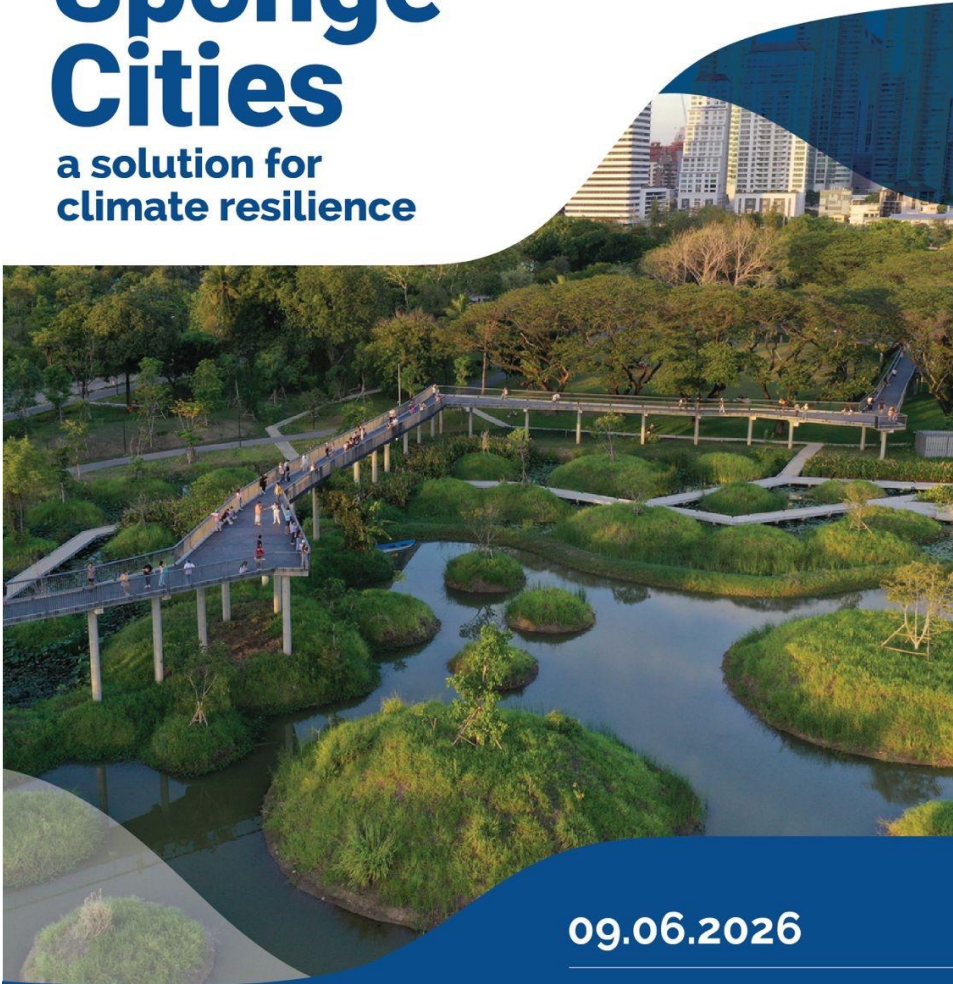


INTERNATIONAL CONFERENCE



Sponge Cities

a solution for
climate resilience



09.06.2026

Bucharest

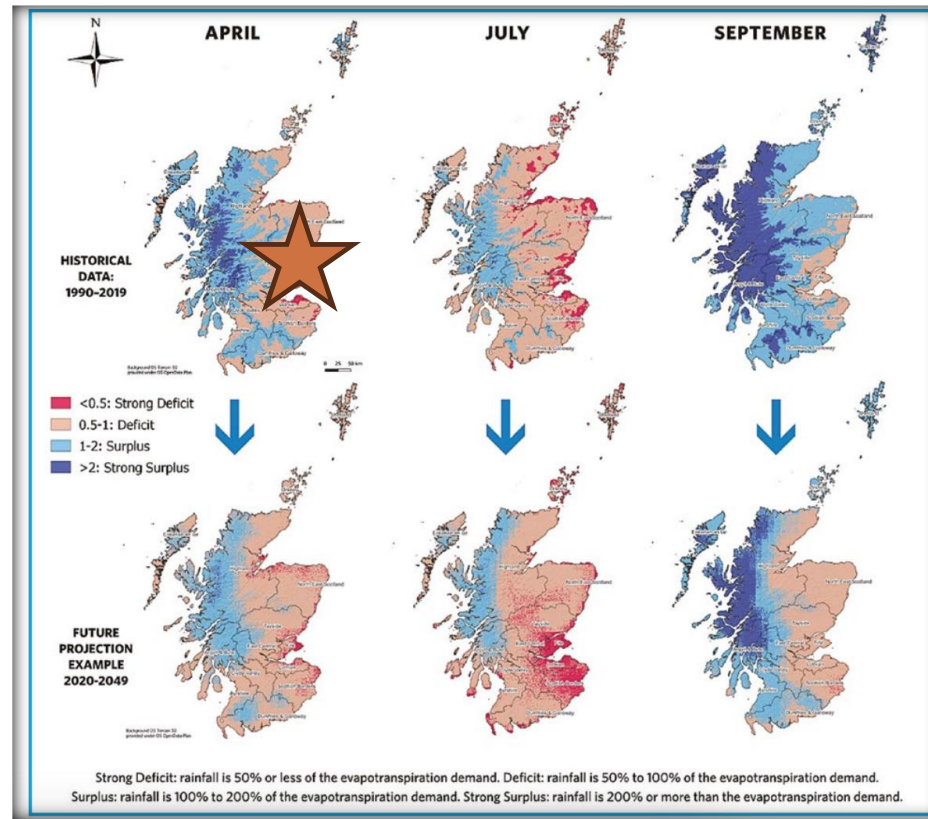
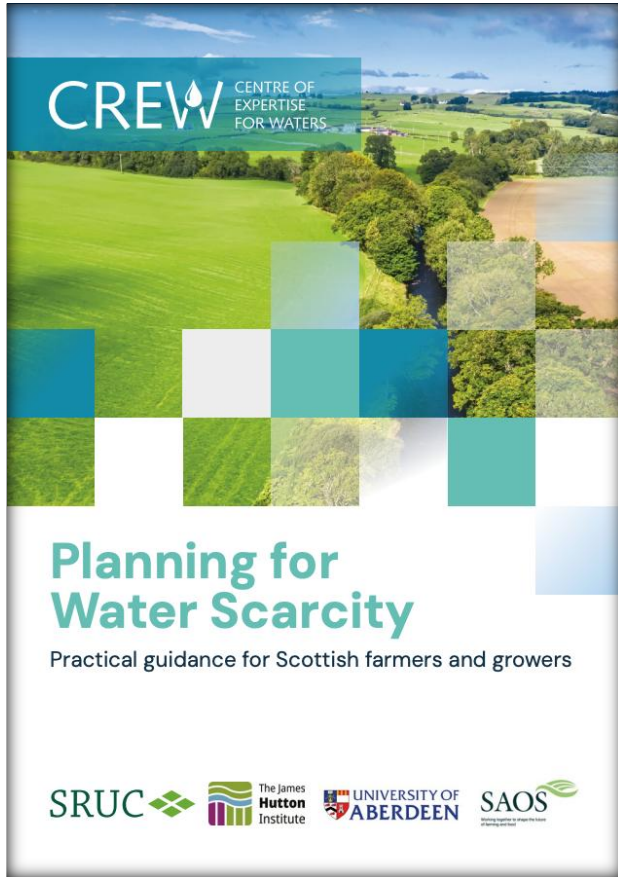
Value beyond drainage from spongy systems

Emeritus Professor Richard Ashley
University of Sheffield, Great Britain
Adjunct Professor, Lulea Technical University, Sweden

STORMWATER IS A PROBLEM

- Pollution
- Flooding
- Water in the wrong place
- Not enough water

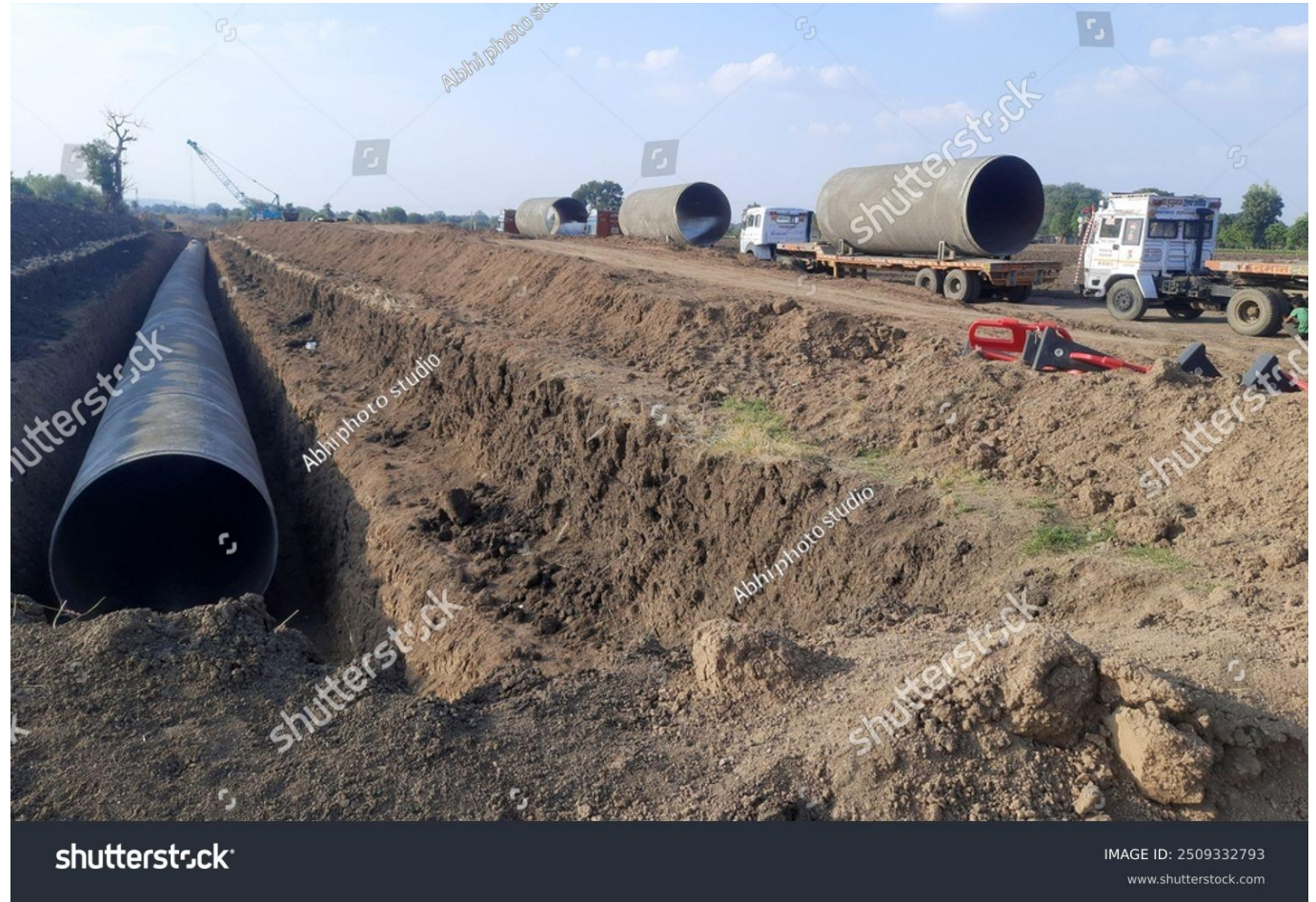




Where I live in North East Scotland we have less than 700mm of rainfall a year

GET IT AWAY TO A SAFE OR USEFUL PLACE

- THE DRAIN
Convey away (quickly), safely and securely (effectually drain)
- We, as professionals are very good at this
- Our communities and clients expect us to do this



shutterstock

IMAGE ID: 2509332793
www.shutterstock.com

CONSEQUENCES OF HOW SW MANAGEMENT IS APPROACHED

- SW management closely tied to land use, land use planning processes and building control measures
 - In towns and cities SW management is intrinsically linked to development plans and cultures of urbanism
 - Often
 - subordinated to how roads and highways are managed
 - conflict between building and drainage regulation
- Disagreements over who should manage and who should pay



WHY?

Because SW is seen as a **PROBLEM** to deal with

CHANGING PLACES

Challenge of creating flood resilience:
– where does the water go

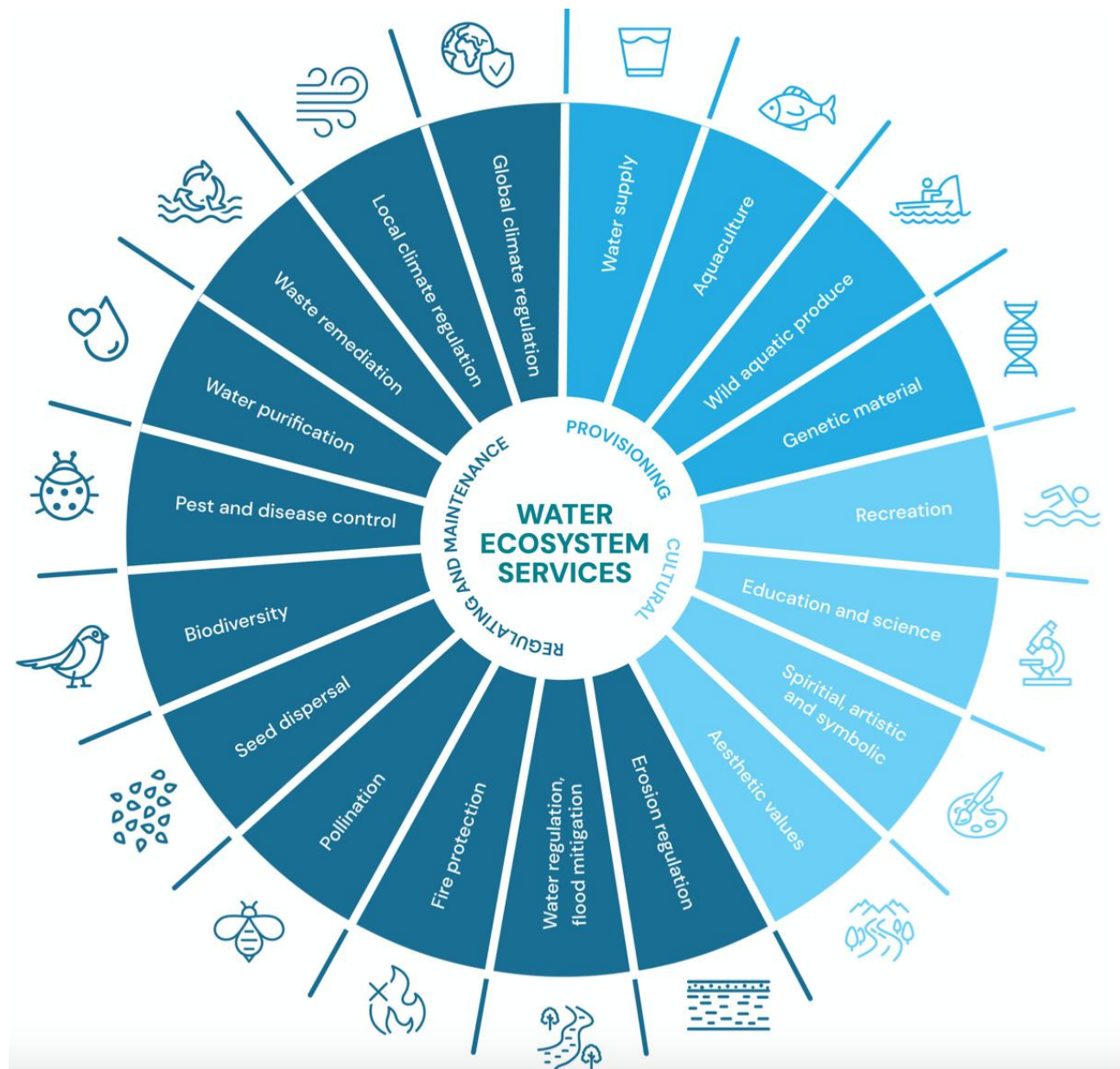


- Not easy with EXISTING



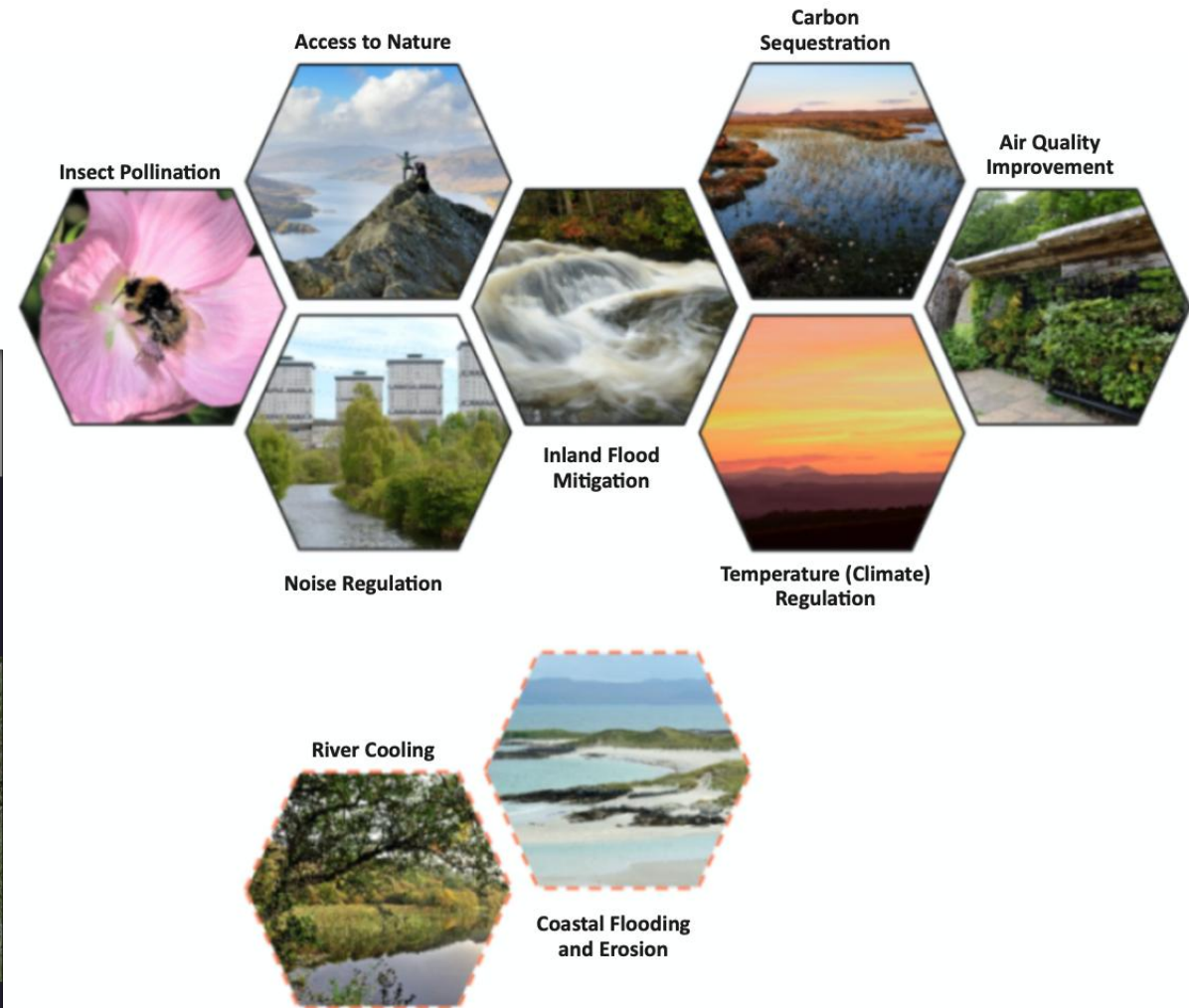
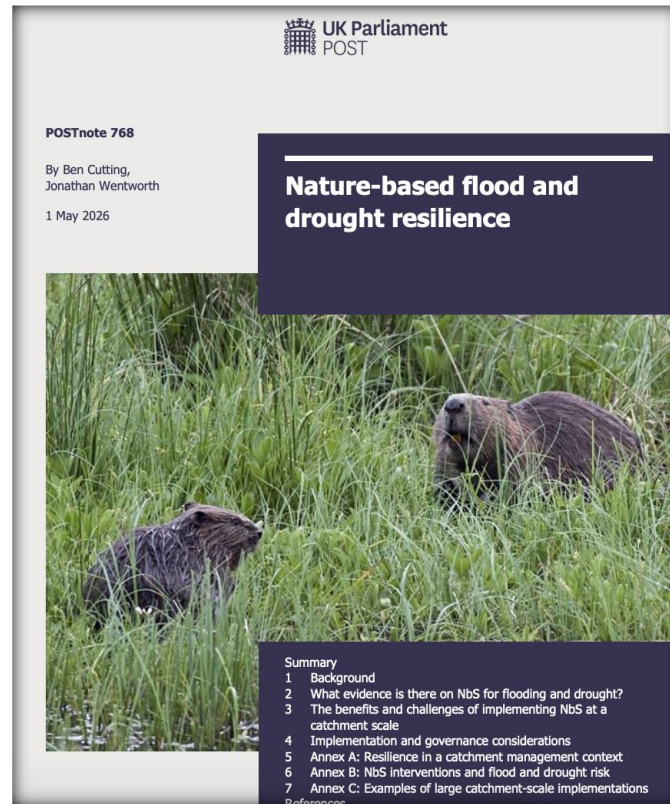
WHAT HAS CHANGED?

- Climate
- Understanding
- Our ability to analyse and manage systems
- Society



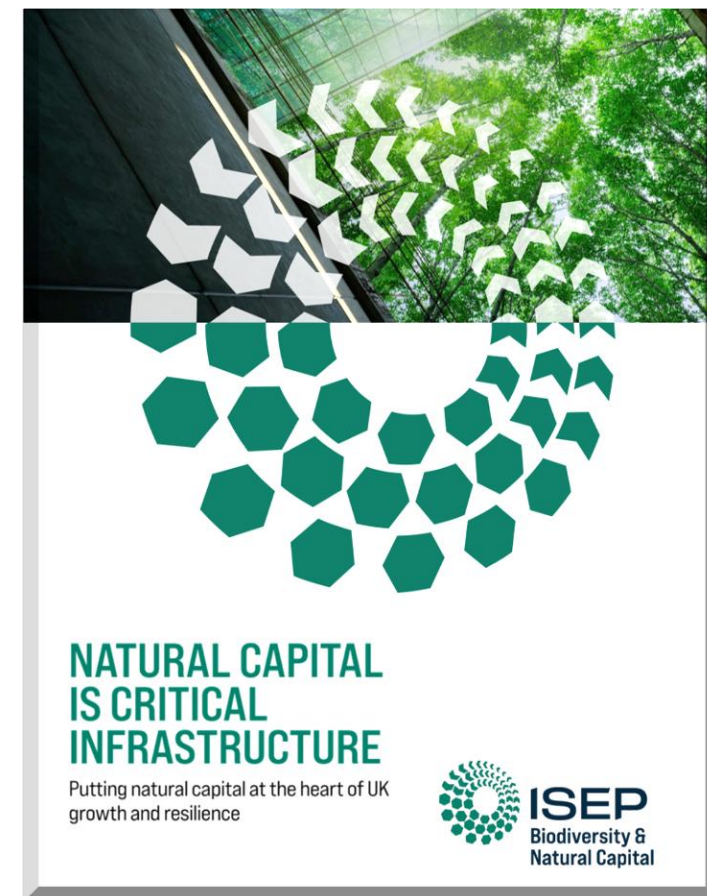
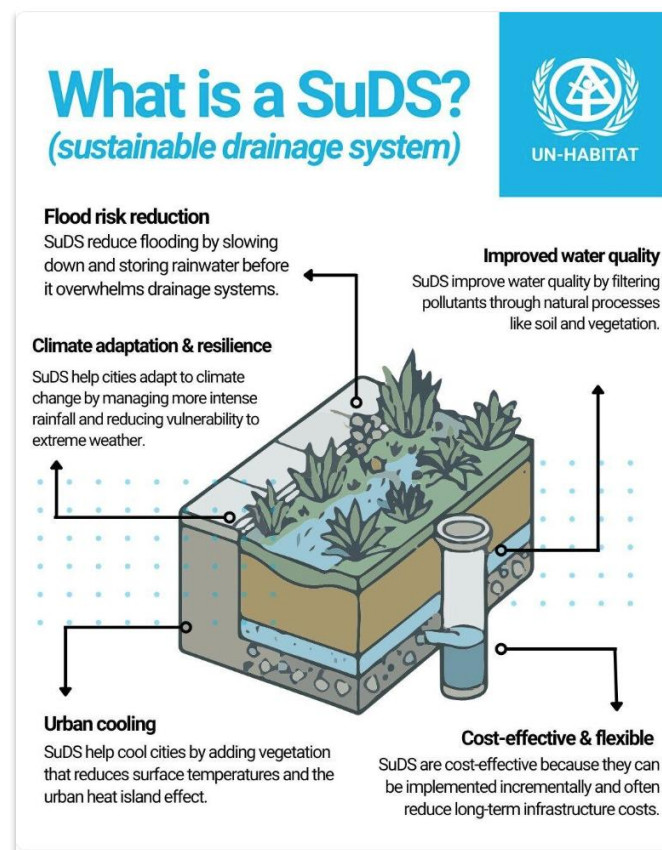
THERE IS A LOT MORE THAT CAN BE ACHIEVED FROM 'DRAINAGE'

- Multi-functional
- Delivering water management AND other benefits



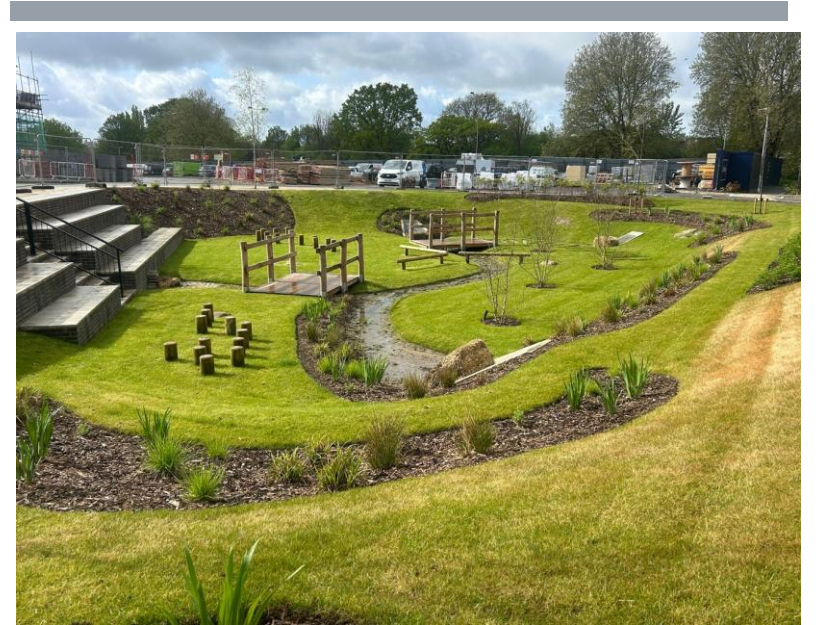
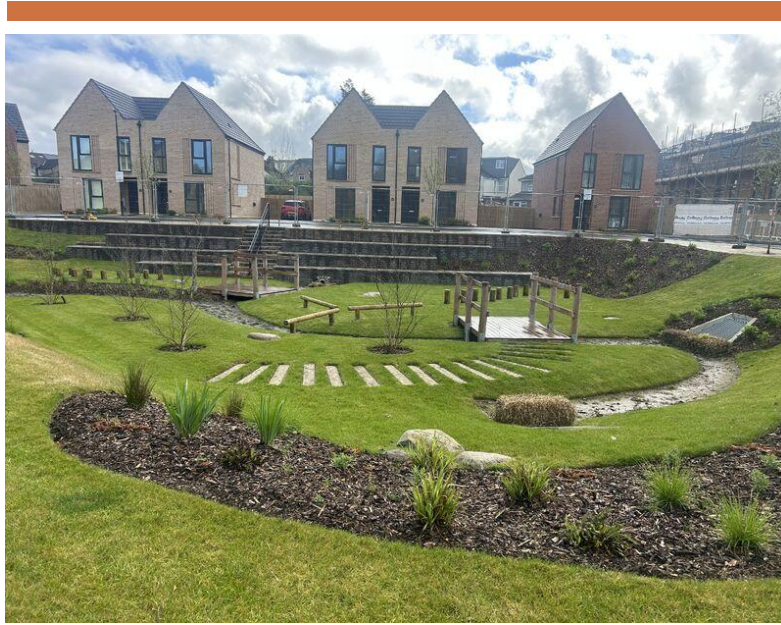
'SELLING' IT NOT AS DRAINAGE

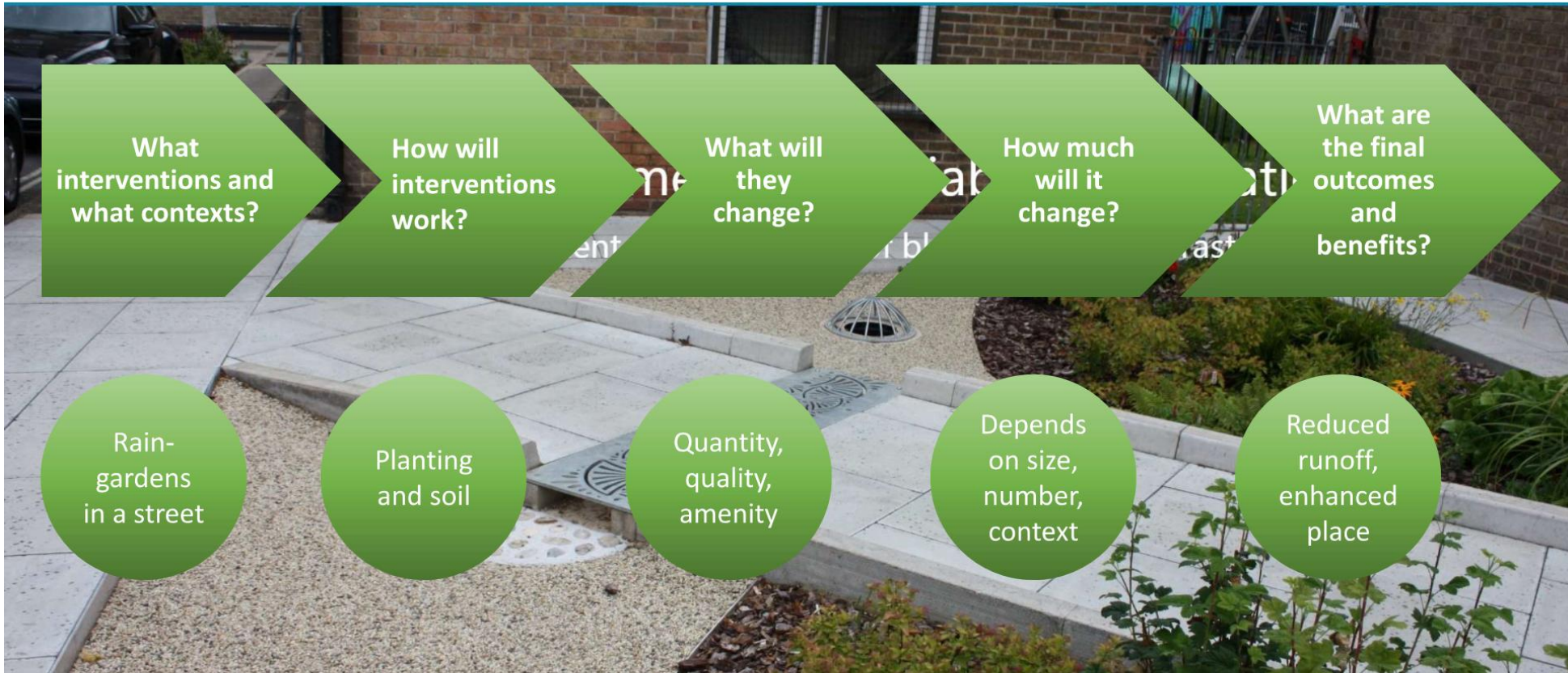
STORMWATER INFRASTRUCTURE
CAN BE AND IS CHANGING



MAKING PLACES

- It's easy when we are building from NEW





DELIVERING VALUABLE CHANGE

Looking at outcomes

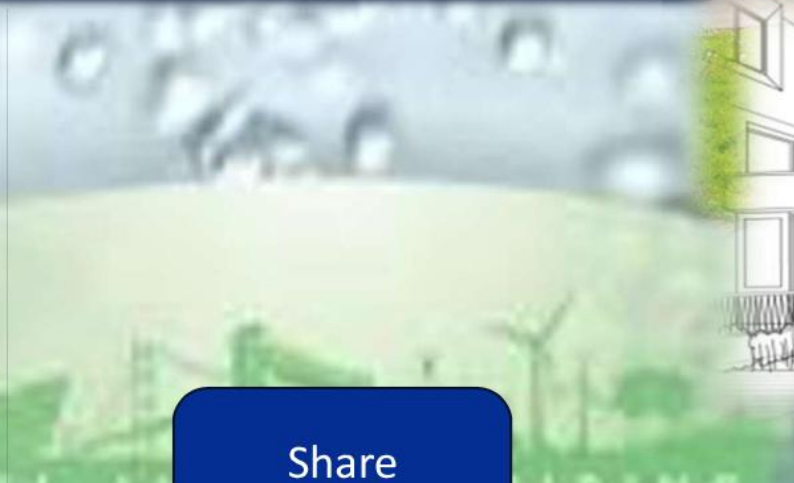
Reduce Flood Risk



Build Community Resilience



Share Knowledge



Enhance Economy

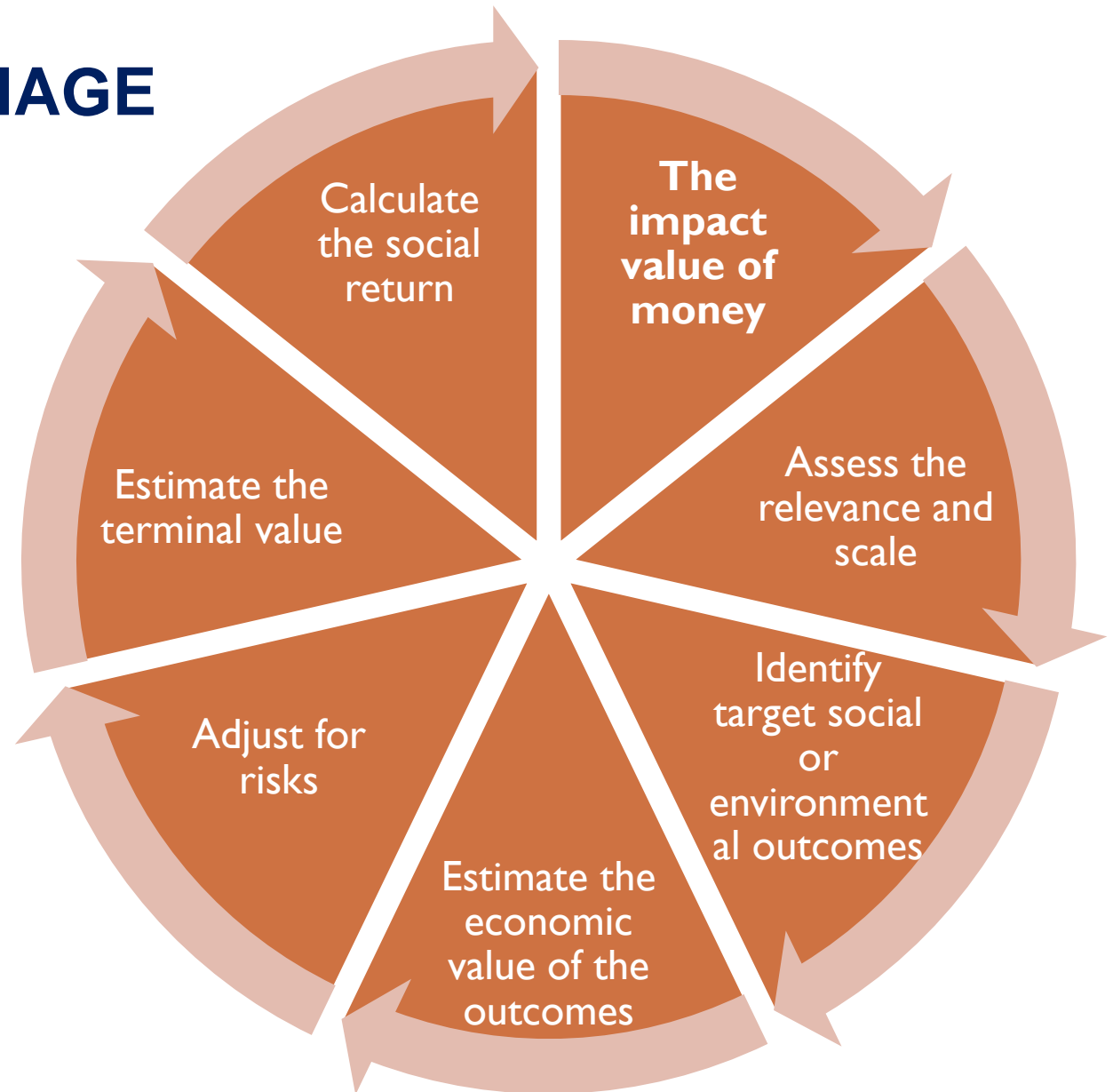


Improve Place



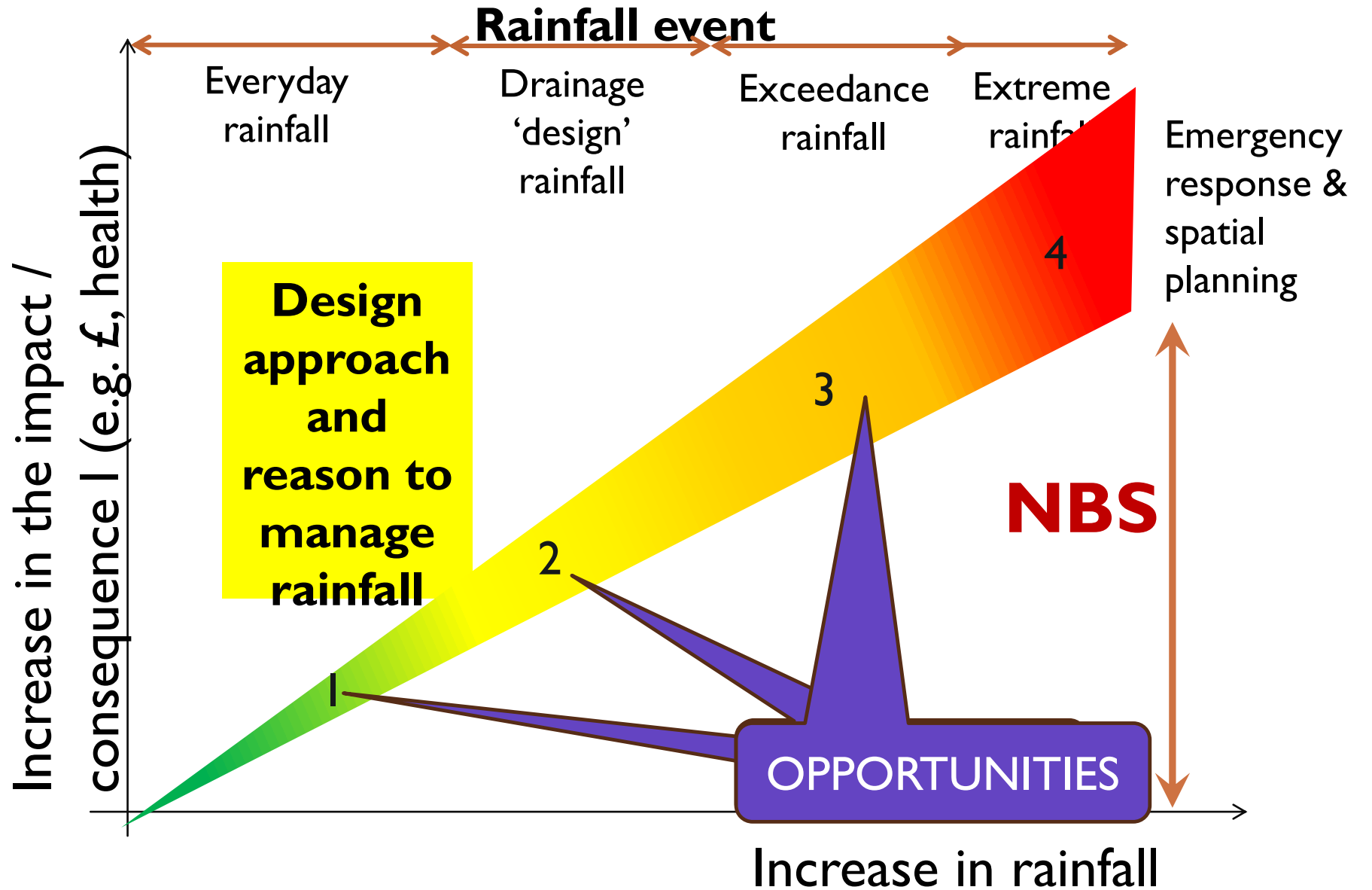
DELIVERING THE *NOT* DRAINAGE

- Some recent experiences
 - Making the business case(s)
 - Sustainable – how?
 - Looking to the future



DESIGNING 'DRAINAGE'

DON'T FORGET THE PRIMARY FUNCTION





UNDERSTANDING THE VALUE OF MULTIFUNCTIONAL NBS



NATURE-BASED INFRASTRUCTURE
GLOBAL RESOURCE CENTRE

Integrated Cost-Benefit Analysis for Nature-Based Solutions

A handbook for using the
Sustainable Asset Valuation
methodology

IISD REPORT

Supported by



Led by



HOW DO WE VALUE NATURE?

Ecosystem services

The services provided by ecosystems giving benefits to humans in the form of security, goods and materials, health and wellbeing

Natural capital assessment

Natural assets in their role of providing natural resource inputs and environmental services for economic production; comprising three principal categories: natural resources stocks, land, and ecosystems



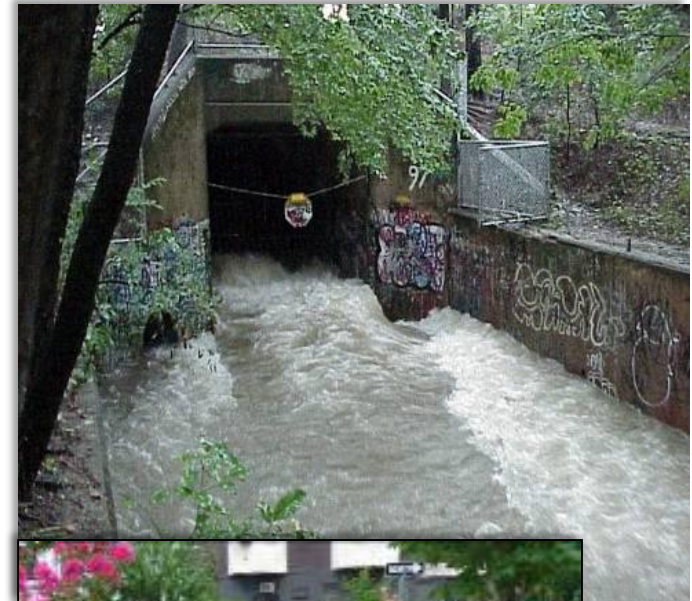
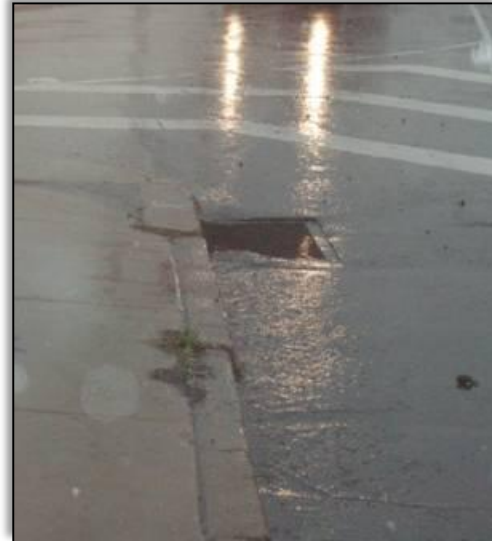
££££££££££££££££

What is possible? How do we account for the benefits and should we?



THE STORMWATER CHALLENGE: PHILADELPHIA'S GREEN CITY CLEAN WATERS PROGRAM

- Combined sewer overflow problems
- Tradition: Collect it and pipe it away quickly!
- Instead add-value by using BGI



In Philadelphia

Be

GREEN STORMWATER INFRASTRUCTURE IMPACT ON PROPERTY VALUES



30 foot sewer
tunnel option
\$million

Increased recreational

Improved

Reduction

Water qu

Wetland services

Social costs avoided by

Air quality

Energy savings/usage

Reduced (increased) d

emissions

Reduced (increased) d

Disruption costs from

Total

Total a

structure

Who pays? Who benefits?

(2.5)

(45.2)

(5.9)

(13.4)

122.0

photo credit: Philadelphia Water Department

GI valuation tool:
I Technology, USA:
values-calculator



Air Quality
Remove pollutants
£000 Benefit

Amenity
Improve a place's look and feel
£000 Benefit

Asset Performance
Reduces flows to pump and treat
£000 Benefit

Biodiversity & Ecology
Enhances the natural environment
£000 Benefit

Building Temperature
Reduces heat stress
£000 Benefit

Carbon Reduction
Soaks up carbon & less used by assets
CO₂
£000 Benefit

Crime
Contribute to safer neighbourhoods
£000 Benefit

Economic Growth
Enable investment through nicer places
£000 Benefit

Education
Supports teaching and engagement
£000 Benefit

Enabling Development
Increase value of developments
£000 Benefit

Flooding
Manages surface water
£000 Benefit

Health
Improves wellbeing
£000 Benefit

Noise
Soaks up noise
£000 Benefit

Recreation
Encourages activity and use
£000 Benefit

Tourism
Encourages more visits
£000 Benefit

Traffic Calming
Can help slow down vehicles
£000 Benefit

Water Quality
Remove pollutants and manage water
£000 Benefit

Water Quantity
Reduces demand through re-use
£000 Benefit



UK has developed a valuation tool

B£ST

-  Natural Capital
-  Human and Intellectual Capital
-  Social Capital
-  Manufactured Capital
-  Financial Capital



Valuation approaches used in B£ST

Benefit category	Valuation approach	Units
Air quality	Damage cost	£ per tonne pollutant
Amenity	Value transfer (hedonic)	% house price change
Biodiversity and ecology	Value transfer	£ per hectare
Building temperature	Long-run variable cost	£ energy saved
Carbon reduction & sequestration	Marginal abatement cost	£ per tonne
Education	Avoided investment	£ per school trip
Flooding	Damage cost	£ per property
Groundwater recharge	Avoided abstraction cost	£ per cu mtr
Health	Avoided health costs	£ per person
Pumping wastewater	Long-run variable cost	£ energy saved
Rainwater harvesting	Avoided investment	£ per cu mtr
Recreation	Value transfer (travel cost)	£ per visit
Treating wastewater	Avoided treatment cost	£ per cu mtr
Water quality	Value transfer (stated pref)	£ per km

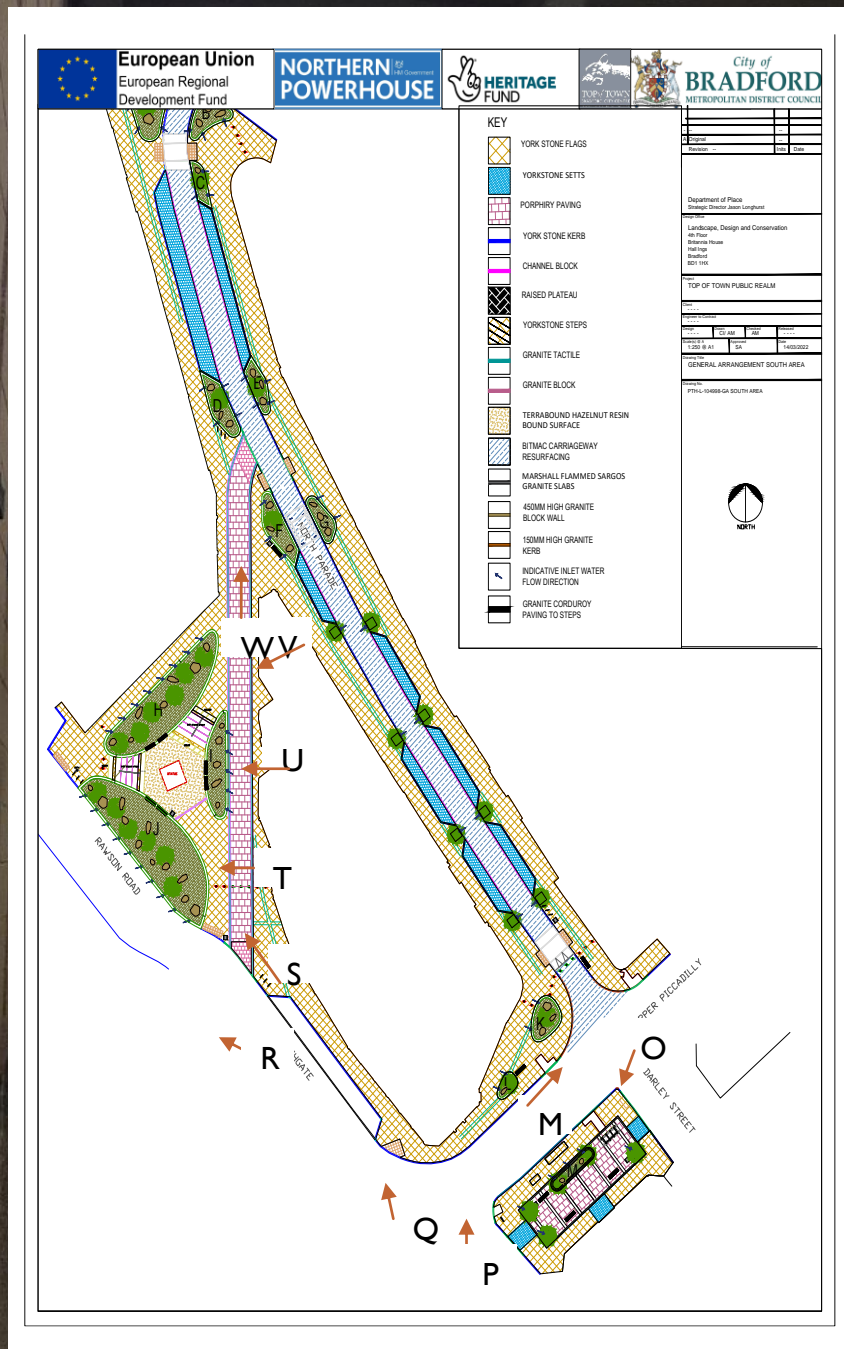


Welcome to ciriabest

Assessment of the benefits of blue and green infrastructure.



Examples of use



I. BRADFORD - INNER CITY REGENERATION



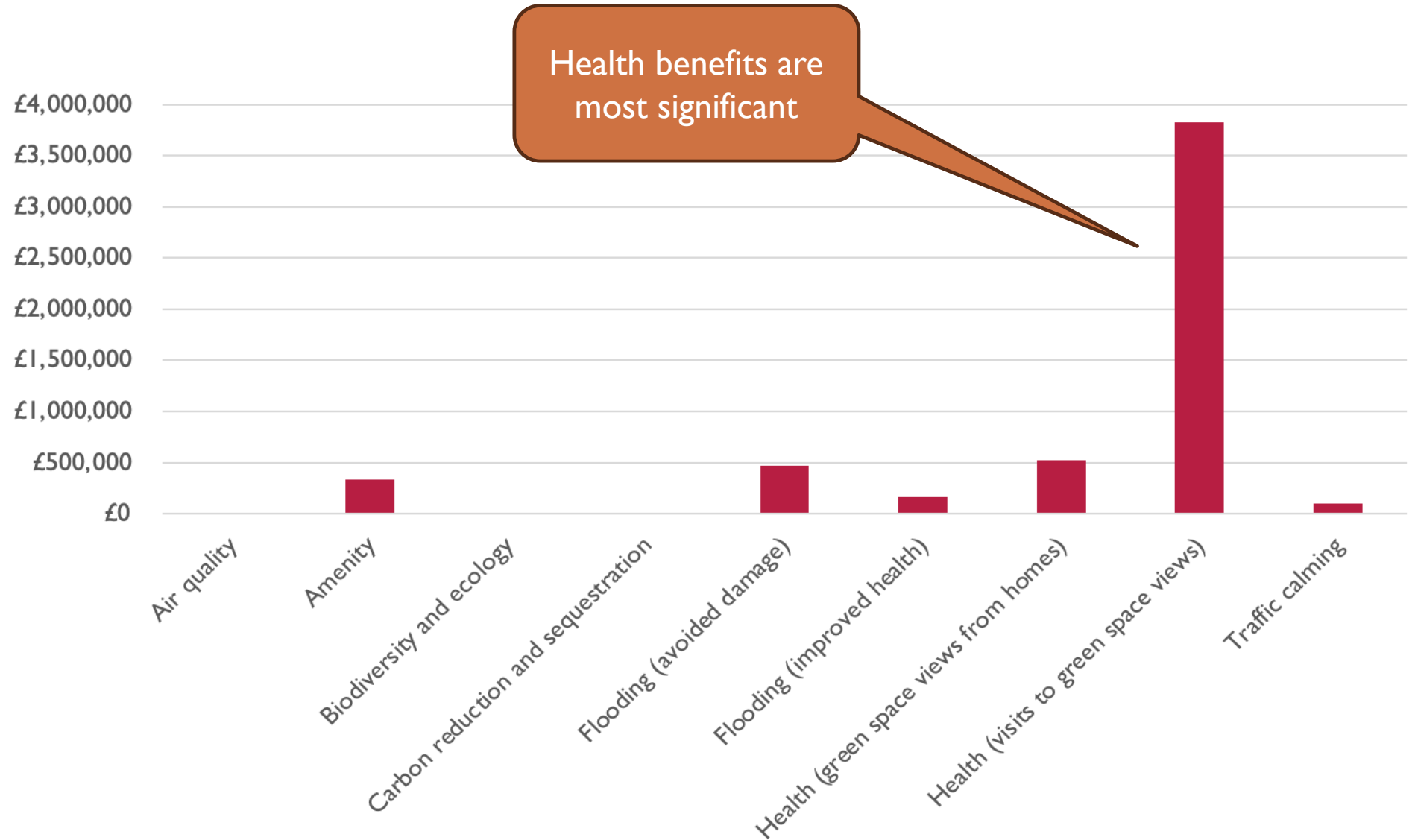
TOP OF THE TOWN - BRADFORD





STREET SUDS

Net Present Value
£1,591,874
Benefit Cost Ratio 1.6



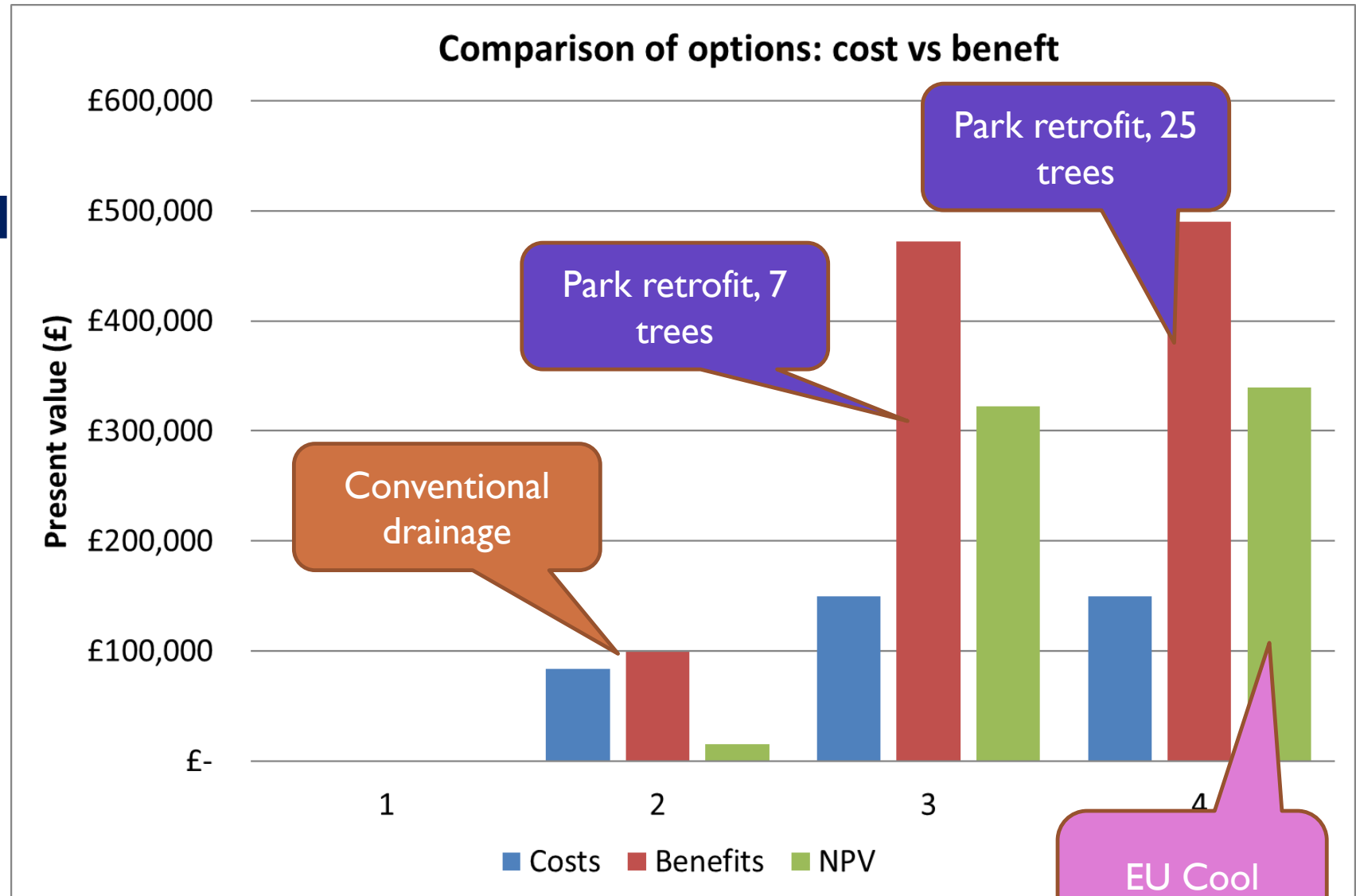


2. GEORGE V PARK MARGATE

- Major problems downstream
 - Areas of medium to high surface water flood risk in the highways surrounding the park
 - Downstream flooding around 1km east of George V Park within the vicinity of the railway bridge near Margate Railway Station.
 - The latter is related to a **lack of capacity within the surface water sewer** (Southern Water)



COMPARING OPTION – GEORGE V PARK REDUCING NEIGHBOURHOOD FLOODING



<https://www.interreg2seas.eu/en/cooltowns>

EU Cool Towns project

3. RETROFIT CASE STUDY ROUNDHAY PARK CATCHMENT LEEDS

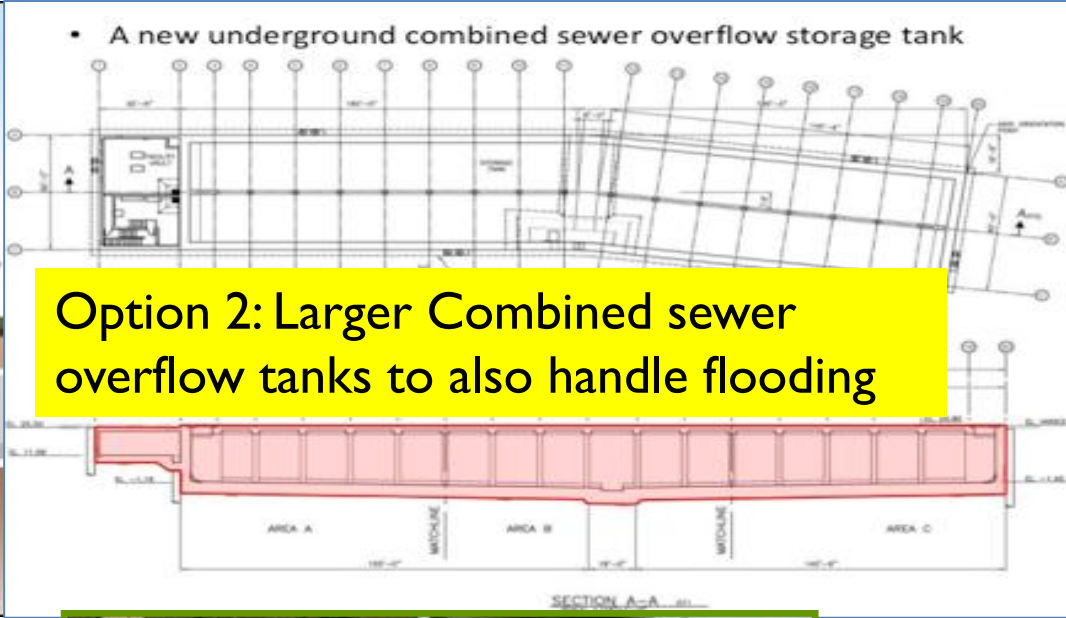
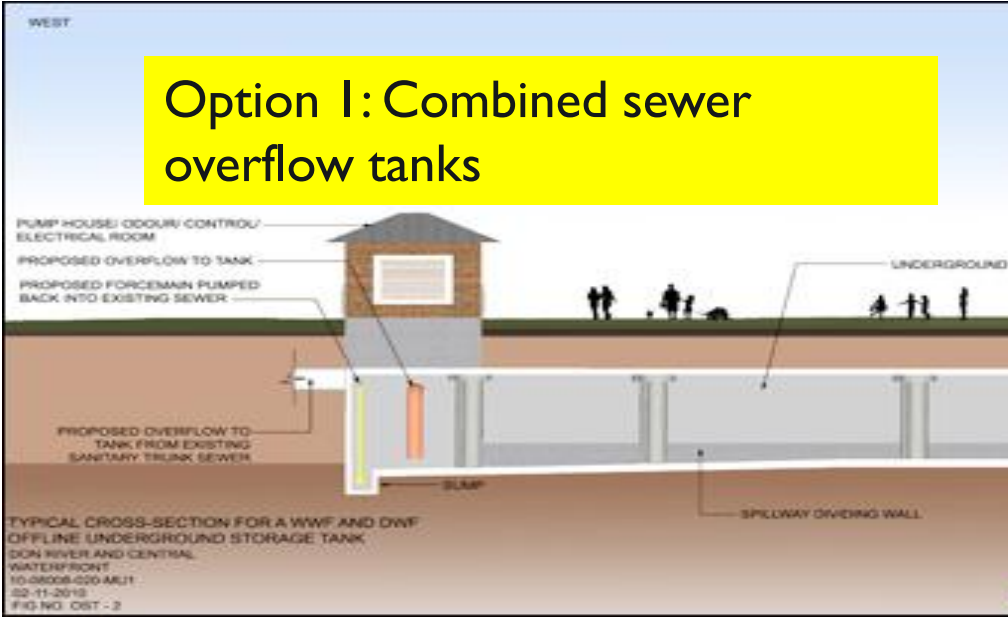
EU Water Framework Directive compliance

Protect the habitat of the White Clawed Crayfish

Control the many combined sewer overflows in the catchment

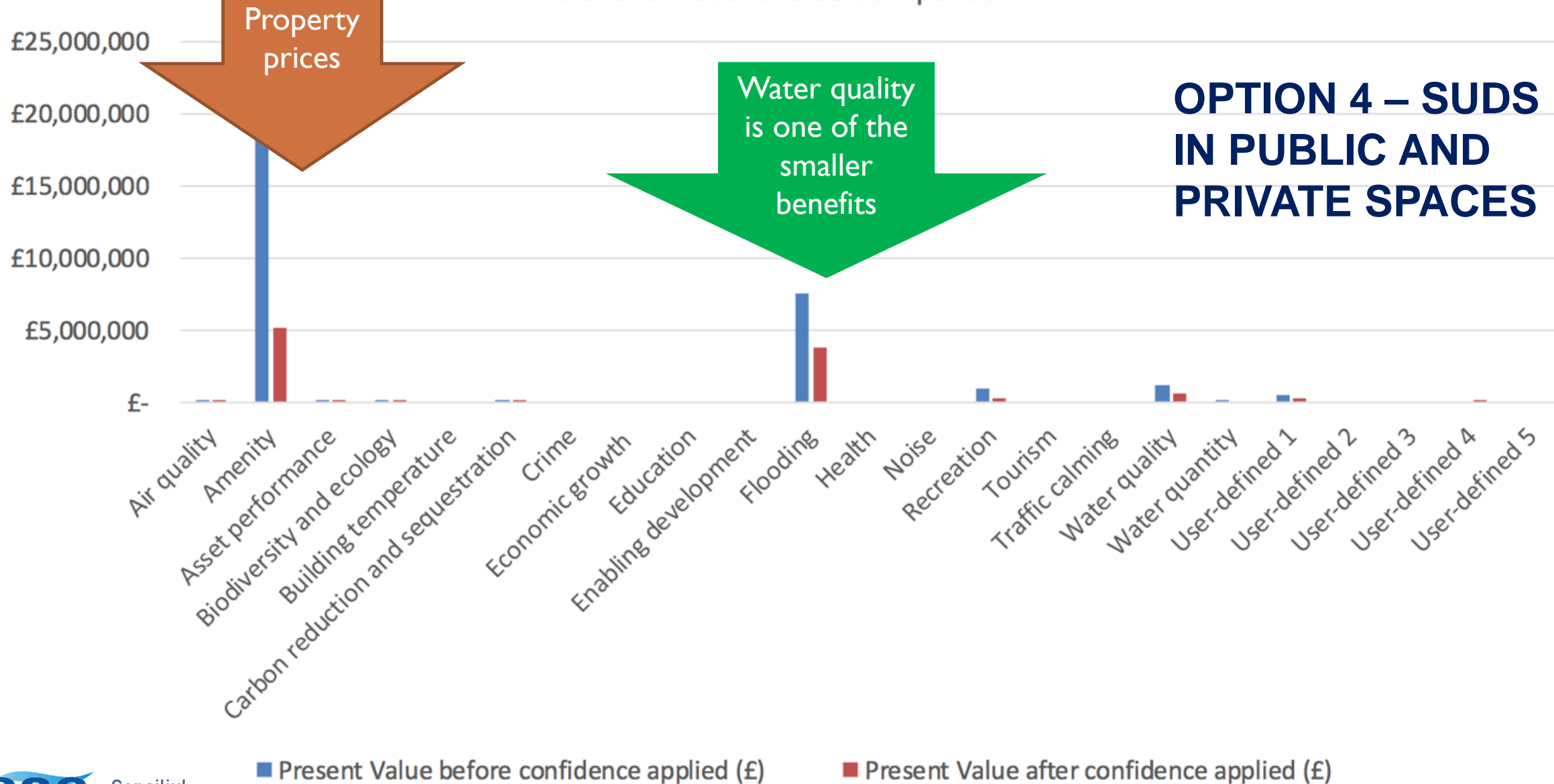


Options considered



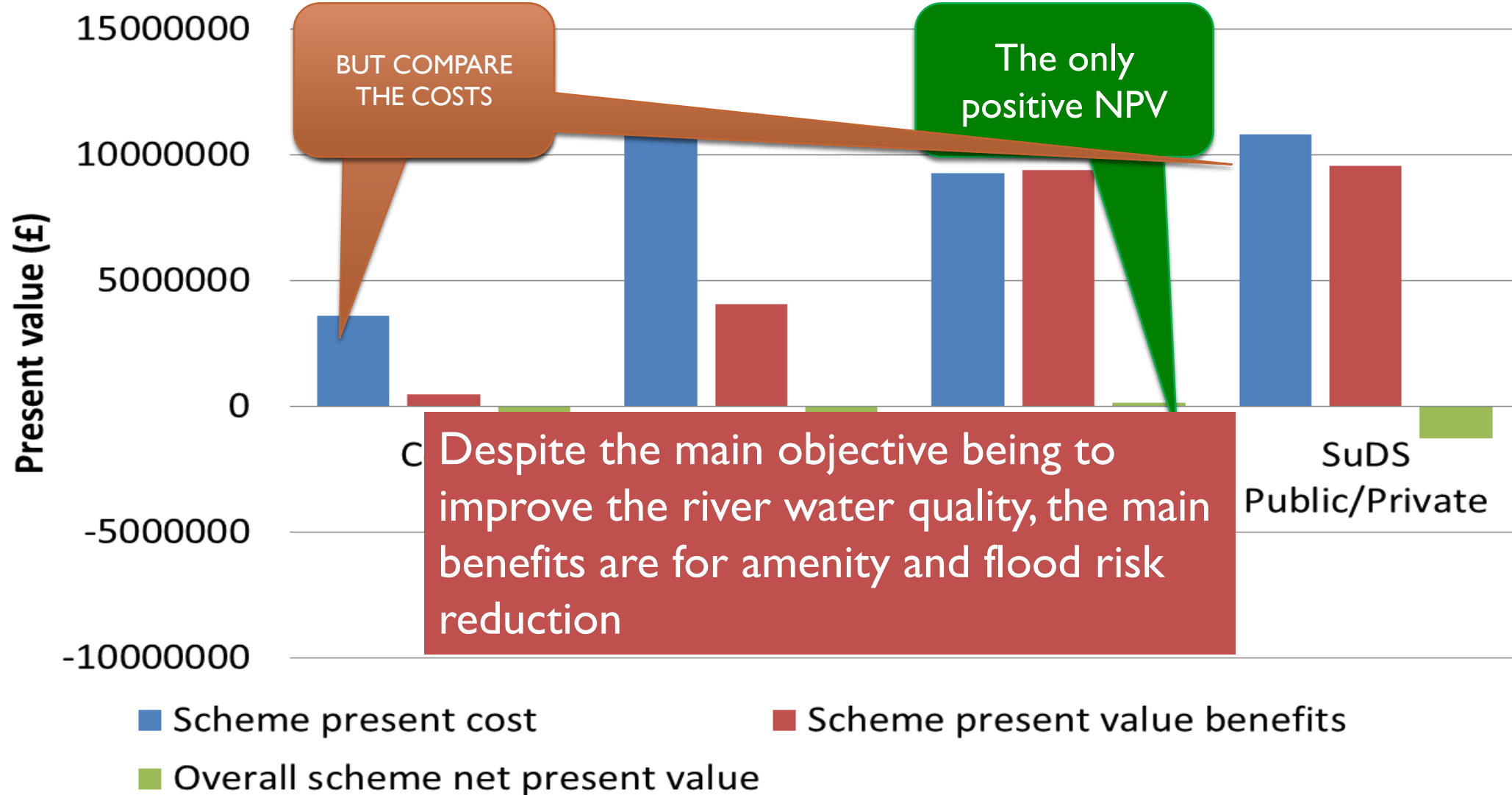
Retrofit SuDS in Islington
CIRIA

Benefit Present Value Comparison



**OPTION 4 – SUDS
IN PUBLIC AND
PRIVATE SPACES**

Comparison of options: cost vs benefit



Retrofitting for Combined sewer overflow control

- BGI provides numerous added benefits
- BUT.... PV costs of £10,825,125, with a benefit cost ratio of 0.9
- Traditional option PV costs are £3,706,120 with BCR of 0.2



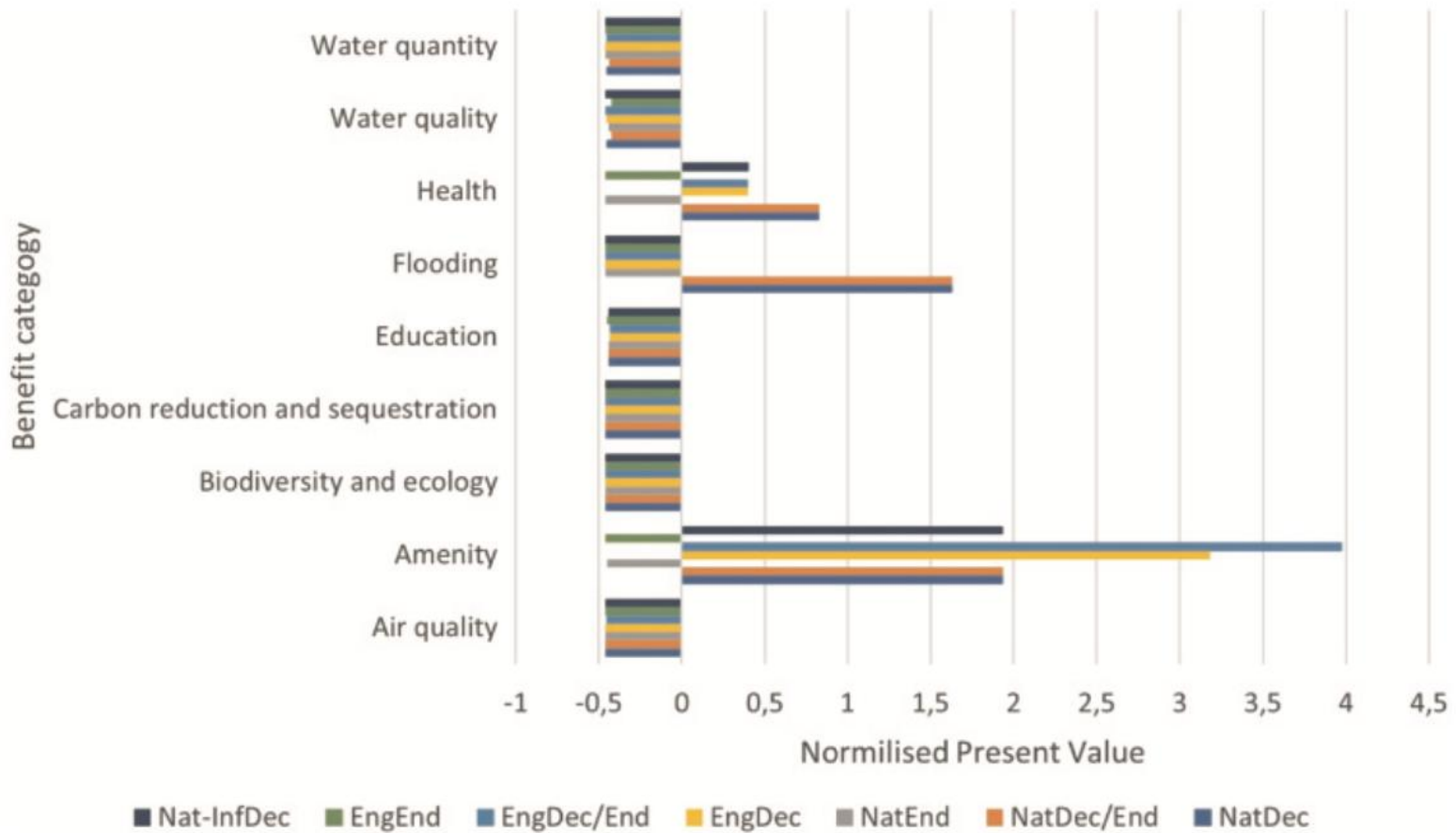
Benefit category	Total PV Benefits (40 years)	
	Traditional Option 1	BGI Option 4
Air quality		£22,397
Amenity		£5,164,098
Asset performance		£1,517,777
Biodiversity and ecology		£1,517,777
Carbon reduction and sequestration	£-1,375 (negative)	£1,517,777
Flooding		£3,745,984
Pumping wastewater	£-5,127 (negative)	
Recreation		£252,261
Treating wastewater	£-9,794 (negative)	
Water Quality	£613,920	£571,025
User defined		£247,469
Total	£597,624	£10,062,056

Who pays?

Who benefits?

Costs £3,706,120

Costs £10,825,125



MAKING THE
CASE – BEYOND
FINANCE
ALONE

Sustainability assessment has never been properly developed
But, it is still possible to assess which option is likely to be more sustainable than another

CRITERIA - EXAMPLES

■ Economic

construction costs and maintenance

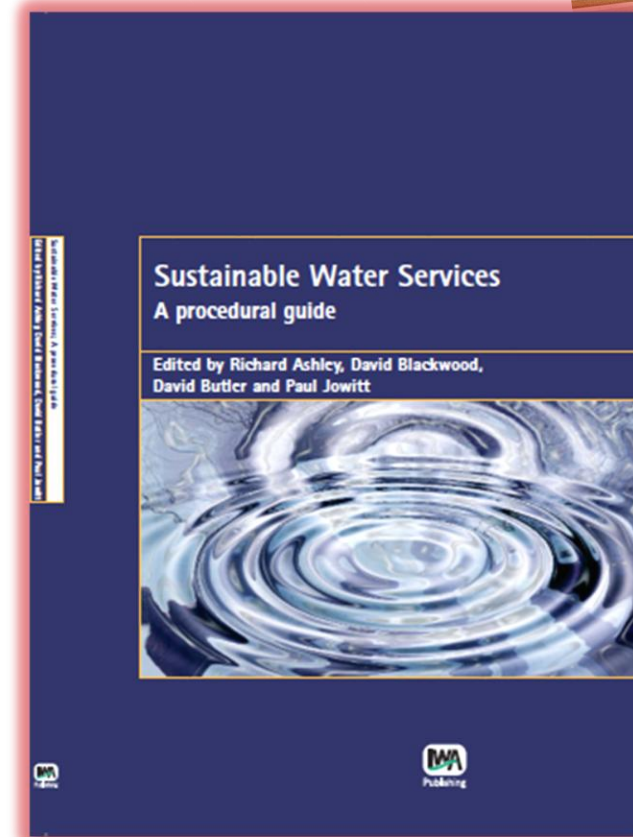
■ Social

amenity (from street improvements including the planting of trees and green verges)

human toxicity (toxicological response of chemical emissions incurred by the bioretention systems)

■ Environmental-Technical

impacts and performance



4. WHAT DESIGN OF RAINGARDEN IS LIKELY TO BE THE MORE SUSTAINABLE?

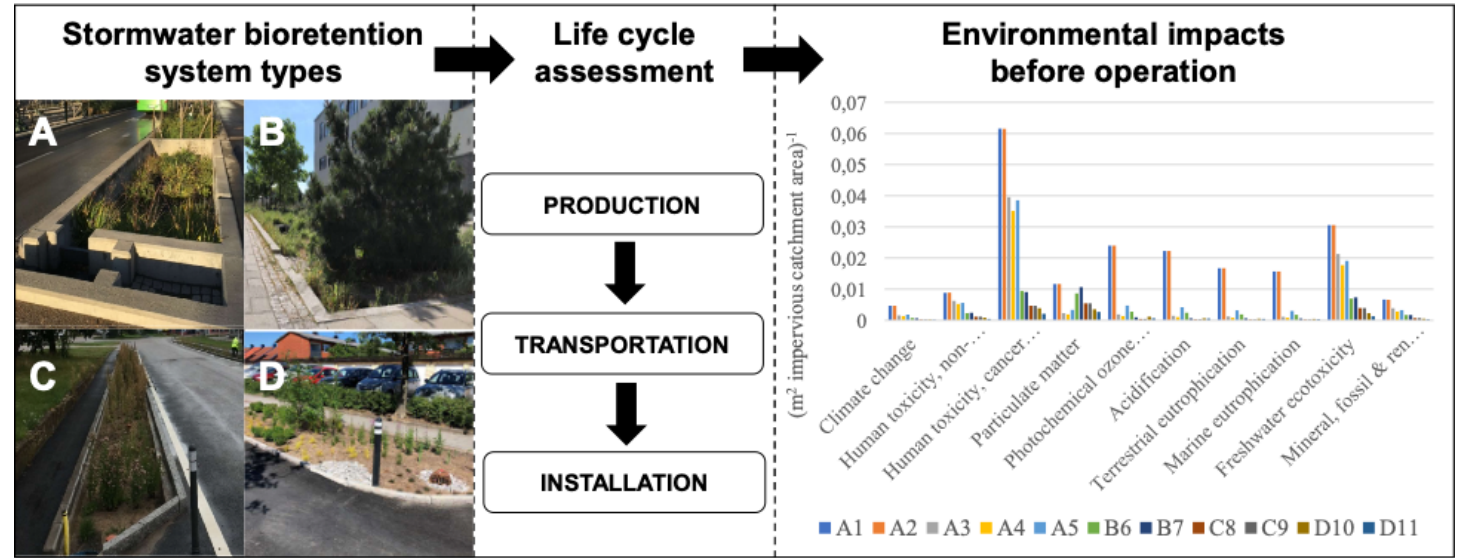
- Davidshall, Malmö, Sweden



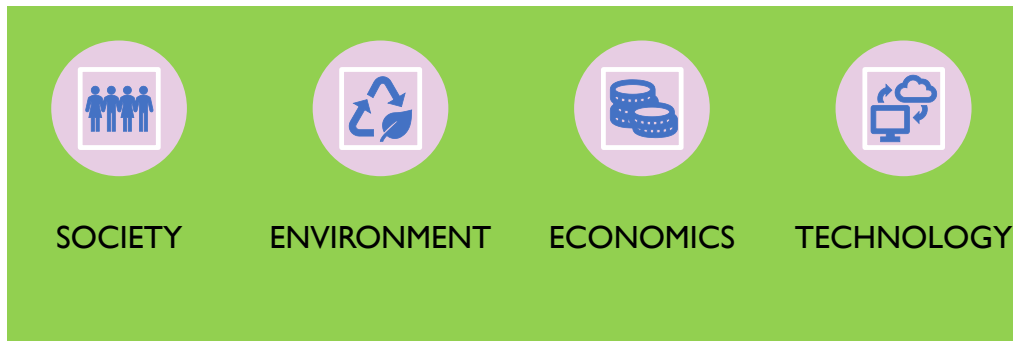
UNDERSTANDING THE IMPACTS - ENVIRONMENT

Building blue-green systems is not without impact






- How the design details can impact... more or less



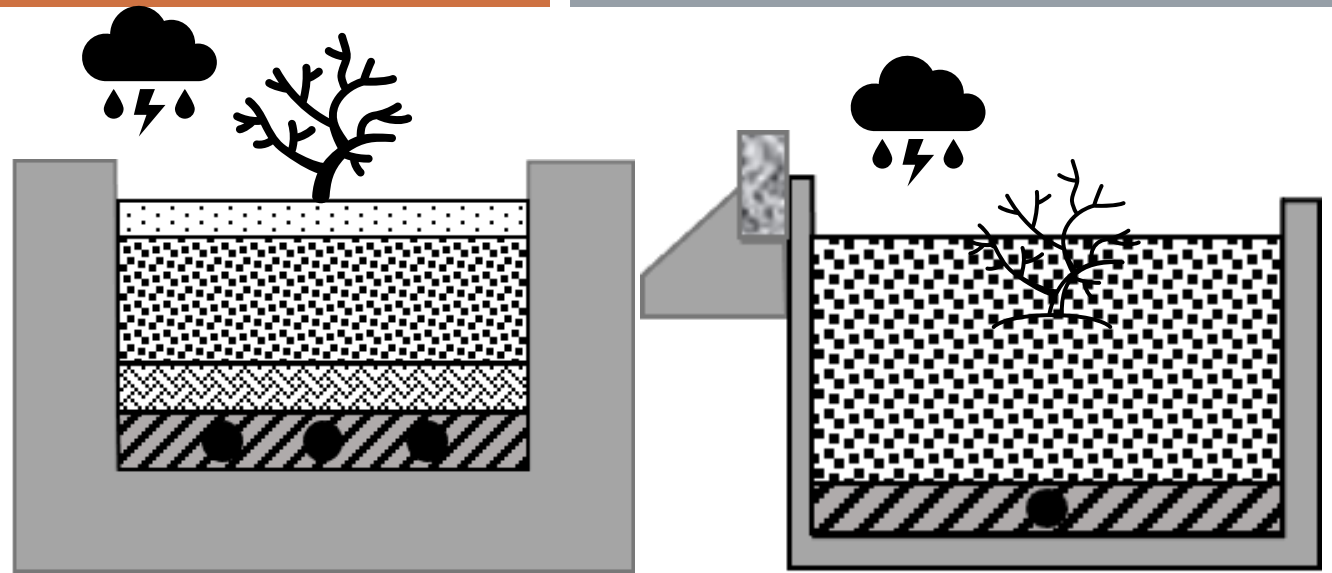
- All rain gardens are designed to remove pollutants from street runoff and also to slow down the flow
- They can also provide attractive streets and slow traffic
- How you design and build your bioretention system creates more or fewer impacts



TYPES OF BIORETENTION SYSTEM EXAMINED - 12 IN TOTAL

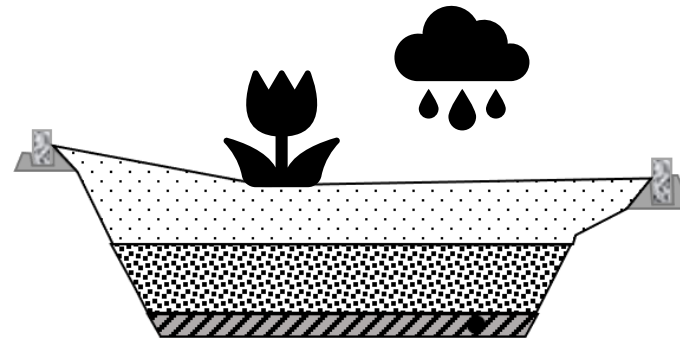
-  Concrete
-  Kerb stone
-  Geotextile
-  Filter media mixture
-  Underdrain with embedded drain pipes

Sagrelius et al., 2021 & 2022

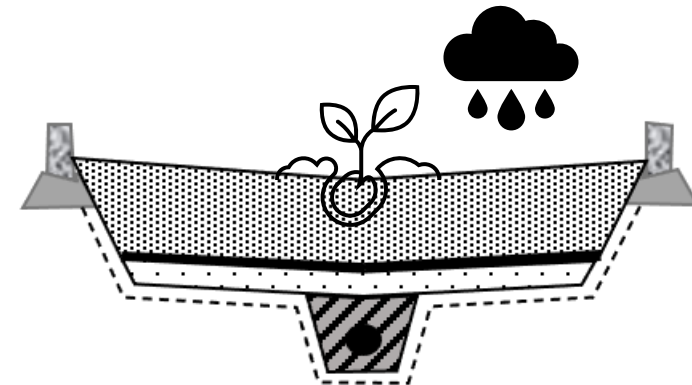


A

B

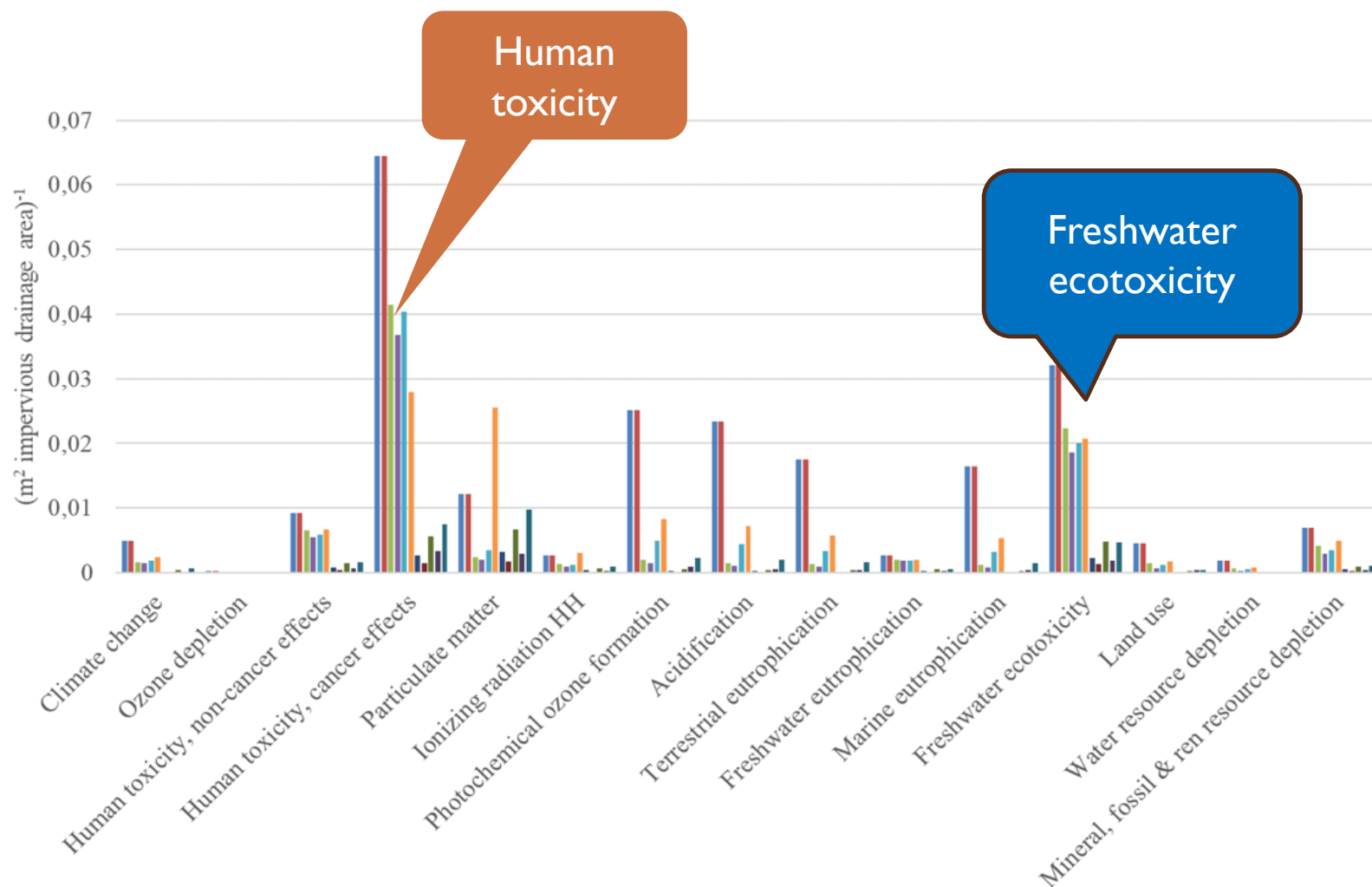


C



D

ENVIRONMENTAL IMPACTS – LIFE CYCLE ANALYSIS (LCA)



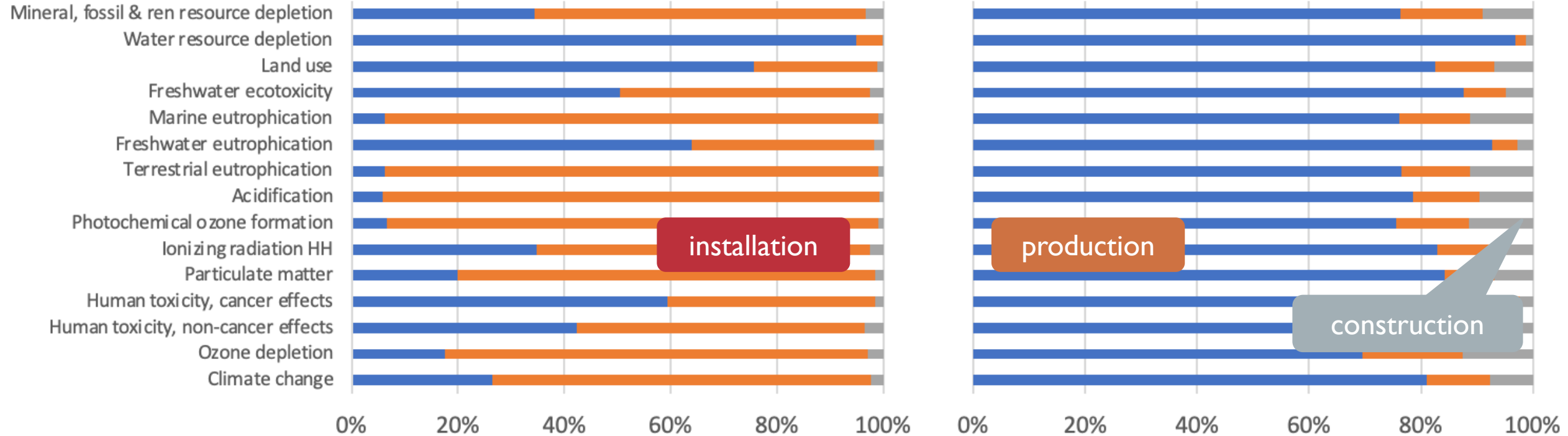
- Cradle to grave fate of chemicals and substances
- Applied using a functional unit of the treatment of 1m³ of surface water runoff
- Relative impact of each system normalized to equivalent catchment area drained



A1 (Type A)

Rain garden examined

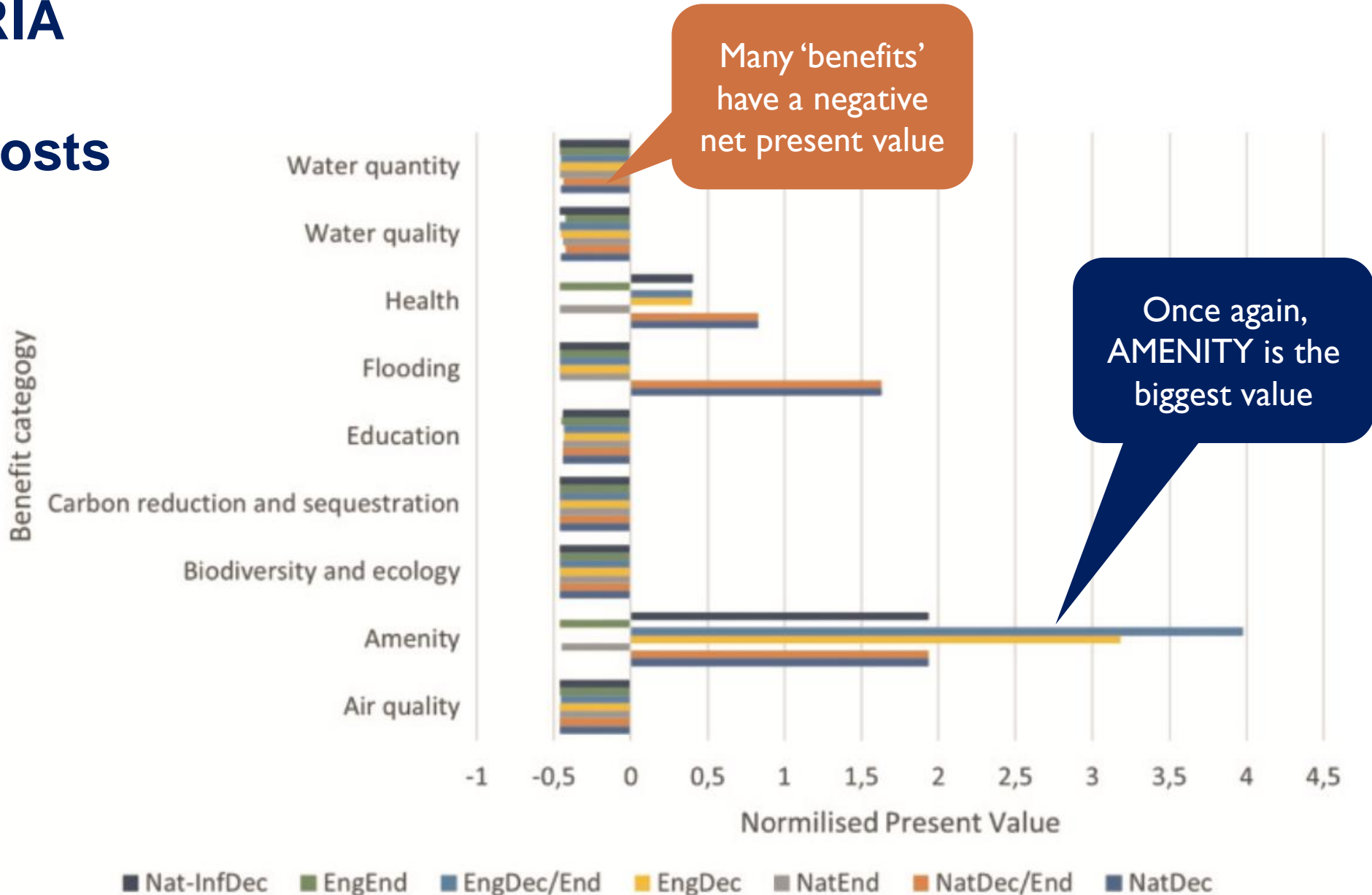
A4 (Type A)



WHERE ARE THE BIG IMPACTS?

- Use of concrete
- Type of filter media
- Transport distances for materials

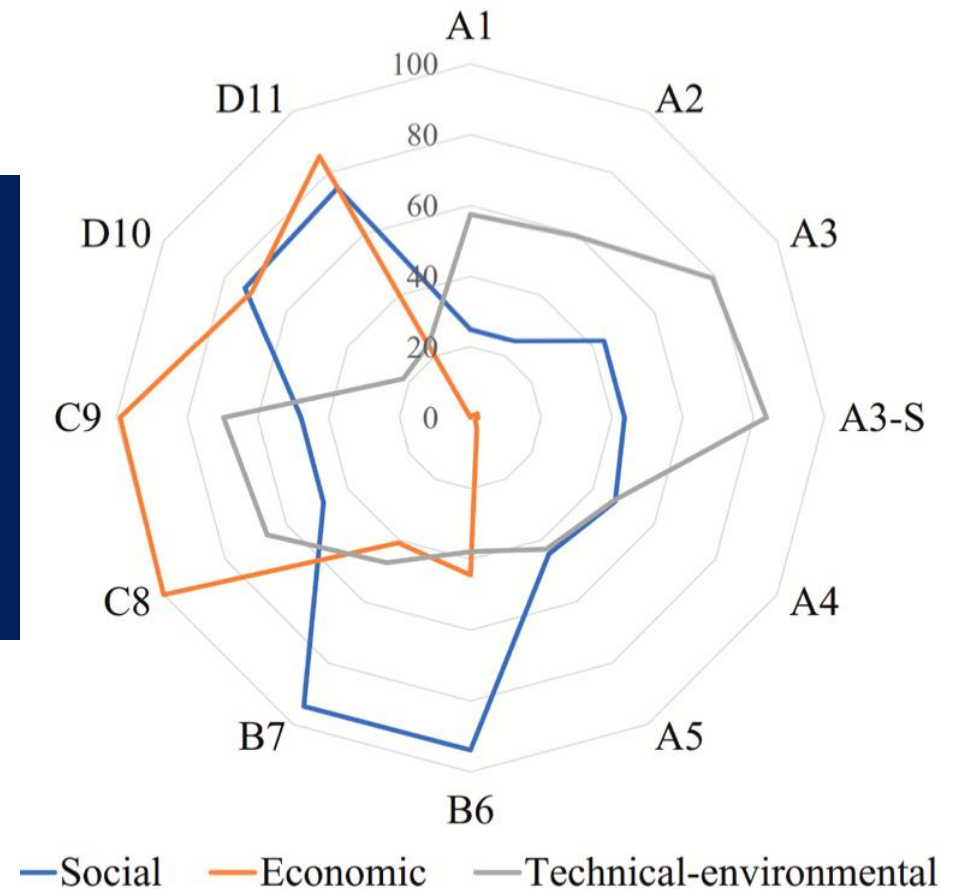
Applying CIRIA B&ST tool – benefits vs costs



VISUAL IMAGE OF SUSTAINABILITY ASSESSMENT

- One way of showing the results of sustainability assessment
- ££s
- Tonnes
- Preferences together

In this case, no one type of bioretention system is any more sustainable than another



SUDS / BGI / NBS WILL CHANGE OVER THE LIFETIME OF THE SYSTEM

Thinking about the future



Change is accelerating

- Climate
- Numbers of people
- Society
- Deterioration and maintenance needs
- People's needs
- People who own or operate

CONCLUSIONS ABOUT SUSTAINABILITY (INCLUDING VALUE) ASSESSMENT

- Sustainability assessment is still more of an art than a science
 - Still an ‘inventory’ based assessment (i.e. an accounting process)
 - Society (especially policy makers) don’t yet understand the shift to nature-based systems
- The beneficiaries are often NOT those intended to be served by the infrastructure
- The people who *have to pay* and the people who *should be paying* are frequently misaligned
- We are learning and still have a lot to learn

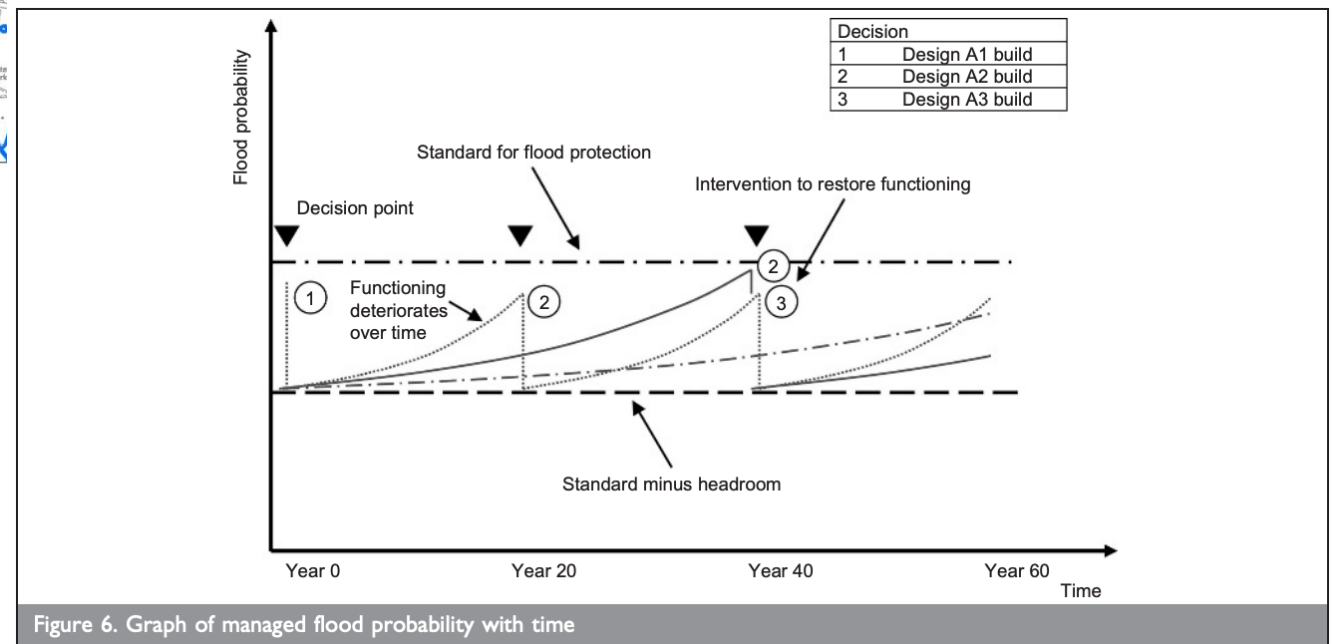
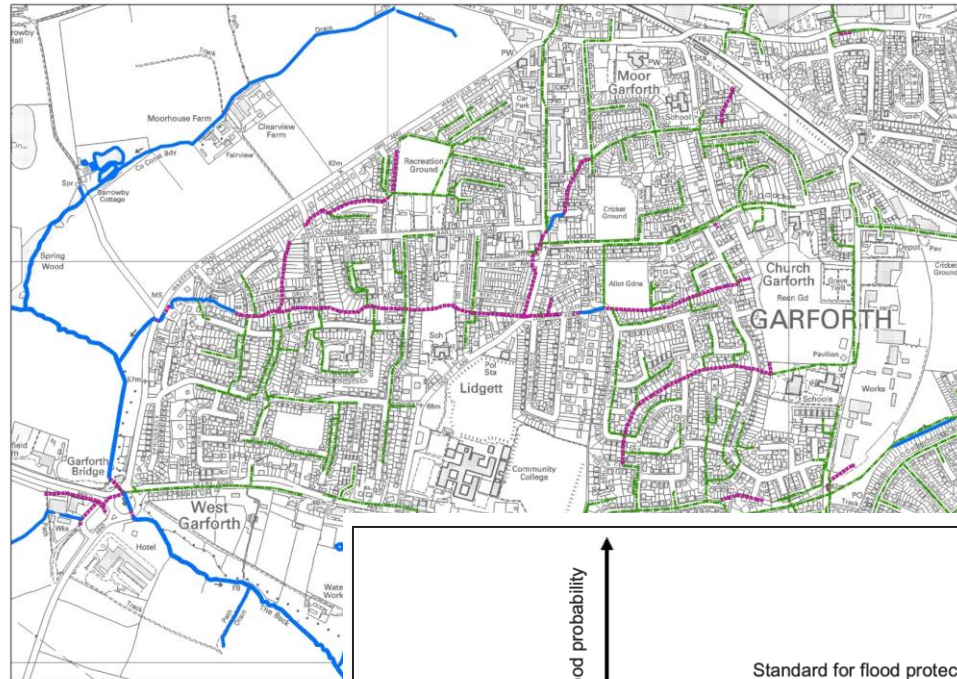


5. MANAGED ADAPTATION (PATHWAYS)

- If, then...

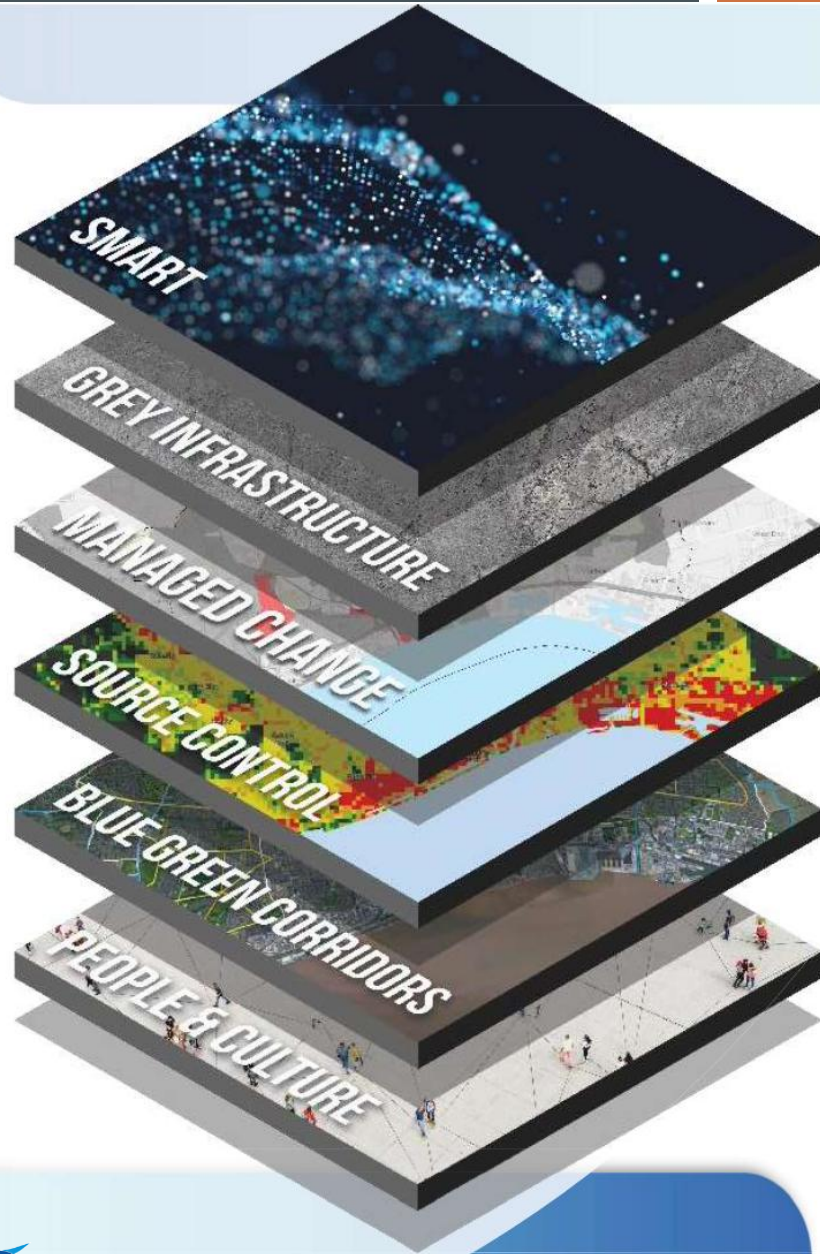
Introduce changes gradually and see if they work

Continue with those that show effectiveness



Gersonius et al 2010

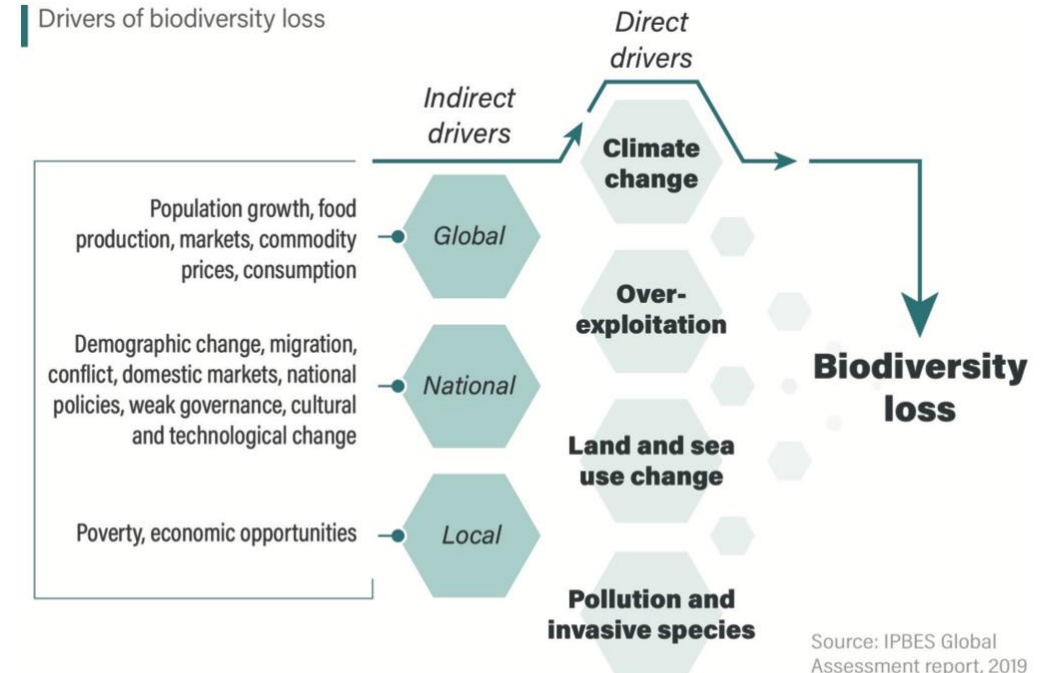
Figure 6. Graph of managed flood probability with time



A layered spatially connected strategy can be adapted over time

DELIVERING SWM INTO THE FUTURE – AXIOMS I

1. Plan approach
 1. Integrate with land use planning and across other systems
 2. To cope with climate change take a managed adaptive approach, promoting flexibility via diversity
2. Use the right technology
 1. Combination of NBS and traditional (pipes always needed)
 2. Utilise intelligent systems
 3. Maximise opportunity and multifunctionality



HM Government

Global biodiversity loss, ecosystem collapse and national security

A national security assessment

DELIVERING SWM INTO THE FUTURE – AXIOMS 2

1. Manage systems appropriately
 1. Operation and maintenance as important as new build
 2. Understand asset management needs and methods across traditional and NBS
 3. Utilise AI opportunities
2. Make the case
 1. Cultural change
 2. Persuade many groups
 3. Business cases
 4. Evidence – including for performance

1 Why is Blue Green Infrastructure important?

Blue Green Infrastructure (BGI) are natural and semi-natural solutions that provide a range of water management functions and other ecosystem services

Infrastructure

Blue Green natural/semi-natural systems

- Wetlands
- Green roofs
- Infiltration basin
- Bio-retention areas
- Swales
- Vegetated filter strips
- Vegetated swales
- Wet retention ponds
- Permeable pavements

Grey Infrastructure

- Water Treatment Plants
- Pipes
- Culverts
- Ditches
- Concrete tanks
- Energy provision
- Transport infrastructure

Drivers

- Climate emergency
- Biodiversity emergency
- Flood risk management
- Water quality management
- Carbon sequestration
- Air quality
- Urban heat
- Urban greening
- Public health
- Habitat provision
- Amenity provision
- Aesthetics
- Active travel

Built environment working in tandem with Blue Green systems

Facts and figures

- £650 billion will be spent on UK infrastructure in the next 10 years
- 70% of emissions come from carbon intensive grey infrastructure
- By 2030 the number of people impacted by floods will double

2 Blue Green Infrastructure needs an Integrated Approach...

Asset Management
"Co-ordinating activity of an organisation to realise value from its assets."

Asset Life Cycle Management

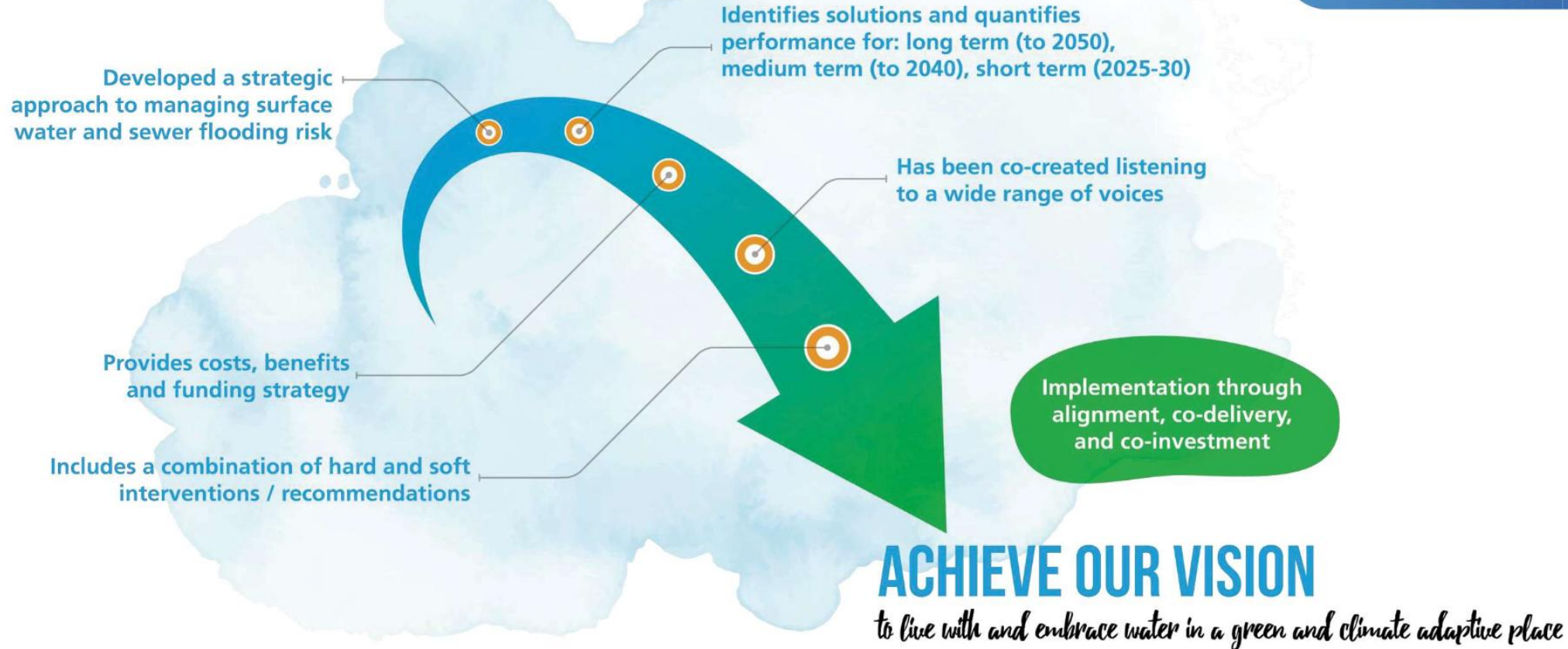
ACQUIRE → OPERATE → MAINTAIN → DISPOSE

Enabled by

- Long term planning
- Asset data and information
- Informed decision making
- Performance management
- System thinking
- Stakeholder engagement and collaboration

Blue Green infrastructure should be subject to the same asset management approaches and rigour we apply to grey infrastructure, like water mains, sewers, roads etc.

The Blue Green Plan:



ADD

V A L U E

THANK YOU!

Emeritus Professor Richard Ashley
University of Sheffield, Great Britain
Adjunct Professor, Lulea Technical
University, Sweden

Email: r.ashley@sheffield.ac.uk