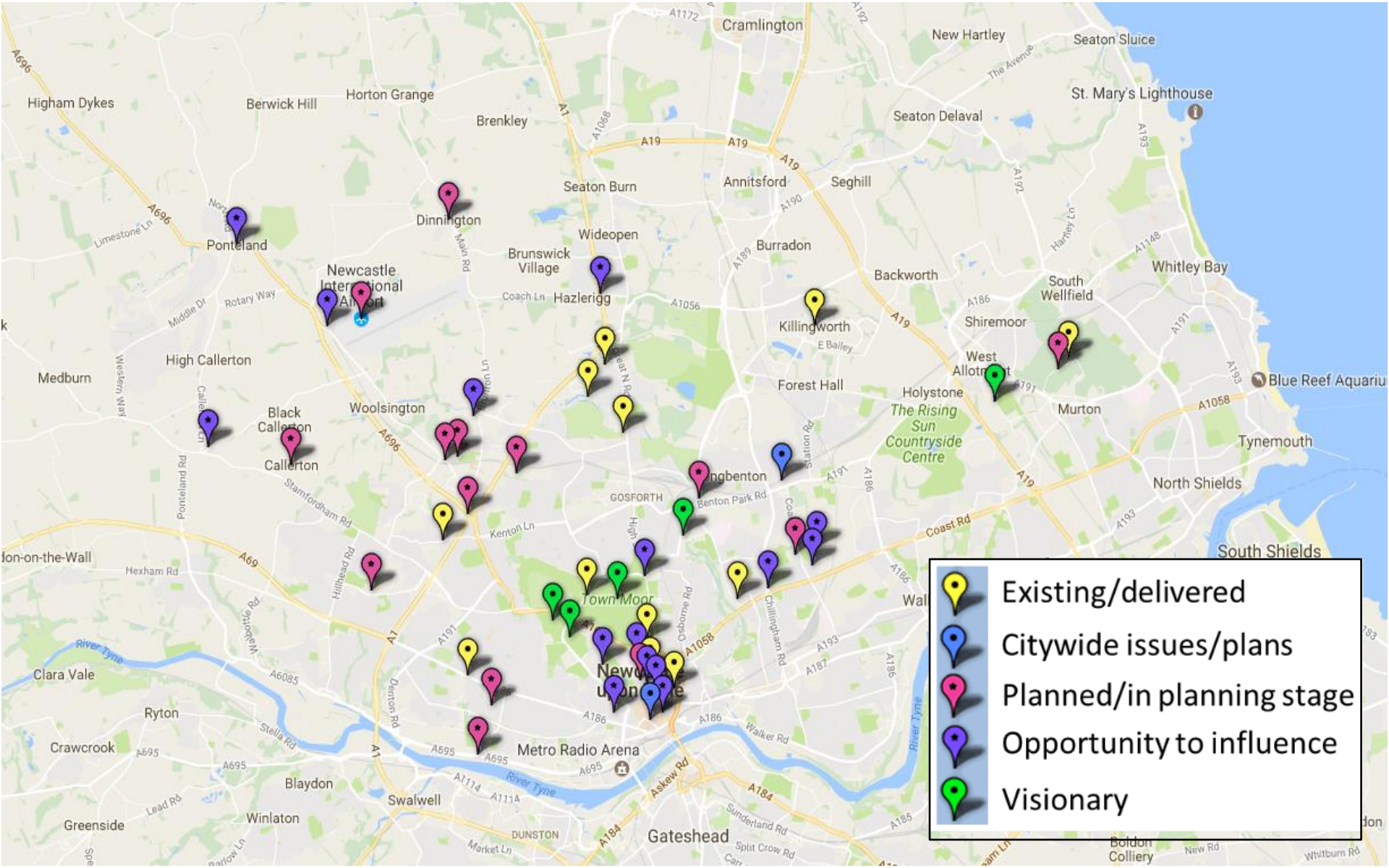
Potential members of new LAA

- Keepmoat Homes
- NE Local Enterprise Partnership

Outputs/achievements

New interactive map of planned, delivered and visionary Blue-Green schemes in Newcastle and region

Blue-Green infrastructure: Newcastle and Region



Acknowledgement

The research presented in this presentation is being conducted as part of the Urban Flood Resilience Research Consortium with supported from: