

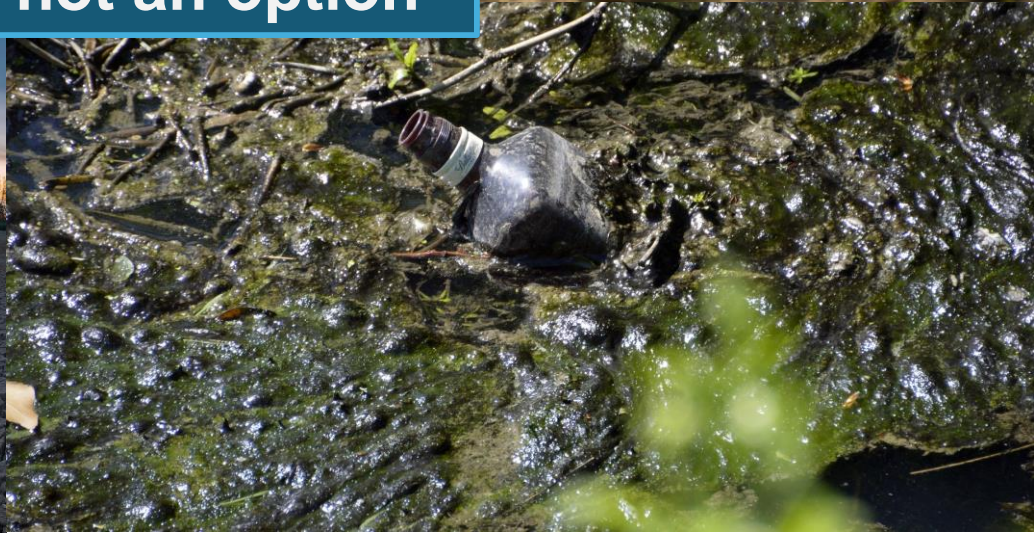
Nature-Based Solutions in Practice

Selecting and Integrating Natural
Elements within the Built
Environment

Laura Wendling, VTT Technical Research Centre



No action is not an option



What are Nature-Based Solutions?

- ▶ “solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience” (European Commission, 2015)

NBS as a concept

EbA → Ecosystem-based adaptation

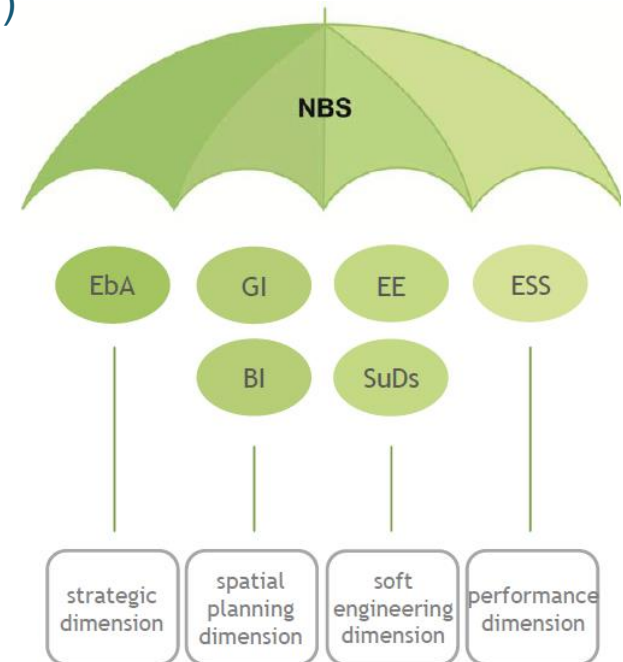
GI → Green infrastructure

BI → Blue infrastructure

EE → Ecological engineering

SuDs → Sustainable urban drainage systems

ESS → Ecosystem services



What are the benefits of Nature-Based Solutions?

- ▶ Provide **solutions to climate change related challenges**: more/less rain, (storm)water quality/quantity, biodiversity, well-being
- ▶ **Multifunctional infrastructure**: water management + recreation + biodiversity
- ▶ **Complement (or replace?) grey infrastructure** + food production
- ▶ **Mimic nature**: biofilter, green roof/wall etc.

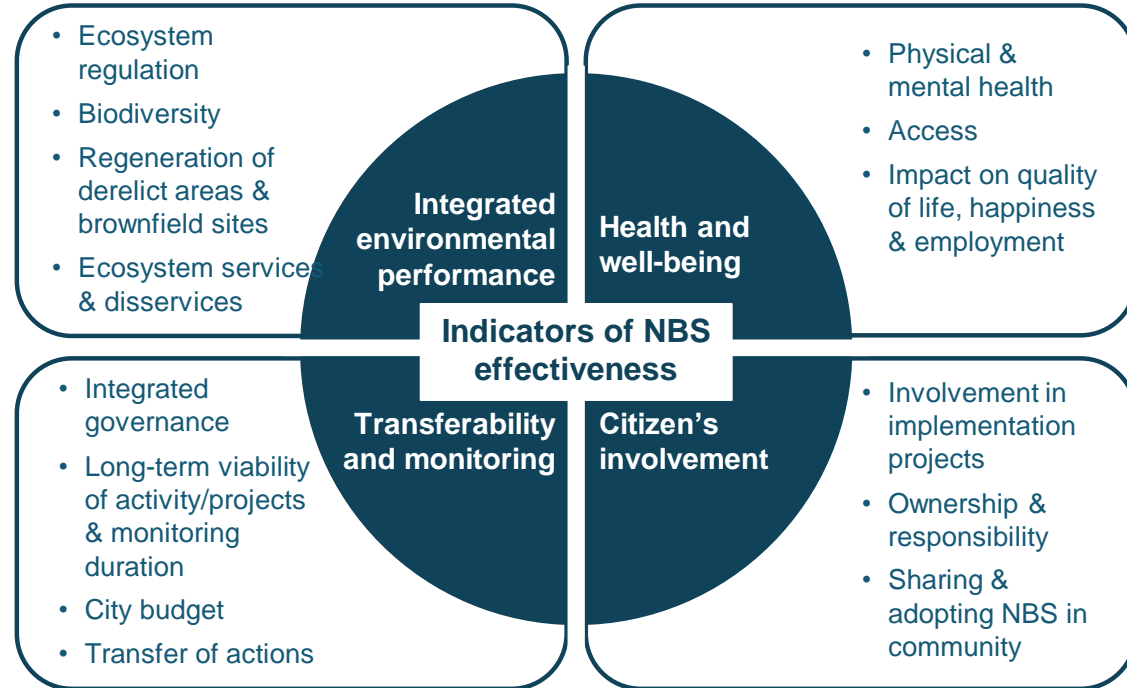


Image reproduced from Kabisch et al. 2016, Ecology and Society 21(2):39

The total quantity of water on earth is approximately constant

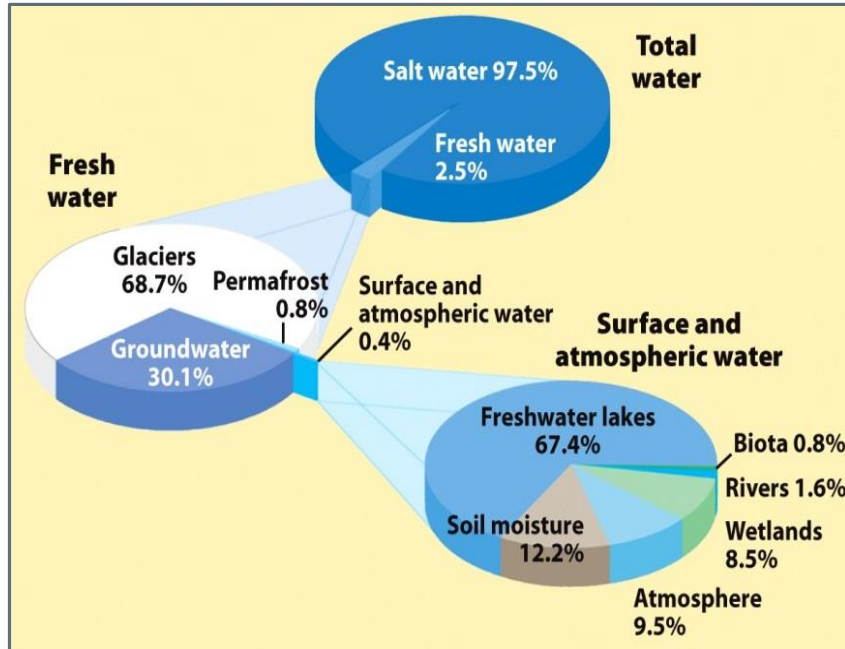
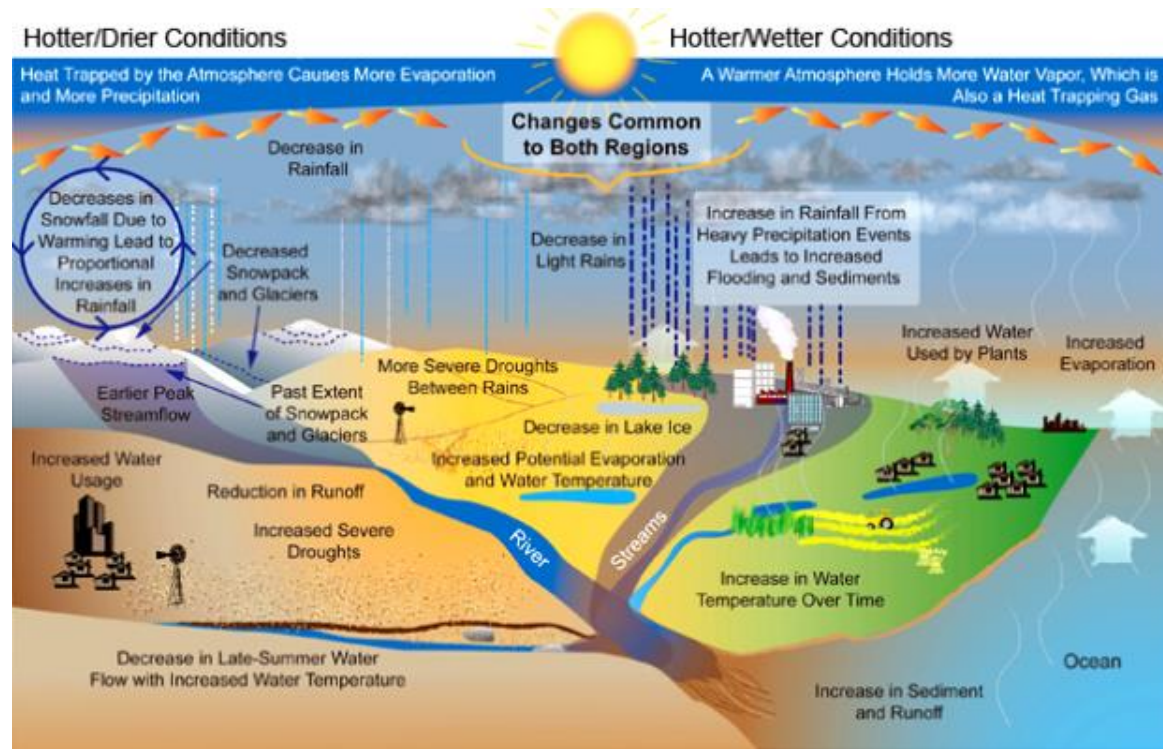


Image from Strahler and Merali (2008) *Visualizing Physical Geography*. Wiley, Boston, USA.

30% of the global population is impacted by flood or drought events

Changing Climate = Water Cycle Intensification



Increasing Scarcity

**3,6 billion
people are
currently
subject to
water scarcity**

ENVIRONMENTAL WATER SCARCITY INDEX BY BASIN: HIGH-STRESS BELT BY 2030

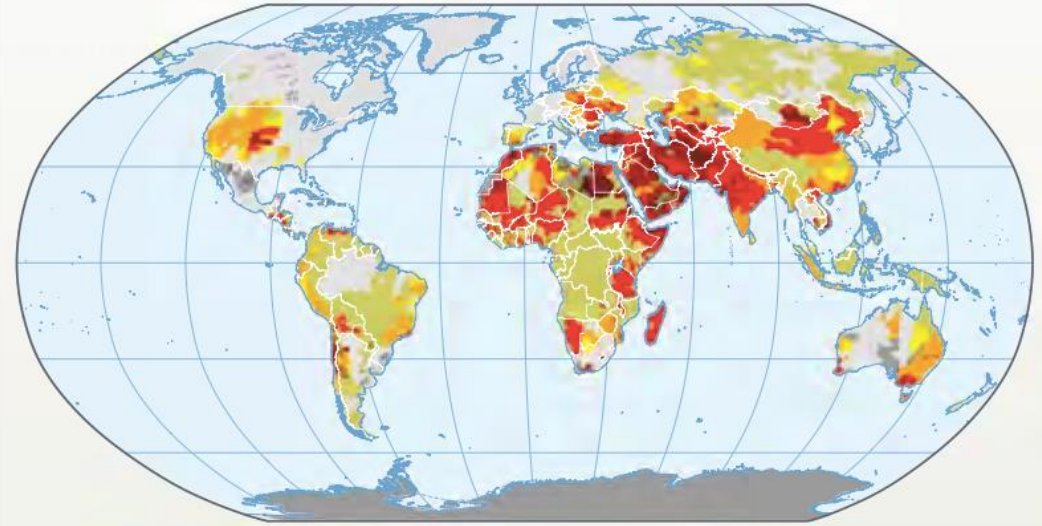
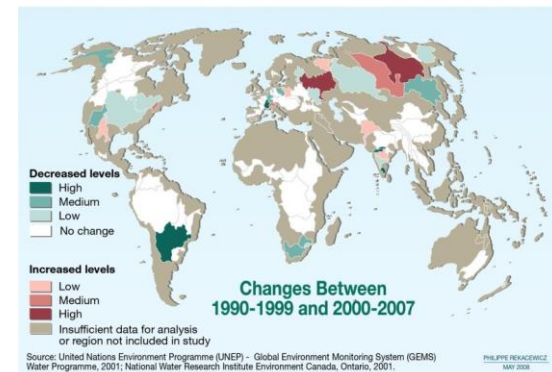
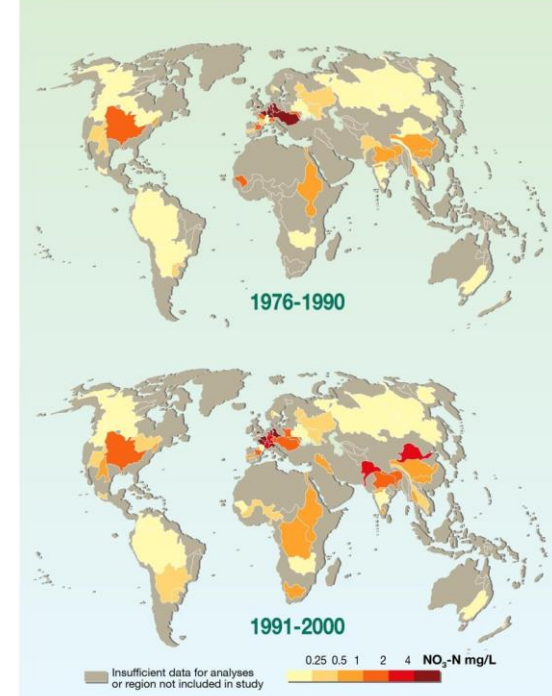


Image: NIC (2013); http://www.dni.gov/files/documents/GlobalTrends_2030.pdf

Increasing Pollution

- ▶ 80% of the world lives in areas where fresh water supply is not secure
- ▶ Contributors: water resource development, climate change & pollution

80% of industrial & municipal wastewater is discharged without any treatment



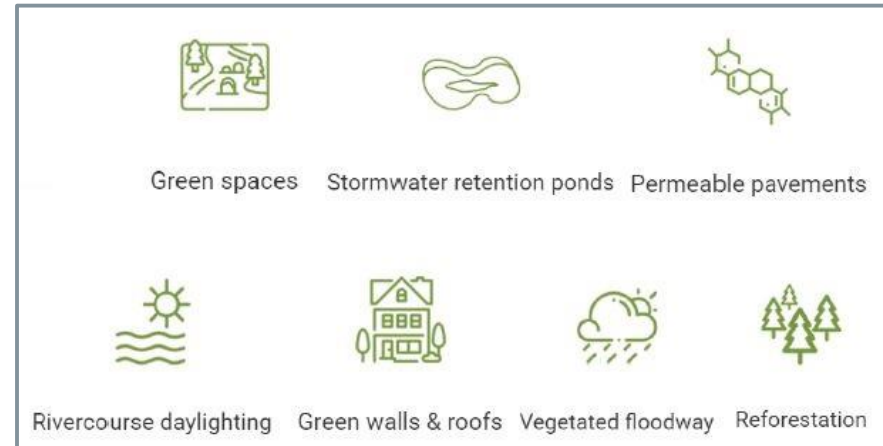
Increasing Floods

- ▶ 4.2 billion people affected since 1992
 - ▶ 95% of all those affected by disasters
 - ▶ ~1,1 trillion EUR damage (63% of all disaster-related damage)

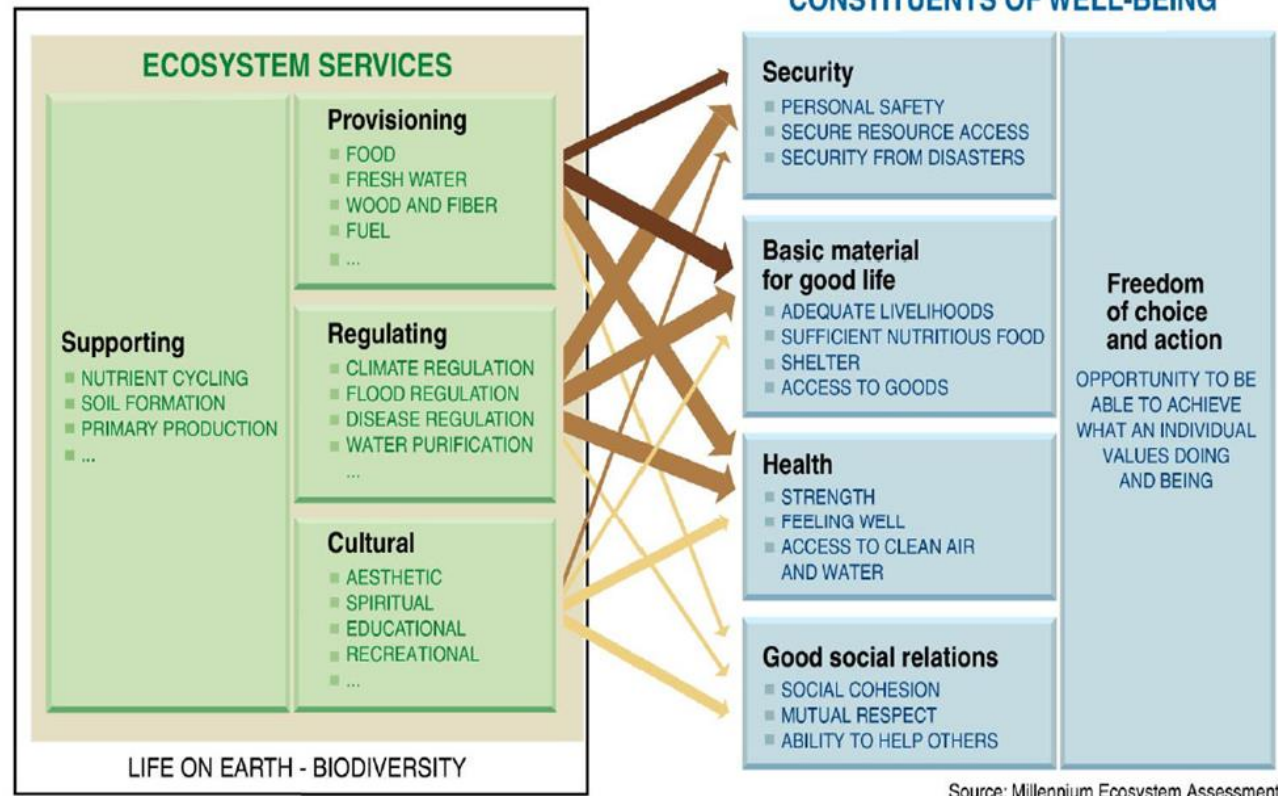
**Economic value of
assets at risk from
floods >38 trillion
EUR by 2050**



Challenges & Nature-Based Solutions



How do NBS deliver benefits to urban society?



Source: Millennium Ecosystem Assessment

ARROW'S COLOR Potential for mediation by socioeconomic factors	ARROW'S WIDTH Intensity of linkages between ecosystem services and human well-being
Low	Weak
Medium	Medium
High	Strong

Cities rely on local ES + services from ecosystems beyond city limits

- ▶ NBS typically deliver groups of benefits in the form of **ecosystem services**
- ▶ *Improved water quality*
- ▶ *Reduced flood risk*
- ▶ *Increased water security / reduced water scarcity*

Examples of Water-Related Ecosystem Services

SECTION	CLASS	SERVICE UNIT	DEMAND
PROVISIONING	Cultivated crops	Fields, orchards, gardens	Consumption
	Surface water for drinking	Watershed	
	Groundwater for drinking		
	Surface water / non-drinking use		
	Groundwater / non-drinking use		
REGULATING	Air filtration/pollutant sequestration	Trees, shrubs	Risk of exposure to pollutants
	Reduced GHG concentration	Vegetation, soil	Risk of climate change
	Micro/regional climate regulation	Vegetation, water bodies	
	Smell/noise/visual impact buffer	Vegetation	Risk of exposure to noise etc.
	Hydrologic cycle maintenance	Vegetated & permeable surfaces	Risk of flood
	Flood control	Wetlands	Exposure to flooding
CULTURAL	Physical use of landscape/waterscape	Green and blue spaces	Potential & direct use
	Scientific/educational		
	Heritage, cultural		

NBS in the City

NBS to manage water flows in urban landscapes

- ▶ **Catchment management** outside urban areas
- ▶ **Improved recycling of water** within urban areas
- ▶ **Green infrastructure implementation** within urban boundaries

Use landscape to store & release water, regulate downstream flows

NBS for water quality management; MAR/ASR, non-potable re-use, etc.

Reconnect or improve hydrological cycle by managing pathways

Catchment-scale management & hydrologic connectivity are key

NBS in the City – Surface Sealing

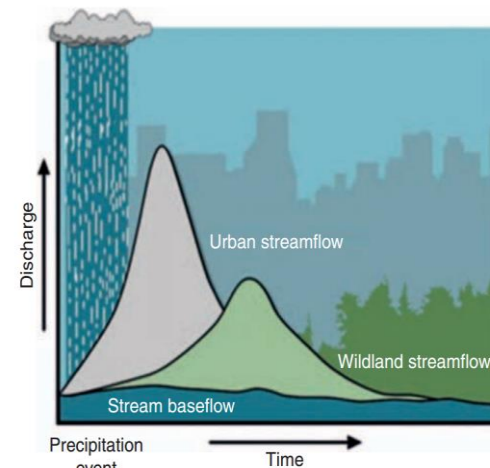
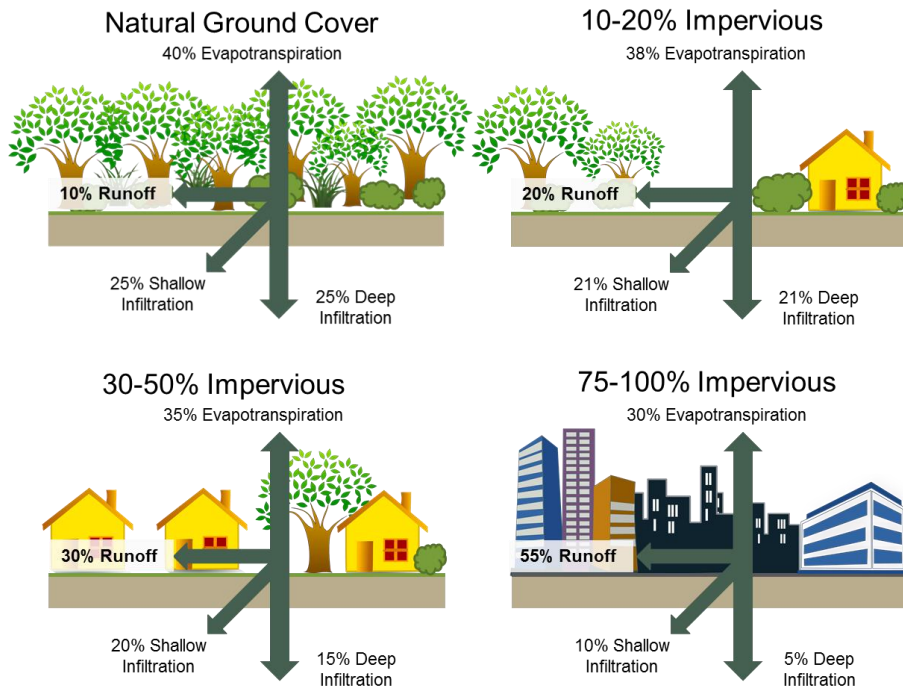


Image adapted from US EPA 1993, Pub. #840-B-92-002

NBS in the City – Surface Sealing



Images: <https://www.dailymail.co.uk/news/article-2789173/Outrage-Italy-shame-Genoa-flood-chaos.html>

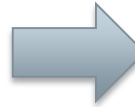
- ▶ In 2014, Genoa received ~65% of the area's mean annual rainfall in 72 h
- ▶ One event among several indicating pattern of **increasing rainfall intensity & flash flooding**

NBS in the City – Gavoglio Barracks, Genova (IT)

NBS in Practice: Genova

Brownfield regeneration & unsealing of surfaces

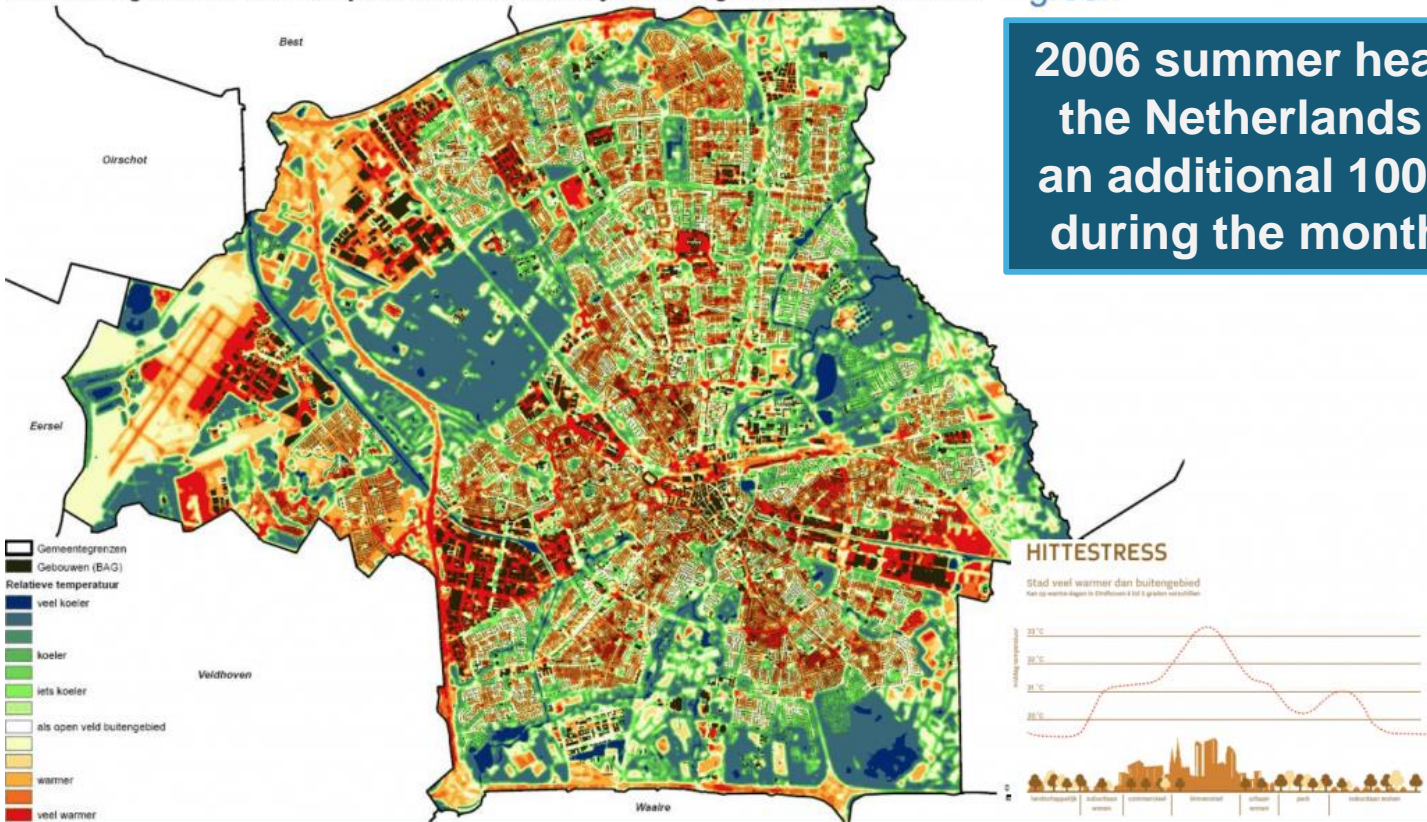
- ▶ Multifunctional green space
- ▶ Recreational areas, community garden, community orchard, stormwater retention ponds, forested slope areas, playgrounds, green wall(s)
- ▶ Underground water storage & watering system to support new vegetation



NBS in the City – Urban Heat Island

Verwachting lokale variatie temperatuur in Eindhoven tijdens hittegolf omstreeks 15:00 uur

• groen



2006 summer heatwave in the Netherlands caused an additional 1000 deaths during the month of July

Source: [CBS](#)

NBS in Practice – Eindhoven (NL)



Cooling with Green?

NBS in the City – Increasing Vegetation

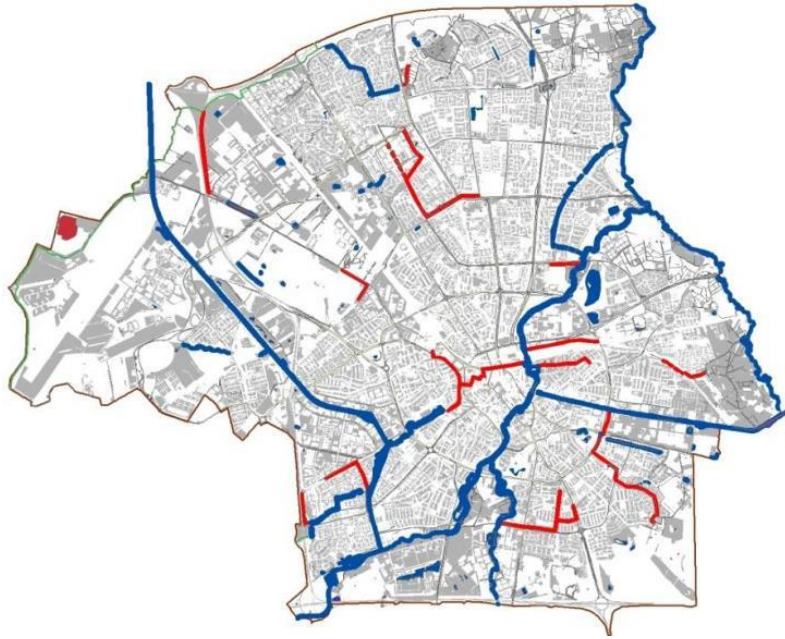
OBJECTIVES

Less sealed surface area
More vegetation
More water

- ▶ Green-blue oases between buildings
- ▶ Green roofs
- ▶ Green walls
- ▶ Street greenery
- ▶ Green cycle paths
- ▶ Fountains
- ▶ Watercourse reconnection



NBS in the City – Reconstructing Watercourses



- In **red**: **new watercourses constructed or to be constructed**
- All different in design/appearance



NBS in the City – Stormwater Management, Tampere (FI)

29

public beaches

45

*Nature Based
stormwater
management
Solutions*

160

lakes

100%

urban wastewaters treated

NBS in Practice: Tampere

Vuores stormwater management system

- ▶ Construction phase green district in the middle of natural waterbodies, target 13 000 residents
- ▶ **Multifunctional blue-green space** with stormwater ponds, surface & subsurface water filtration (wetlands, biofilters)



NBS in the City – Stormwater Management, Tampere (FI)

HEIDANRANTA

- ▶ Planning phase brownfield area
- ▶ Smart, sustainable & dense centre of Western Tampere where new ideas, pilots and urban culture flourish
- ▶ Target 25 000 residents to the area



NBS in the City – What do we know?

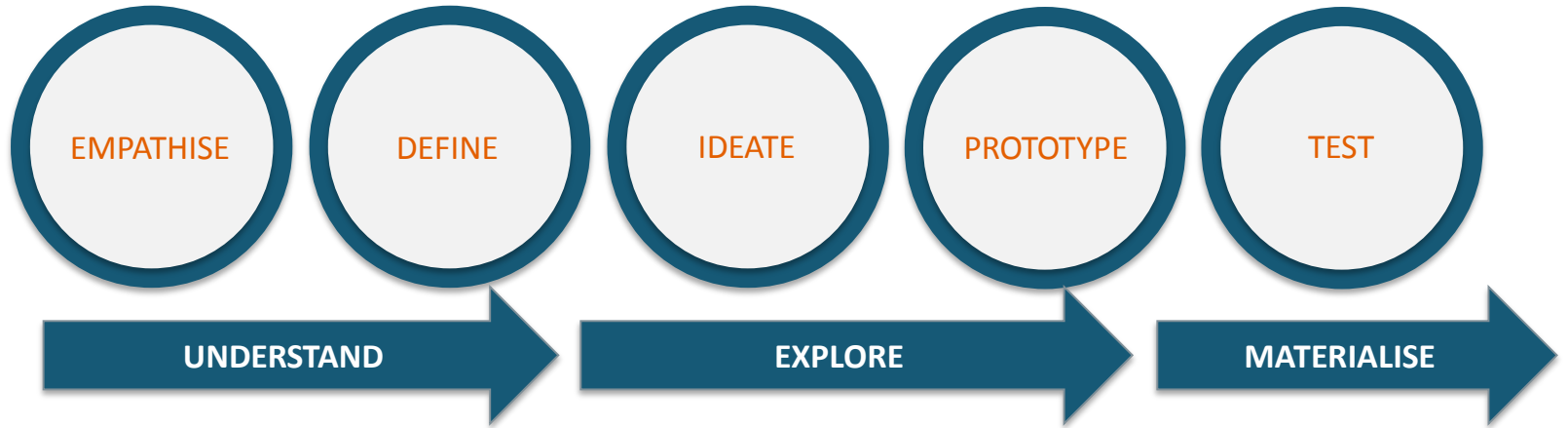
ACKNOWLEDGED

- ▶ Co-creation is critical to NBS success
- ▶ Need for adaptive management schemes & detailed NBS monitoring
- ▶ Need for coherent legal and governance frameworks
- ▶ Valuation of ecosystem services required for successful NBS mainstreaming

MORE DISCUSSION NEEDED

- ▶ **Scale of interventions & NBS impacts**
- ▶ **Ecosystem-based management** as primary means of climate change adaptation
- ▶ **Collaborative transboundary management** of water resources is essential
- ▶ **Effective integration of blue-green & grey infrastructure & supporting technologies**

Co-Creating NBS in the City – Design Thinking

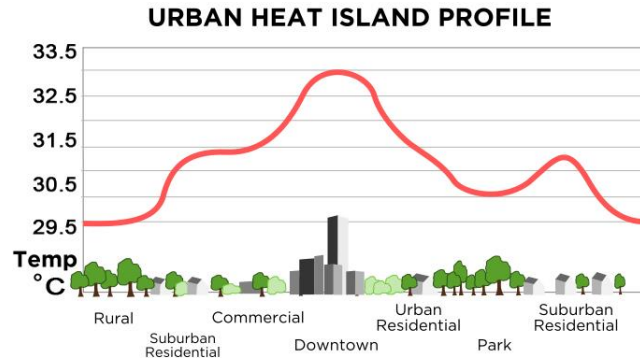


VTT's Work on NBS

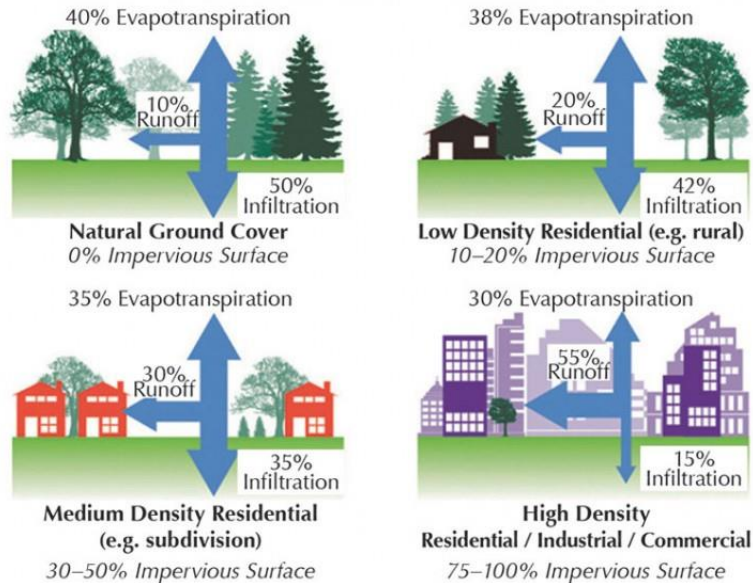
Significant challenges include urban densification & extreme weather conditions / climate change

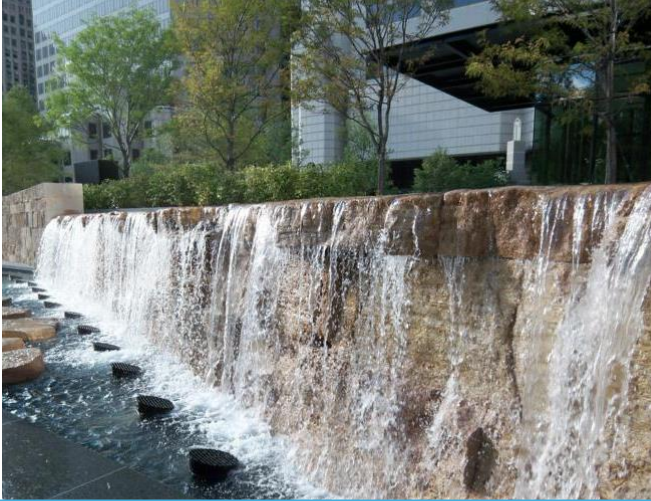
Solution: integrating SOTA + innovative, smart technologies & decision-making processes with in-depth understanding of social fabric of cities

- Developing & optimising novel technologies
- Providing quantitative evidence of integrated, smart technologies' efficacy, applicability, & cost-effectiveness
- Leveraging industry partnerships to commercialise technology & support new economic opportunities (jobs, products, services)
- Applying blue-green-grey innovations to create liveable, inclusive urban areas

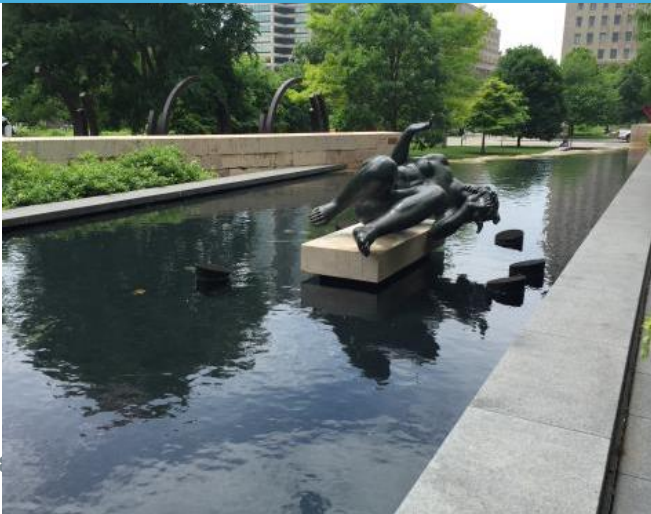


EFFECTS OF IMPERVIOUSNESS ON RUNOFF AND INFILTRATION





We don't inherit the earth from our ancestors, we borrow it from our children



Acknowledgements & Further Information

All partners in the Urban Nature Labs (UNaLab) project (www.unalab.eu) for sharing ideas and inspirations, especially:

- ▶ Sami Kazi, VTT
- ▶ Maarit Särkilahti & Salla Leppänen, City of Tampere
- ▶ Mayke van Dinter & Luuk Postmes, City of Eindhoven
- ▶ Silvia Campailla & Sonia Zarino, City of Genova
- ▶ Anna Ståhlbröst, Abdolrasoul Habibipour & Diana Chronéer, Luleå University of Technology
- ▶ Ines Vaittinen, Spela Zalokar & Clara Mafe, European Network of Living Labs (ENOLL)

**For more information about Nature-Based Solutions visit
the Urban Nature Labs homepage:
www.unalab.eu**



Thank you!

Dr Laura Wendling
VTT Technical Research Centre
PO Box 1000
FI-02044 VTT, Finland
Laura.Wendling@vtt.fi