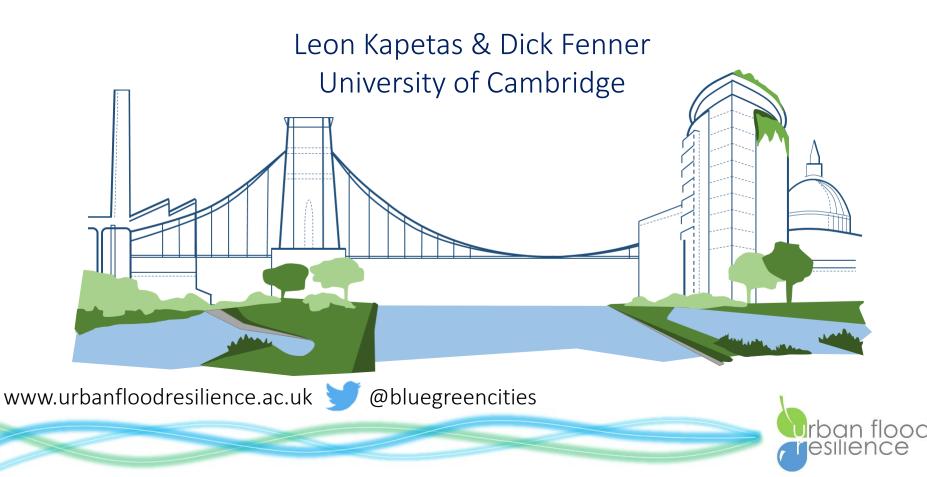
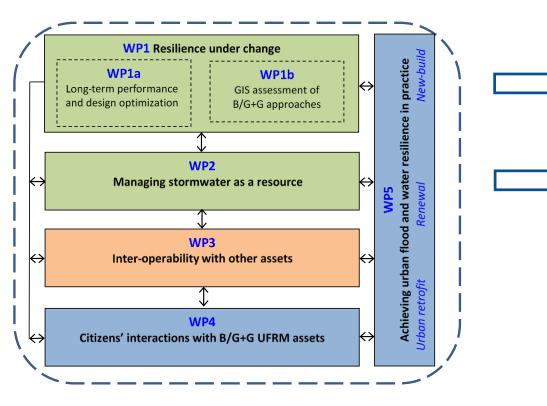
An adaptation pathways approach to deliver multiple benefits of Blue-Green Infrastructure: insights from London Borough of Sutton



Research streams



1. Adaptation Pathways for long-term drainage infrastructure planning

2. Energy Recovery from urban stormwater

3. Using stormwater in managed aquifer recharge for drought mitigation



Talk Outline

- Research Questions
- Multiple Benefits (MB)
- MB evaluation and co-design
- Sutton flooding
- Adaptation Pathways for a long-term drainage infrastructure plan
 - Options
 - Modelling
 - Options and pathways appraisal
- Key Deliverables



Research Questions:

What is the right mix of blue-green and grey infrastructure at any location and time?

When are blue-green interventions necessary under future development and climate scenarios?

How can flexible design approaches be valued incorporating multiple benefit assessments (and real options)?

#blue/green infrastructure #multiple benefits #flexibility



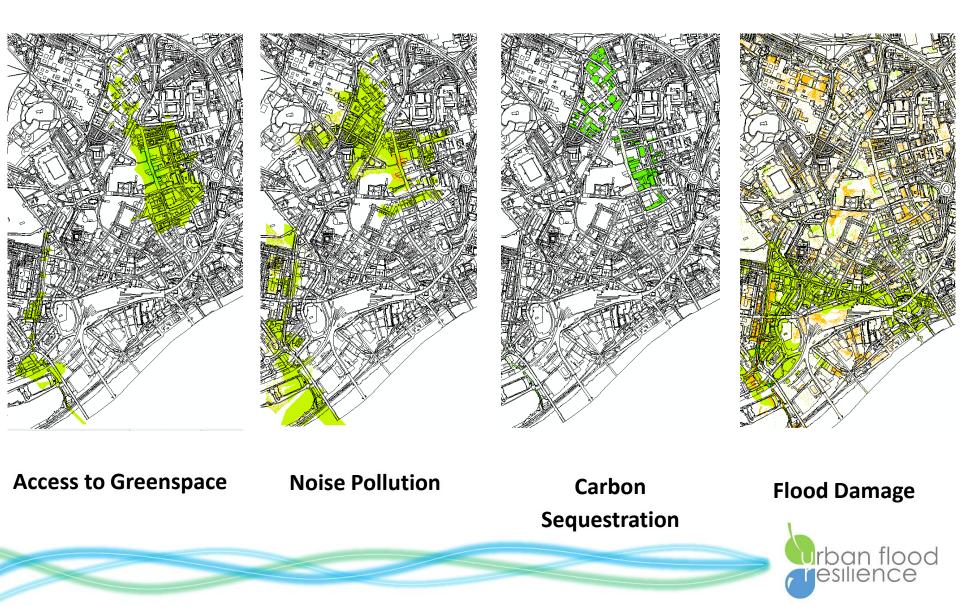
Examples of multiple benefits from SuDS / GI

| Potential Benefits from SuDS and | Mechanisms |
|----------------------------------|---|
| Blue Green Infrastructure | |
| Pollutant trapping | e.g. Adsorption of PM_{10} onto leaf surfaces |
| Biodiversity | e.g. through habitat creation |
| Amenity and recreation | e.g. through greater access to green space |
| Enhanced urban form | e.g. through landscape connectivity into green corridors |
| Groundwater recharge | e.g. maintenance of natural hydrology |
| Air temperature | e.g. through mitigating urban heat island effects |
| Health | e.g. by providing areas for exercise, improving air quality etc |
| Noise reduction | e.g. where adjacent to major roads |
| Traffic calming | e.g. by using street gardens as width restrictors |
| Carbon mitigation | e.g. by sequestering CO ₂ |
| Property value uplift | e.g. by proximity to green space |

Ce



Spatial distribution of benefits: normalised uplift



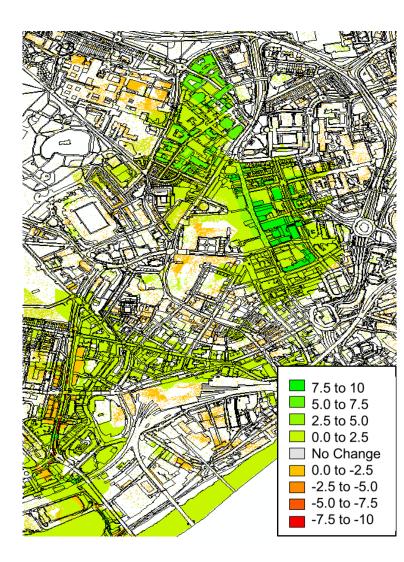
Background conditions

AIR QUALITY (PM2.5) Air pollution can reduce mortality and life expectancy (COMEAP, 2009; Defra, 2008). It could cause concomitant health costs in the UK of up to £15 billion a year (DEFRA, 2008). In addition, it is also thought to have a negative impact on the natural environment and to reduce biodiversity (CEH RoTAP Report, 2009). Experience Modelled air quality baseline - PM25 Best Worst PRESTWICH MSOA Assessment PENDLEBURY ALSWORTH SWINTON ш Air Quality Management DROYISDEN Z Areas (AQMAs) **Milliond Park** Ш 00 ENISMORTH PM2.5 Concentration (µg/m3) STREFFORD High-123 RIDAL SULES Law 10.1 4 The indicator used to indicate air quality is the mean background AOMAs concentration of PM2.5 in 2016. These are areas that have been identified by Local Authorities as being unlikely to meet the national objectives for air quality.

Defra, 2016, Local Action Project



Cumulative benefit intensity:

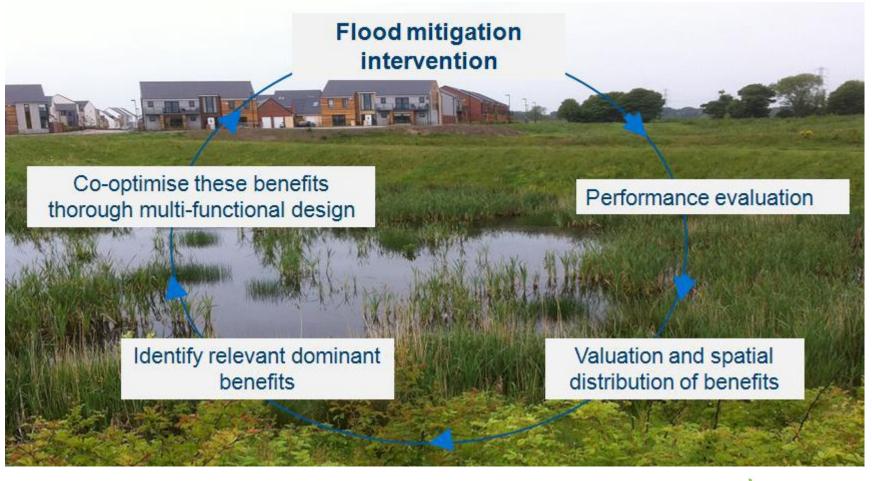


Key principles:

- 1. Benefits are location- and contextspecific
- 2. Simultaneous optimisation of all benefits is not possible
- The value of each benefit will be dependent on background environmental conditions
- Benefits develop over time and need to be assessed as an improvement from an initial condition state
- The spatial distribution of benefits is important and accrue to different stakeholder groups other than the asset owner, and scales from local to regional to global

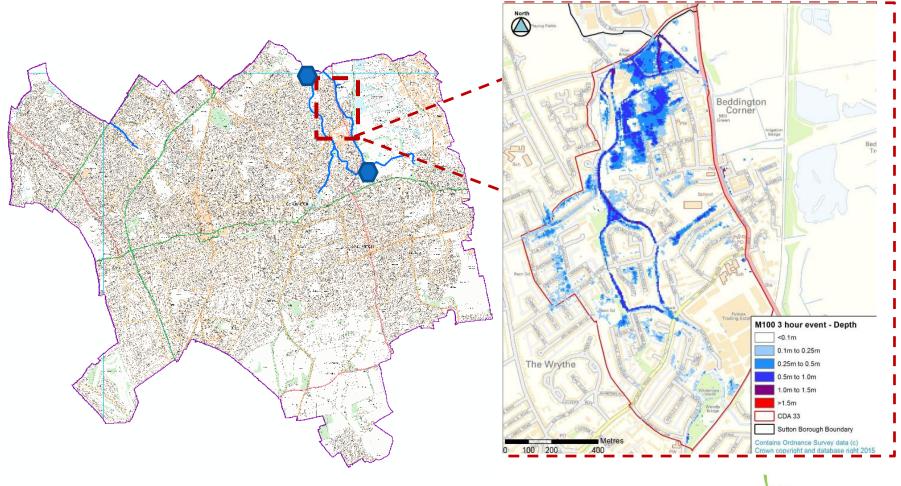


Co-design of SuDS to achieve multi-functionality





What is the right mix of blue-green and grey infrastructure **IN SUTTON** and **FOR THE NEXT 40 YEARS**?





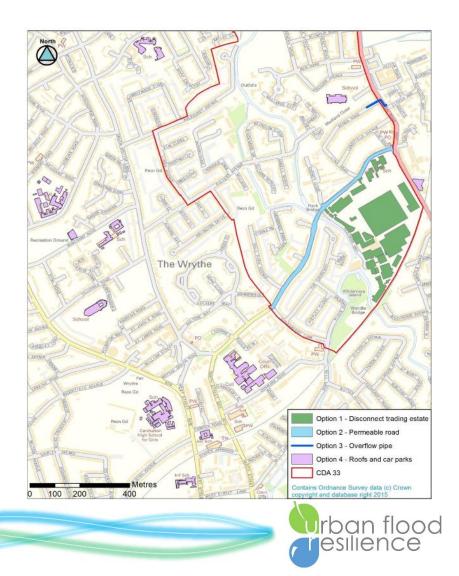
What is the right mix of blue-green and grey infrastructure **IN SUTTON** and **FOR THE NEXT 40 YEARS**?

SuDS in Sutton Schools Project:

- Reduce flooding from 135 to 20 properties for a 1 in 30 years event
- Sutton Council, South East Rivers Trust, METIS ; Thames Water
- SuDS interventions in 07 schools + City Council Estate

Considering climate change and urban intensification

- Pilot as evidence
- Static response to a dynamic problem
- Which intervention comes next?



SuDS in Sutton Schools: work in progress



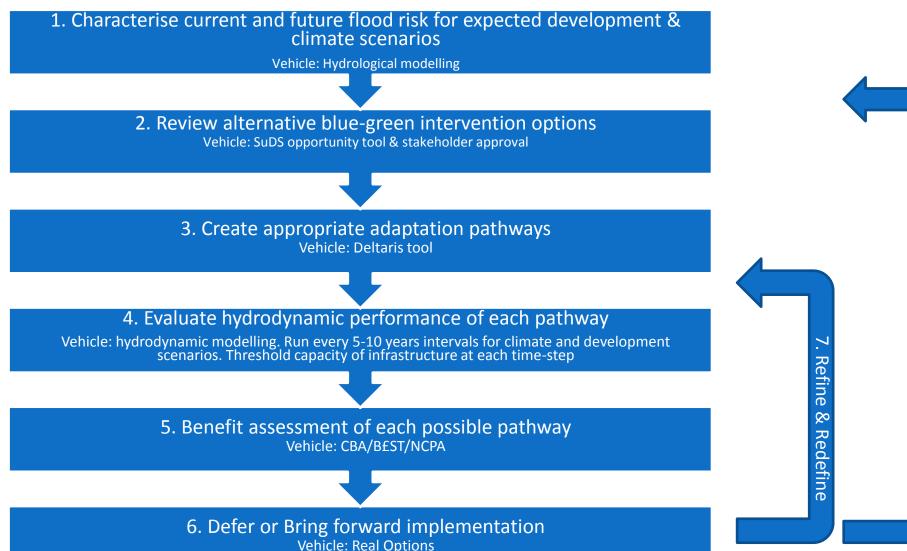


What is the right mix of blue-green and grey infrastructure IN SUTTON and FOR THE NEXT 40 YEARS?

- i. What is the desired performance threshold?
- ii. What are the intervention options and how does one combine with the other?
- iii. Which intervention should be prioritised?
- iv. What is the assessment approach?
- v. When should they be implemented?
- vi. How do we respond to climate change and urbanisation?



Procedure for the development and assessment of Adaptation Pathways



1a. Understanding Drivers for intervention in Sutton

Climate Change (expected flood risk increase)

- Population growth: 10,000 households in 30 years.
- > AQMA zones with Sutton
- SuDS on streets policy (TFL)
- Water stressed area
- Natural Capital uplift policy planner's priority



1b. Flood modelling: SWMM model



Model data:

- Subcatchment areas
- Manhole data
- Pipe data
- Permeable area %
- Slope%

→ Establish **current** flood risk conditions

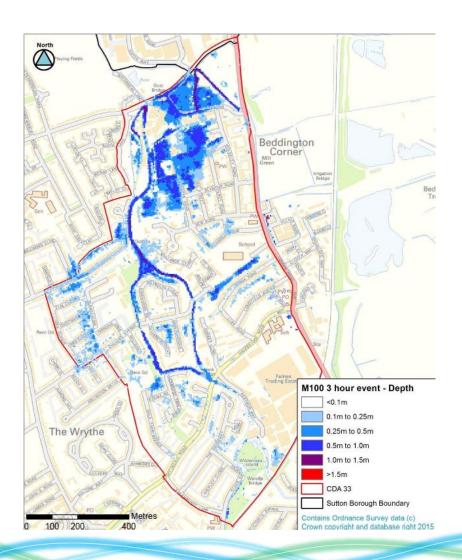
Climate and Intensification scenarios:

- Storm profile increase
- Impermeable area increase

→ Establish **future** flood risk conditions

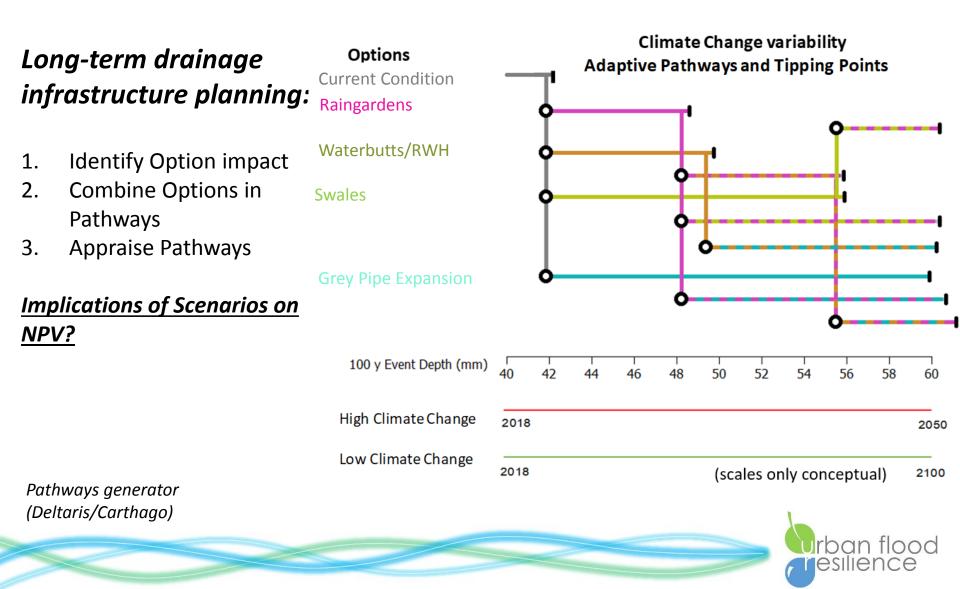


2. Identifying BG/G intervention options: SuDS opportunity tool

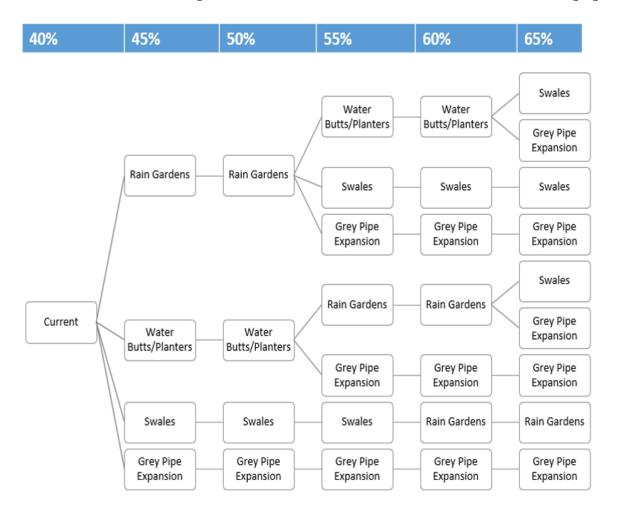




3. Generating the Pathways



Adaptation Pathways approach: *Quantitative CBA and qualitative multi-criteria appraisal*



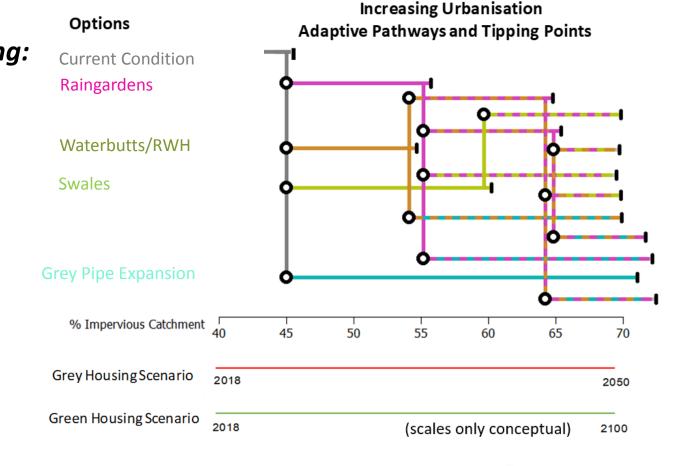
Adaptation pathways tree as a response to urbanisation



3. Generating the Pathways

Long-term drainage infrastructure planning:

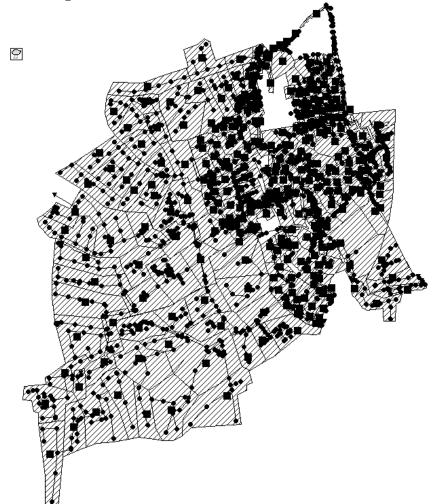
- 1. Identify Option's impact
- 2. Combine Options in Pathways
- 3. Appraise Pathways





Pathways generator (Deltaris/Carthago)

4. Flood modelling to assess option/pathway viability



BG and G Interventions:

Model modification of permeable area and storage volume in specific sub-catchments

Climate and Intensification scenarios:

- Storm profile increase
- Impermeable are increase

Option viable until flooding is observed and tipping point to next step in pathway: Trigger Point Timing



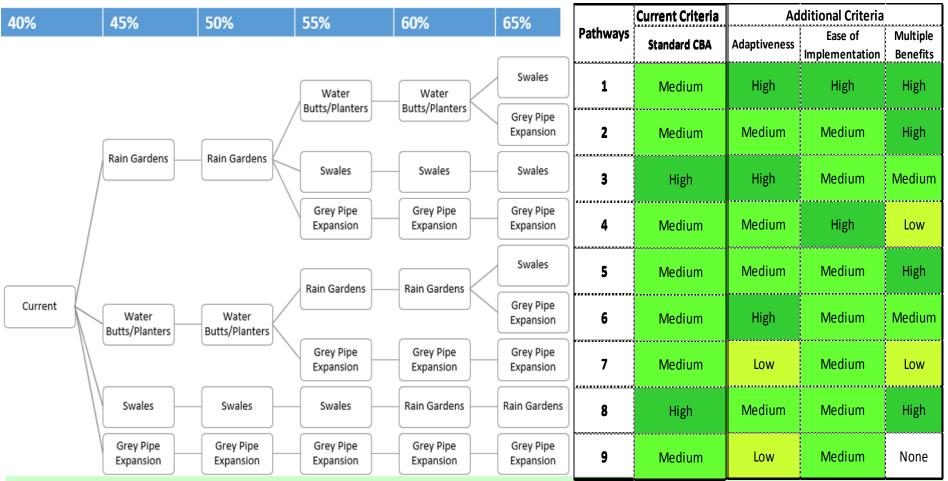
5. Carrying out a Cost Benefit Analysis

Components:

- Flood Damage avoided
- Options costing (HR Wallingford Tool CAPEX/OPEX 40 years)
- Cost of Grey System
- BEST MB monetisation (currently undertaken)



Pathways appraisal Quantitative CBA and qualitative multi-criteria appraisal



Adaptation pathways tree and multi-criteria pathway assessment as a response to urbanisation



Conclusions

- Identify the right mix of BG/G infrastructure; implications on investment planning
- Include wider criteria in SUDS decision making, particularly Multiple Benefits
- Take uncertainty into account by developing flexible grey/blue-green pathways
- Carry out valuation of flexibility when comparing/combining grey and blue-green options
- Applicable to numerous UK and international urban environments



Key Deliverables at the end of project

- Methodology to assess energy recovery potential
- Understanding barriers and opportunities in SuDS/MAR conjunctive systems including cost and quality concerns.
 - Partnership with Thames Water
- Practical guidelines on how to incorporate flexibility in drainage infrastructure planning while delivering multiple benefits.
 - Partnership with Sutton Council and SERT

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