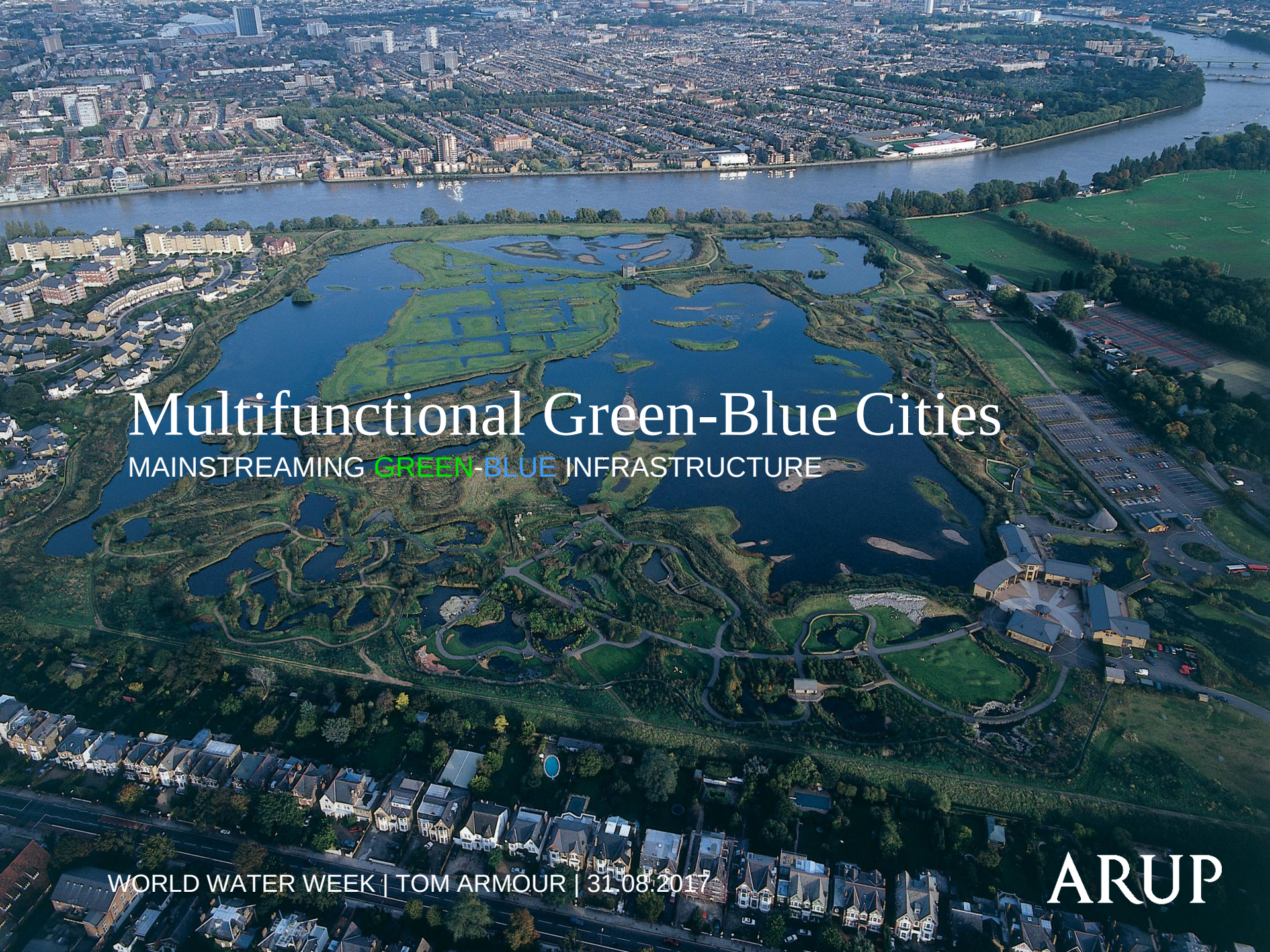


# Multifunctional Green-Blue Cities

## MAINSTREAMING GREEN-BLUE INFRASTRUCTURE

WORLD WATER WEEK | TOM ARMOUR | 31.08.2017

ARUP


# …by 2050, 70% will live in cities

* UNITED NATIONS – WORLD URBANISATION PROSPECTS (2010)


# Climate change is costing the world more than $1.2 trillion annually

CLIMATE CHANGE VULNERABILITY MONITOR (2015) - DARA GROUP AND CLIMATE VULNERABLE FORUM

Urban heat

Drought

Urban noise

Loss of urban green

Flooding

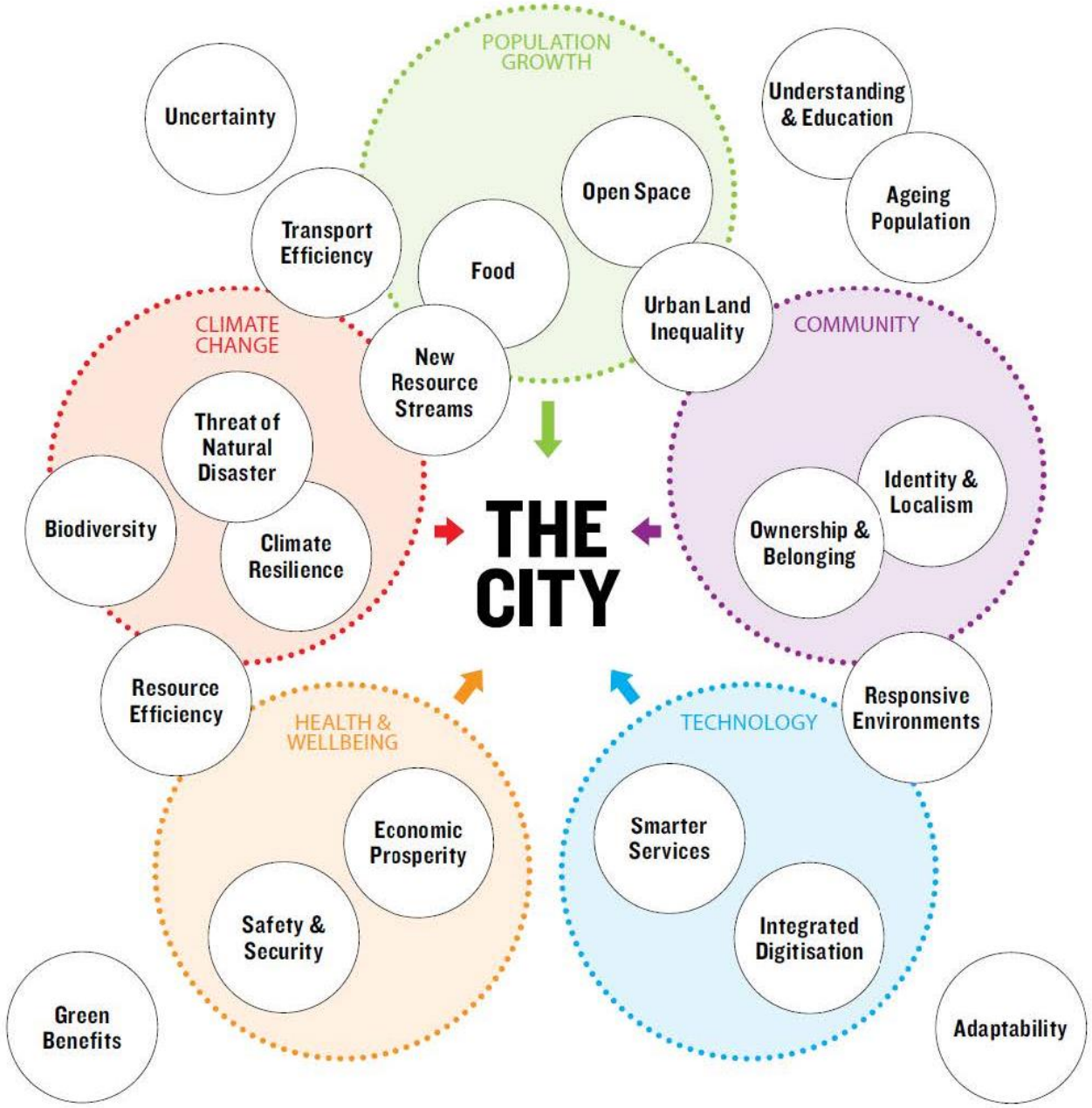
Air pollution

Stress

Health crisis

Mental health

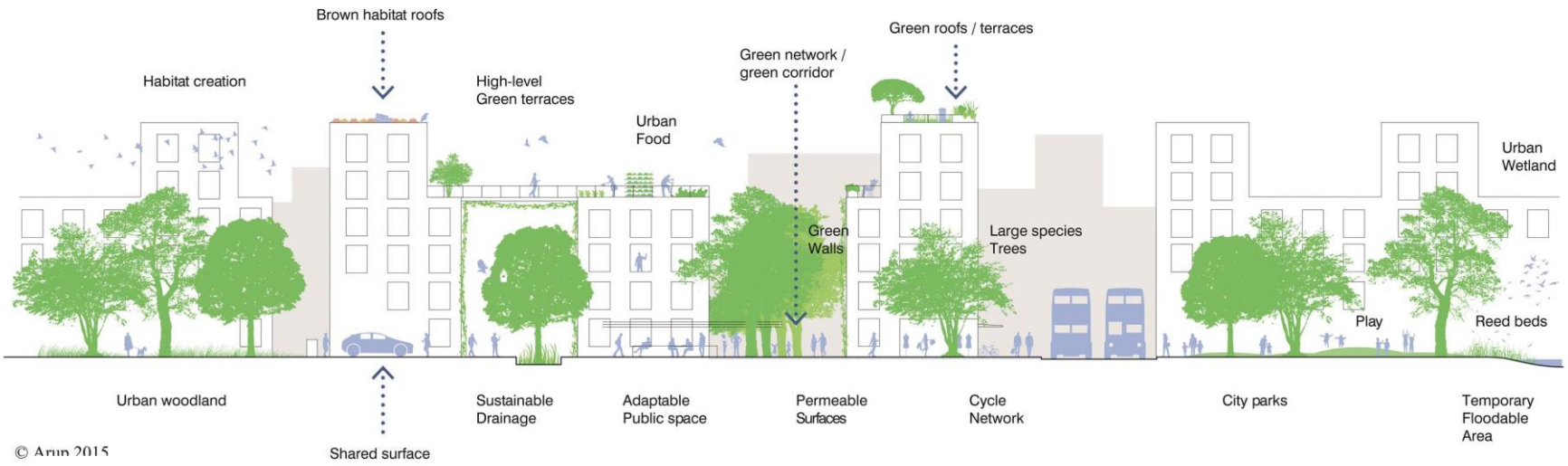

FIRE
WATER
FRONT
CHANGE
PEOPLES CLIMATE MARCH




CITY CHALLENGES

# Definition of green+blue infrastructure

‘Natural or semi-natural networks of green (soil covered or vegetated) and blue (water covered) spaces and corridors that maintain and enhance ecosystem services’




NAUMANN S, DAVIS M, KAPHENGST T, PIETERSE M, RATMENT M (2011) DESIGN, IMPLEMENTATION & COST ELEMENTS OF GREEN INFRASTRUCTURE PROJECTS, FINAL REPORT TO THE EU COMMISSION (ECOLOGIC INSTITUTE AND GHK CONSULTING)

= Green + blue interconnected natural systems that perform vital functions

- Climate proofing our cities
- Providing buffers from extreme weather
- Providing healthy, liveable environments
- Purifying water, soil and air

GREEN = CITY PARKS, OPEN SPACES, GREEN STREETS, URBAN SQUARES & PLAZAS, URBAN WOODLAND, SCRUB & HEDGEROWS, NATURAL AREAS, POCKET PARKS, GREEN WALLS & ROOFS, PRIVATE GARDENS, AGRICULTURAL LAND, ALLOTMENTS BLUE = WATERWAYS, RIVERS, LAKES, CANALS, URBAN WETLAND, RAIN GARDENS, PONDS & OTHER WATER BODIES

# The benefits of urban green + blue infrastructure

| ENVIRONMENTAL BENEFITS | ECONOMIC BENEFITS | SOCIAL BENEFITS |
|---|---|---|
| Improved visual amenity | Increased property prices | Encouraging physical activity |
| Enhanced microclimate | Increased land values | Improving childhood development |
| Improved air quality | Faster property sales | Improved mental health |
| Reduced flood risk | Encouraging inward investment | Faster hospital recovery rates |
| Better water/ soil quality | Reducing building energy costs | Lowering stress |
| Water storage and reuse | Faster planning permission | Improved workplace productivity |
| Improved biodiversity | Improving areas for tourism | Increasing social cohesion |
| Reducing ambient noise | Lowering healthcare costs | Reducing crime |

SOURCE: SUMMARY OF GLOBAL RESEARCH ON THE BENEFITS OF THE NATURAL ENVIRONMENT - FROM 'CITIES ALIVE' - ARUP (2014)

High performance infrastructure in urban areas

*‘PEOPLE IN GREENER AREAS REPORTED LOWER LEVELS OF STRESS AND HIGHER DEGREES OF LIFE SATISFACTION’

EXETER UNIVERSITY HEALTH RESEARCH – 5,000 HOUSEHOLDS OVER 17 YEARS

# ‘Contact with nature lowers stress levels & improves life satisfaction’

# ‘Urban green cleans the environment’

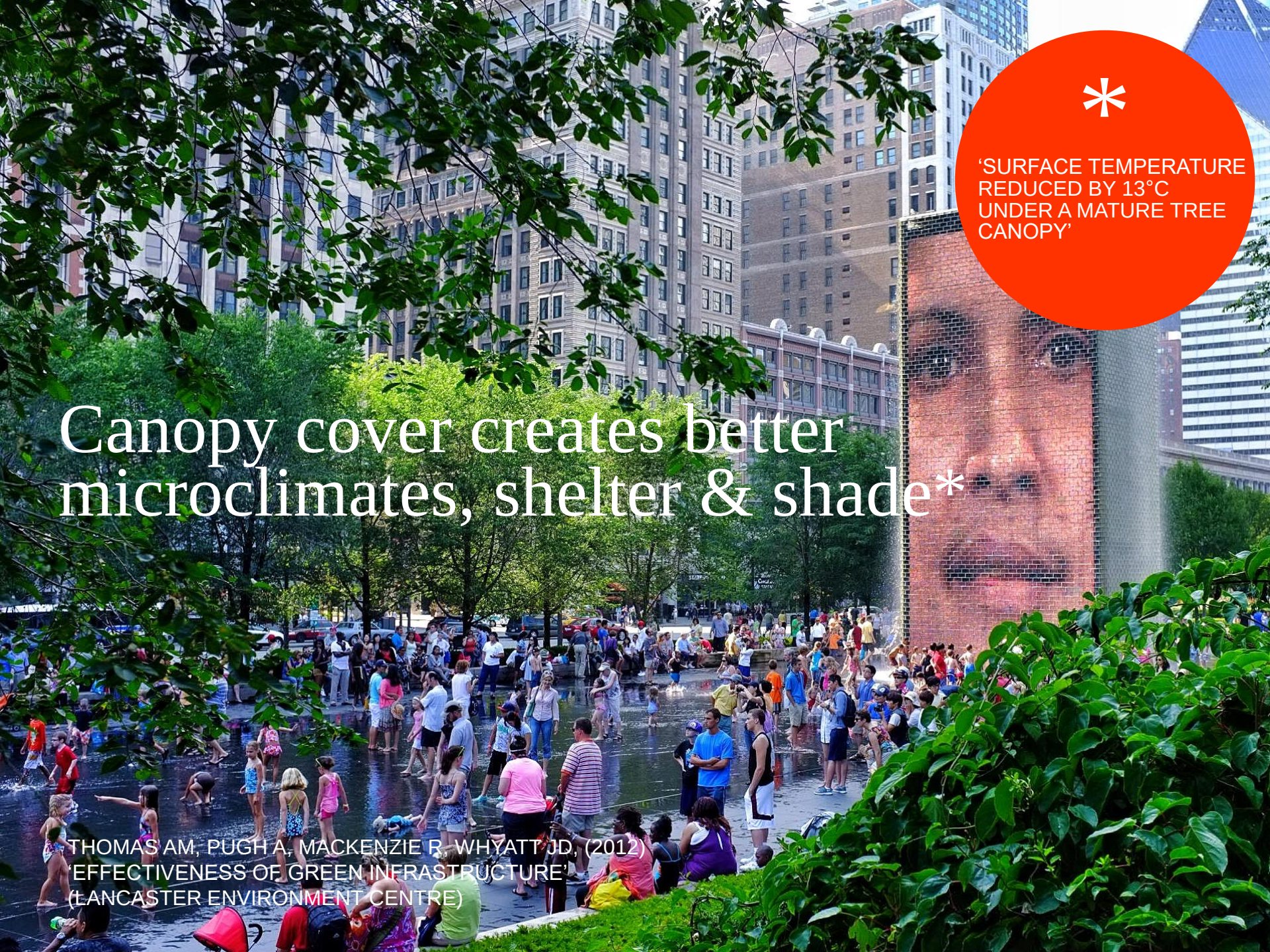
*

‘GREEN STREETS CAN CUT POLLUTION BY 30%’

)

PUGH T, MACKENZIE A, WYATT J, HEWITT C, ‘EFFECTS OF GREEN INFRASTRUCTURE FOR IMPROVEMENT OF AIR QUALITY IN URBAN STREET CANYONS – ENVIRONMENT, SCIENCE + TECHNOLOGY (2012)


*
*RESIDENTS IN GREEN ENVIRONMENTS WERE 3.3 TIMES MORE LIKELY TO TAKE FREQUENT PHYSICAL EXERCISE'
'A green environment stimulates better physical health'
FORESTRY COMMISSION UK (2010) 'THE CASE FOR TREES IN DEVELOPMENT AND THE URBAN ENVIRONMENT'



# Canopy cover creates better microclimates, shelter & shade*

* ‘SURFACE TEMPERATURE REDUCED BY 13°C UNDER A MATURE TREE CANOPY’

THOMAS AM, PUGH A, MACKENZIE R, WHYATT JD, (2012) ‘EFFECTIVENESS OF GREEN INFRASTRUCTURE’ (LANCASTER ENVIRONMENT CENTRE)

# Urban wetland, permeable surfaces provide flood resilience*

* ‘URBAN GREEN CAN SLOW DOWN & REDUCE STORM WATER RUNOFF BY 4 TO 8%’

HERRERA ENVIRONMENTAL CONSULTANTS (2008) ‘THE EFFECTS OF TREES ON STORM WATER RUNOFF



# Green City, Clean Waters

*Green City, Clean Waters* is Philadelphia's plan to reduce stormwater pollution currently entering our Combined Sewer System through the use of green infrastructure.

*Green City, Clean Waters* represents a major shift in the way we think about and deal with stormwater in Philadelphia. We're recreating the living landscapes that once slowed, filtered, and consumed rainfall by adding green to our streets, sidewalks, roofs, schools, parks, parking lots and more—any impermeable surface that's currently funneling stormwater into our sewers and waterways is fair game for greening. It's going to take decades of work, but when it's all done, we'll have reduced the stormwater pollution entering our waterways **by a stunning 85 percent.**

That means rivers and streams that are swimmable, fishable, drinkable on a level exceeding even the memory of Philadelphia's oldest residents.

By employing green tools instead of just relying on traditional infrastructure like pipes and storage basins, we meet standards set by the Clean Water Act while **saving Philadelphia an estimated $5.6 billion.**

Since *Green City, Clean Waters* was adopted in June 2011, Philadelphia Water and private developers have added **over 1,100 green stormwater tools to our landscape.**

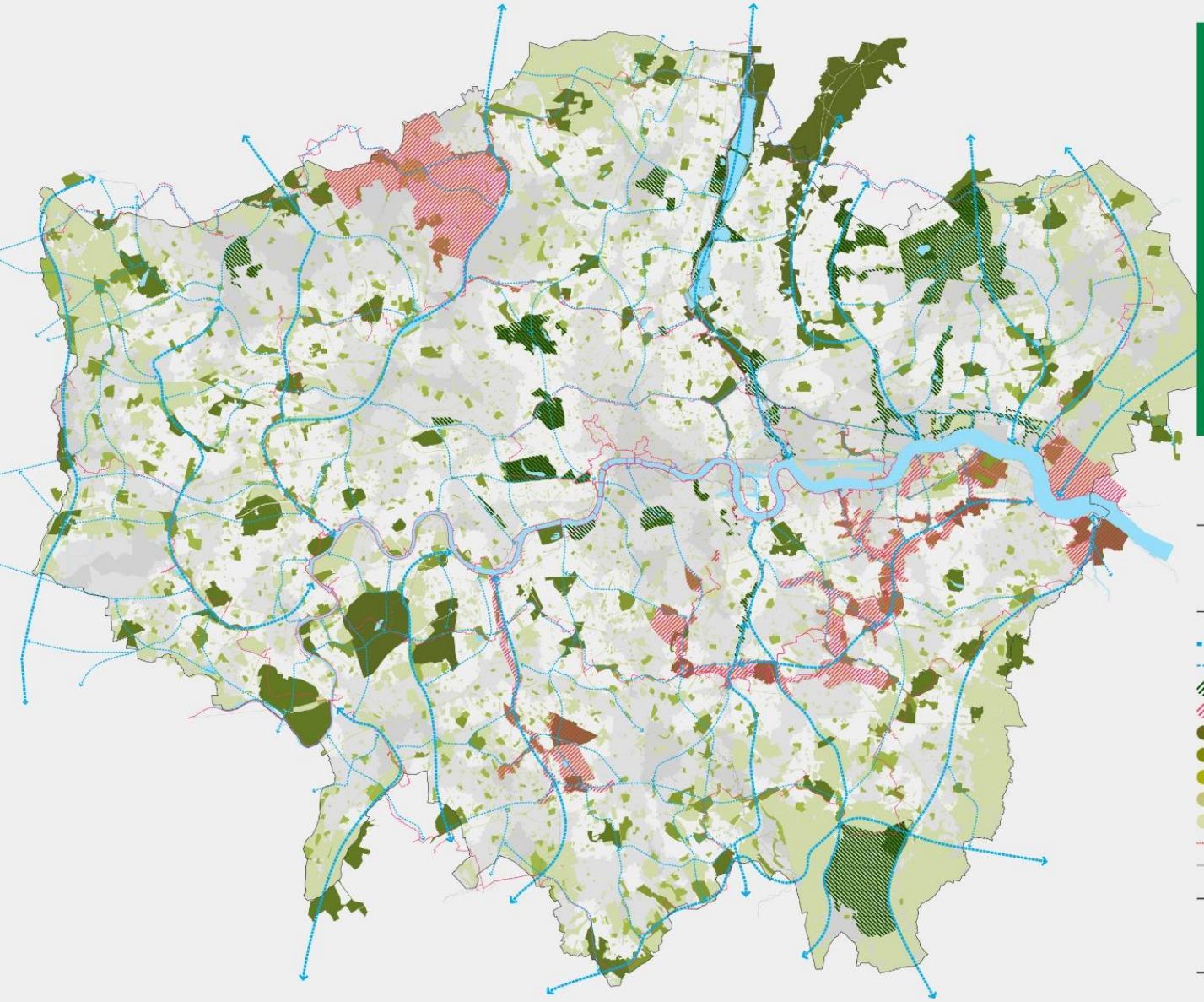
## Why Green City, Clean Waters?

**Now**. Unlike a massive underground tunnel system that would tear up neighborhoods for years, our green infrastructure is already providing water quality benefits. Green City, Clean Waters improvements allow Philadelphia to enjoy better water quality and environmental and social benefits right now.

**Fairer.**Our 25-year plan is a cost-saving program that lets Philadelphia Water minimize rate increases and keep water affordable for all.

**Better.** Green City, Clean Waters is creating environmental, social, and economic benefits that our neighborhoods would otherwise miss out on. Green infrastructure projects are increasing property values, beautifying neighborhoods, fighting extreme summer heat, creating natural habitats, enhancing public space and schools and even making neighborhoods safer.

**Jobs.** Green City, Clean Waters is fueling a green jobs economy in Philadelphia, creating high-value new jobs for residents and attracting smart workers and firms to our city. An ambitious and forward-thinking green infrastructure plan needs an ambitious and forward-thinking workforce to succeed, and we're making that happen right here, right now.



## Green infrastructure

We can enhance and expand the All London Green Grid, so that by 2050 we will have a network of green infrastructure providing flood protection, shade, biodiversity, space for cycling, walking and recreation, and a more attractive environment.

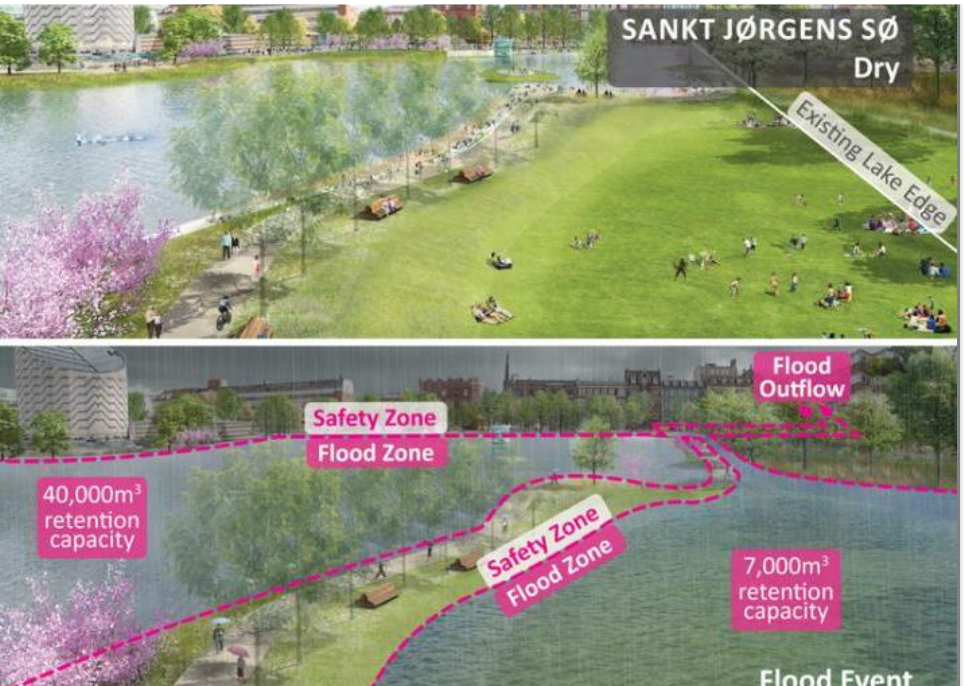
THE ALL LONDON GREEN GRID FRAMEWORK PLAN

- Strategic corridors
- Strategic links
- Metropolitan park opportunities
- Regional park opportunities
- Regional parks
- Metropolitan parks
- District parks
- Local parks & open spaces
- Other/private spaces
- Strategic walking routes
- Strategic cycling routes

Source: Greater London Authority

CHEONGGYECHEON RIVER, SEOUL

# The city as ‘blue gym’


# Urban blue can often be cheaper than traditional solutions

Copenhagen 'Cloudburst Project'

£610m = cost of rectifying a single flood event in 2011

£410m = cost of implementing sustainable drainage project

SOURCE: LONDON INFRASTRUCTURE PLAN 2015 | LANDSCAPE INSTITUTE POSITION PAPER ON GREEN INFRASTRUCTURE (2012)