

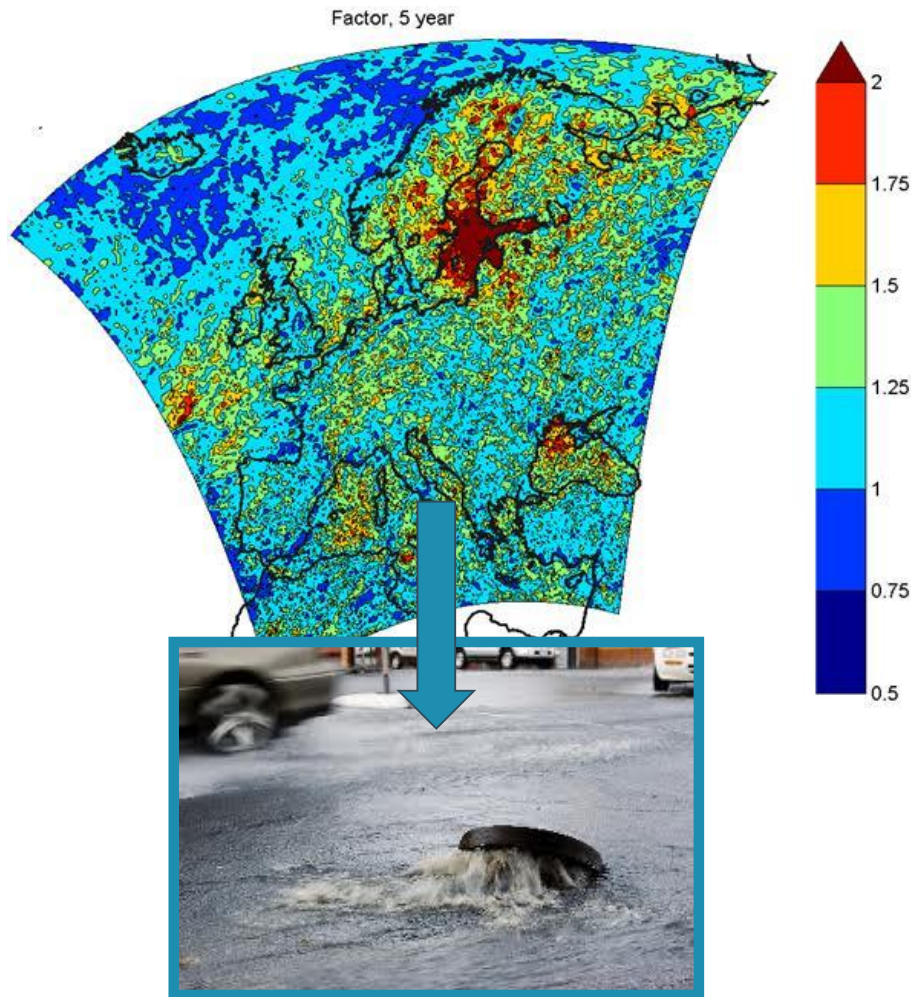
# Benefits of SUDS and climate proof planning

prof. Patrick WILLEMS

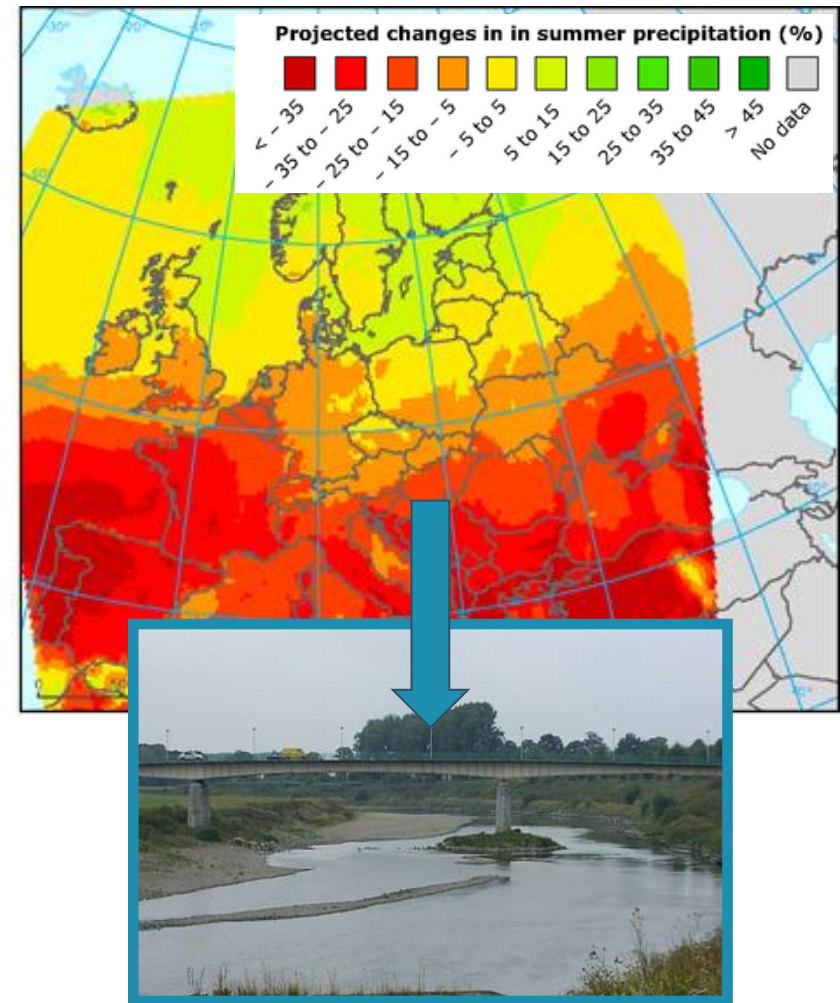
water engineering & climate adaptation KU Leuven

# Climate scenarios

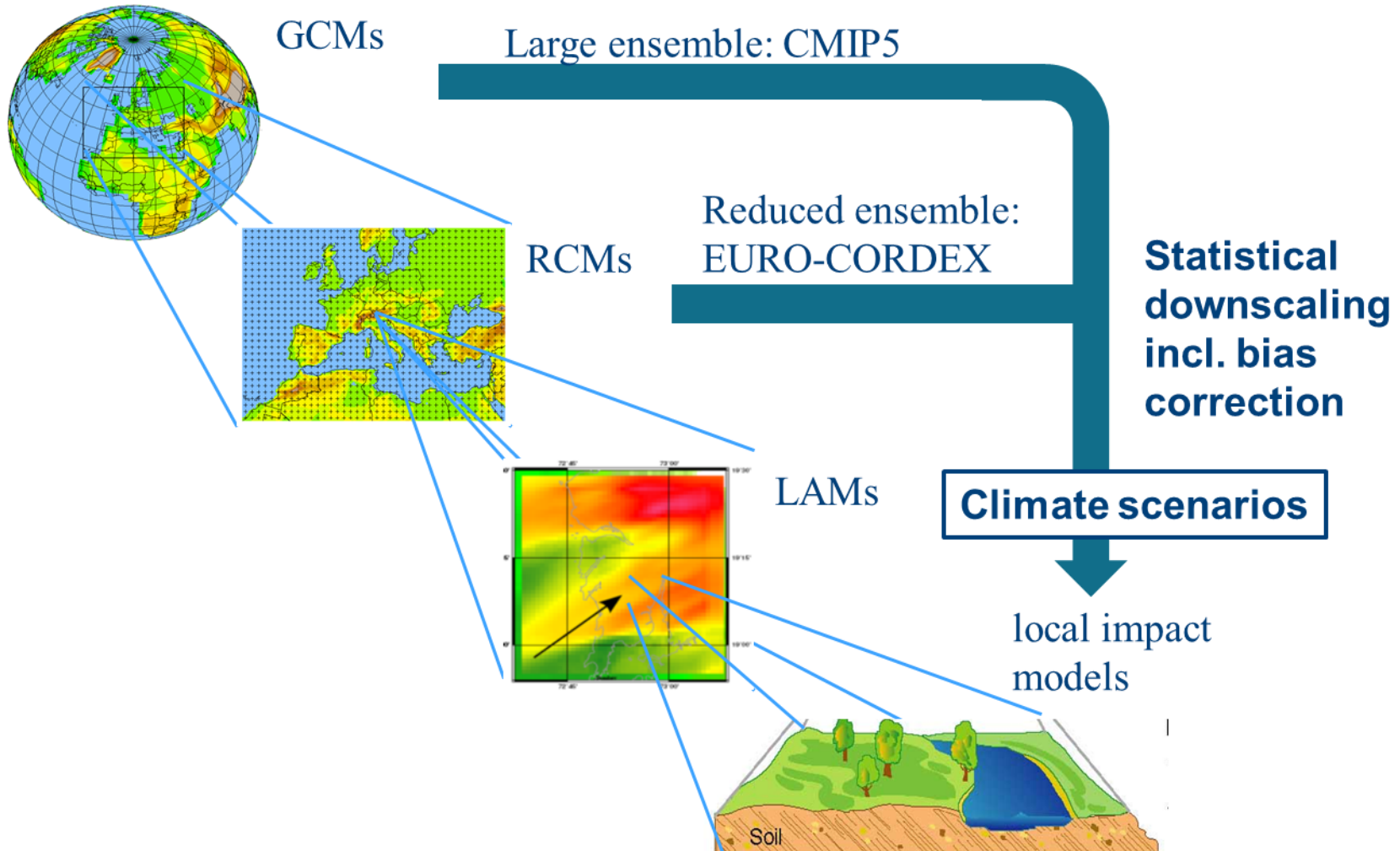
**Increased peak rainfall intensities**  
: more floods



**Longer dry periods**  
: lower water availability



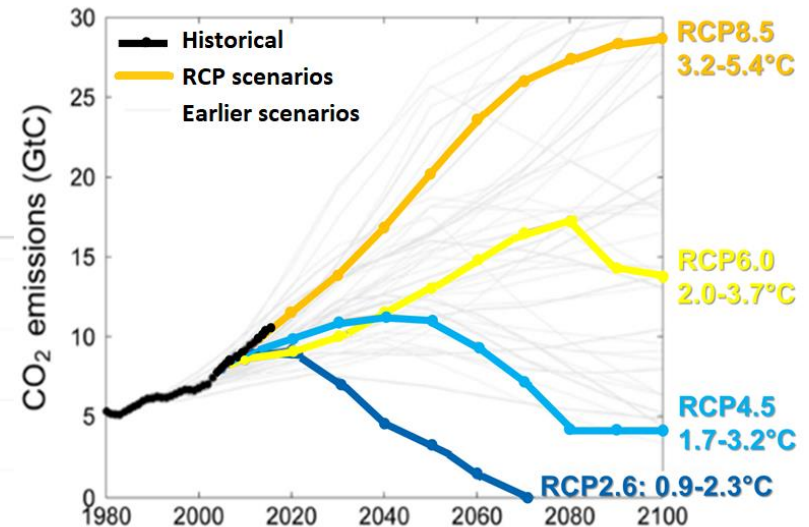
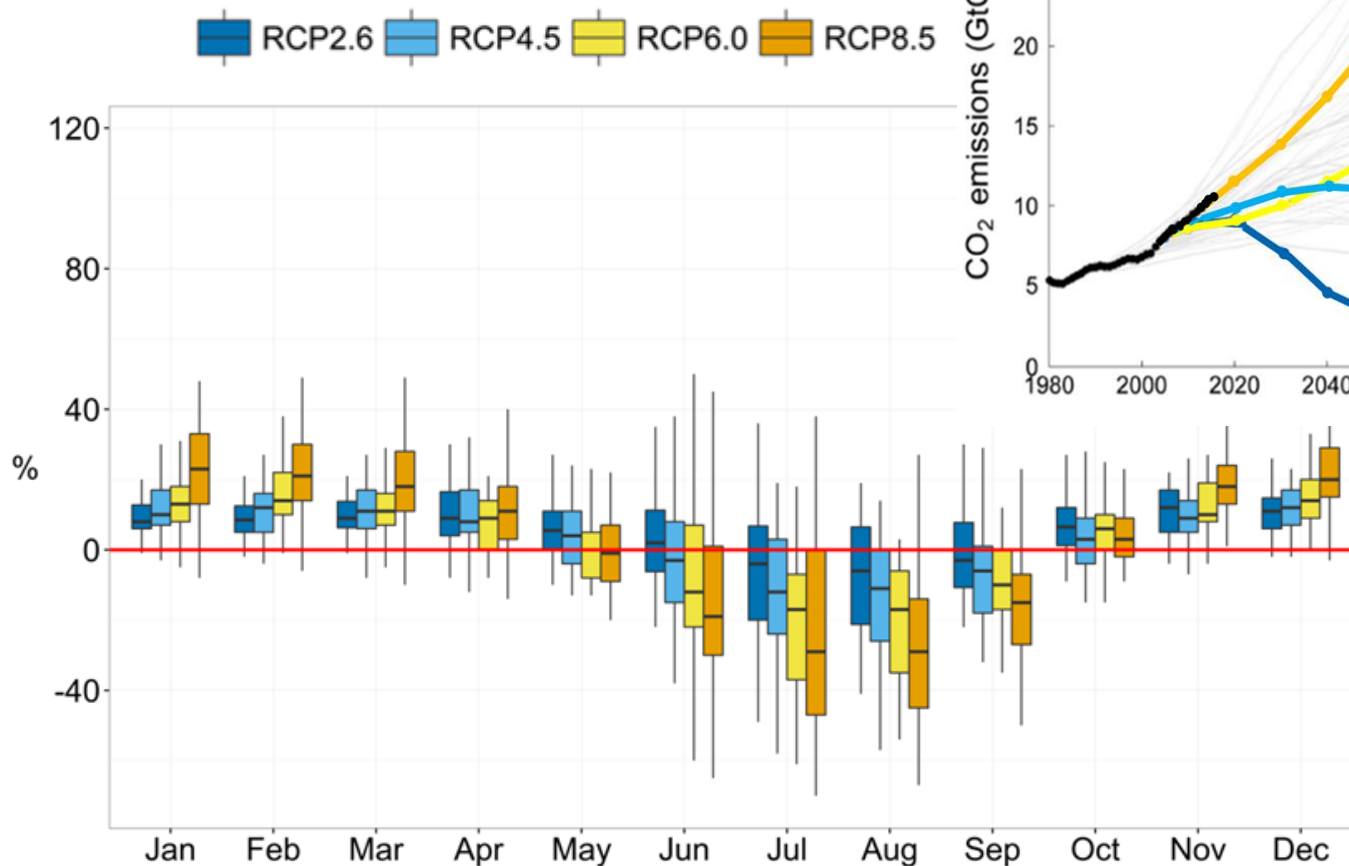
# Climate scenarios



# Climate scenarios

>200 climate model runs CMIP5 (RCP based) for Bruges: change up to 2100:

Change in mean monthly rainfall:

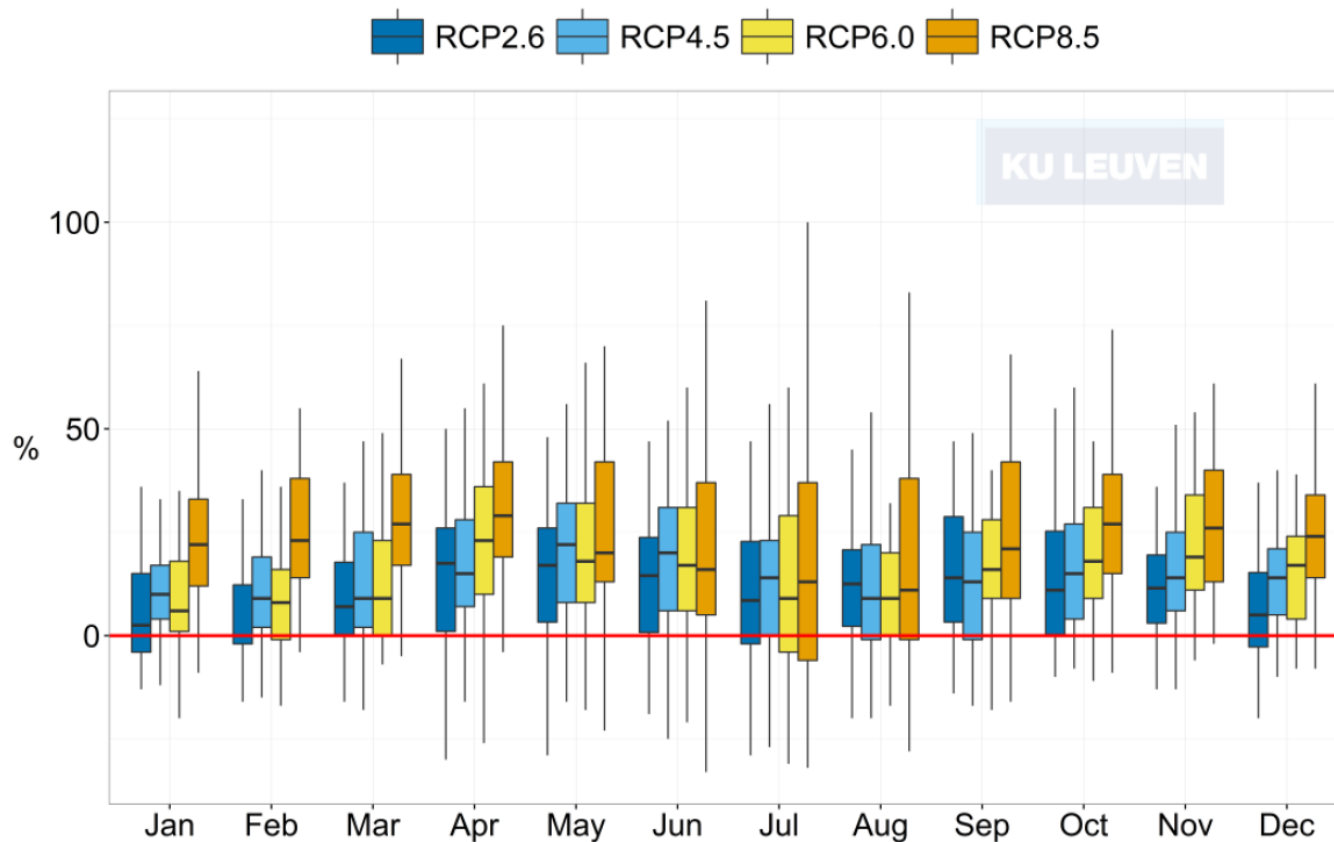


Peters et al.

# Climate scenarios

>200 climate model runs CMIP5 (RCP based) for Bruges: change up to 2100:

Change in rainfall intensity for 20-year storm:



# Climate proof planning under uncertainty

Impact analysis of climate scenarios:

for given (e.g. high) climate scenario

**Risk = Probability \* Consequence**

≥ high

?

very high



Precautionary principle:

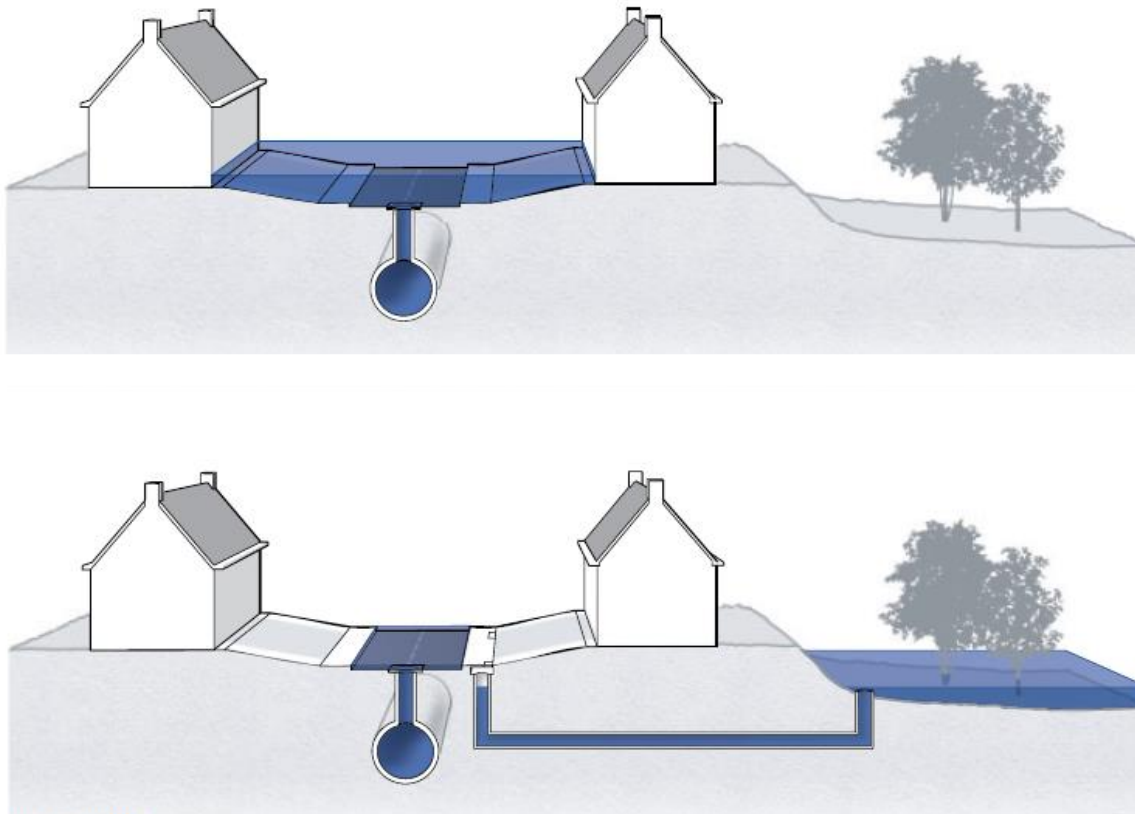
take those scenarios that provide high risk into account in management and planning

# Climate proof planning under uncertainty

- ✓ Avoid that such climate scenarios become real (**MITIGATION**)
- ✓ Look for solutions (**ADAPTATION**), but take large uncertainties into account!
  - ✓ **Sustainable solutions**: that are effective for all climate scenarios (e.g. source control)
  - ✓ **Flexible/adaptable solutions**: account for the potential need for future adjustments depending on the real climate trends
  - ✓ **Avoid closing off options** (reversibility, “no regret” solutions)
  - ✓ **Follow-up future trends** (observations, climate research)
  - ✓ **Active learning, public debate**
    - <-> traditional engineering approach, which is rather static and is often based on design rules set by engineering communities
    - recognize that flexibility is required as understanding increases



# Climate proof planning under uncertainty

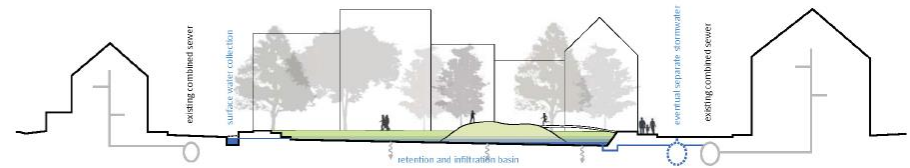


Source figure: RIONED



# Climate proof planning under uncertainty

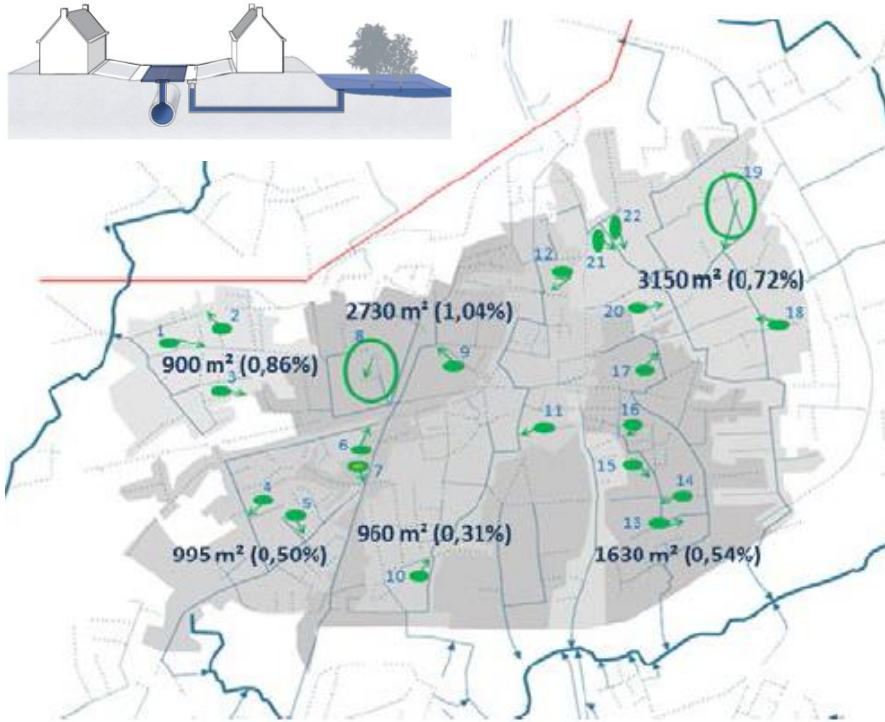
complement grey infrastructure with blue-green surface solutions



Proposal to convert an existing playground into a multi-use water infiltration/retention facility

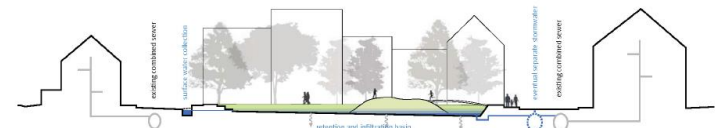


# Climate proof planning under uncertainty

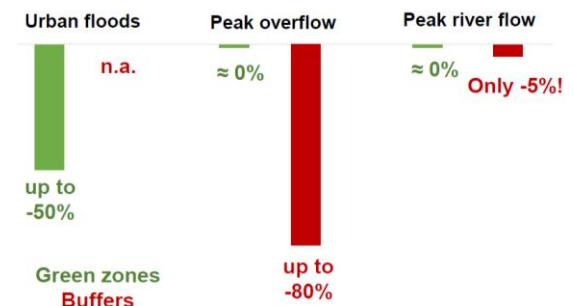


## Example for Belgian city:

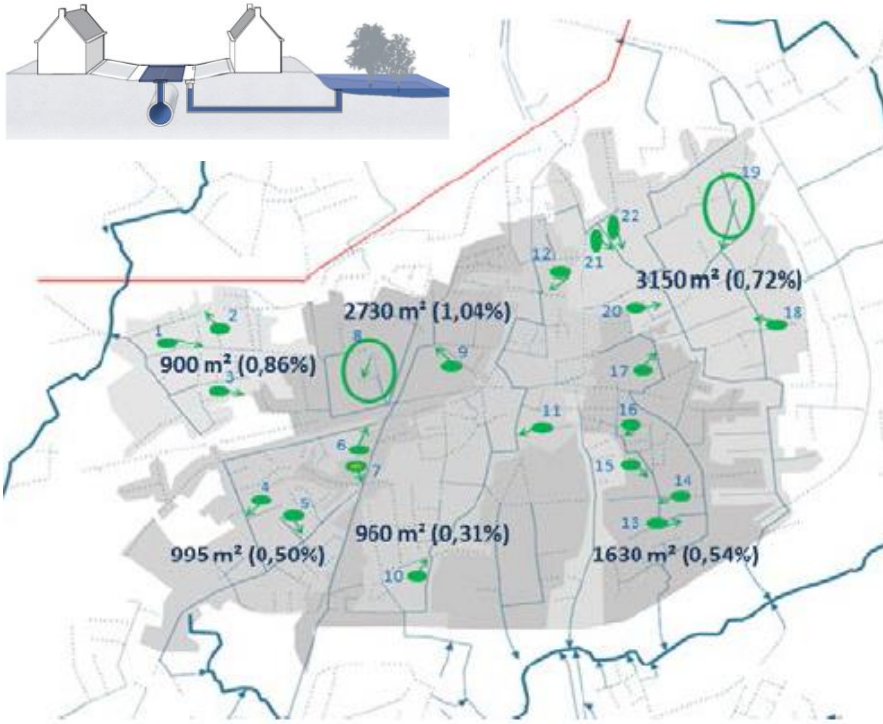
*Rain water storage & infiltration in 22 open, green city areas (= 10365 m<sup>2</sup> = 1% of total runoff area):  
up to 50% reduction in urban flood volume*



Proposal to convert an existing playground into a multi-use water infiltration/retention facility



# Climate proof planning under uncertainty



- ✓ **Sustainable:** effective for all climate scenarios (source control, no end-of-pipe)
- ✓ **Flexible/adaptable:** step-wise implementation, taking future climate trends into account
- ✓ **Avoids closing off options** (reversible, “no regret” solution)
- ✓ **Multiple benefits**
- ✓ **Allows active learning, public debate and bottom-up implementation**



# Multiple benefits of SUDS

Klimaat- en waterrobuuste  
inrichting stedelijke ruimtes



co-benefits:

- ✓ minder riooloverstromingen
- ✓ tegengaan gevolgen droogte
- ✓ minder hittestress
- ✓ betere luchtkwaliteit
- ✓ hogere leefbaarheid steden
- ...



- ✓ Reduced urban flood hazard
- ✓ Groundwater recharge  
(reduced vulnerability to droughts)
- ✓ In combination with green:  
cooling, shadow, heat stress control
- ✓ Increased biodiversity
- ✓ Improved air quality
- ✓ Increased well-being in city
- ✓ Increased social cohesion
- ✓ Etc...

# SUDS by co-design



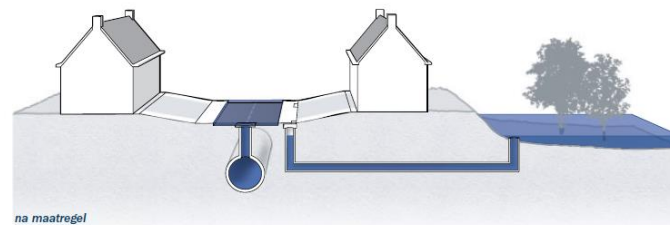
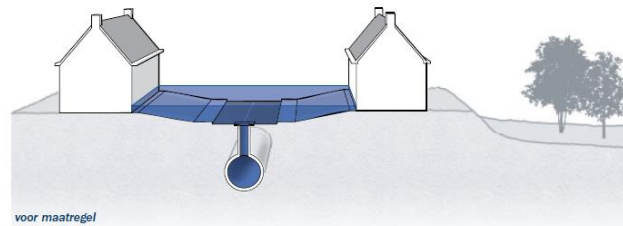
Bentemplein Rotterdam

Bottom-up approach:  
Active involvement of  
local citizens



# SUDS in public spaces

from grey to blue-green solutions



# SUDS in public spaces

from grey to blue-green solutions

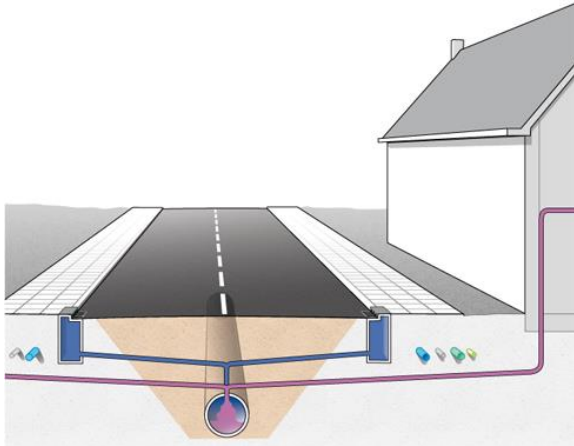


: Botermarkt Mechelen



# SUDS on private domain

from grey to blue-green solutions



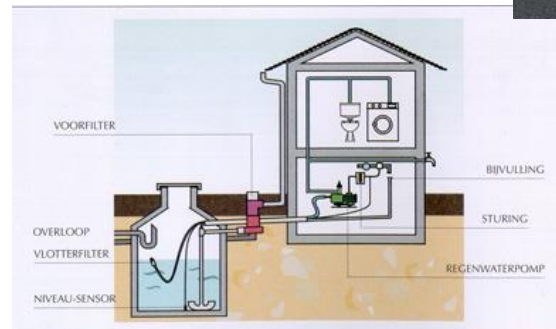
*greenroofs:*



*: permeable pavements  
and green front garden*



*infiltration:*



*: rainwater harvesting & reuse,  
ev. collective rain water tanks*

# SUDS on playgrounds of schools and on business parks

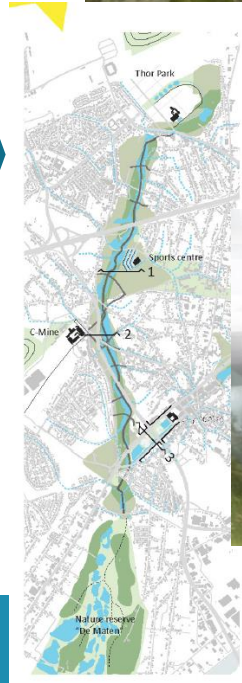
from grey to blue-green solutions





# Blue-green networks at macro level

Towards better integration of water in spatial planning  
: blue-green macro networks



# Blue-green networks at macro level

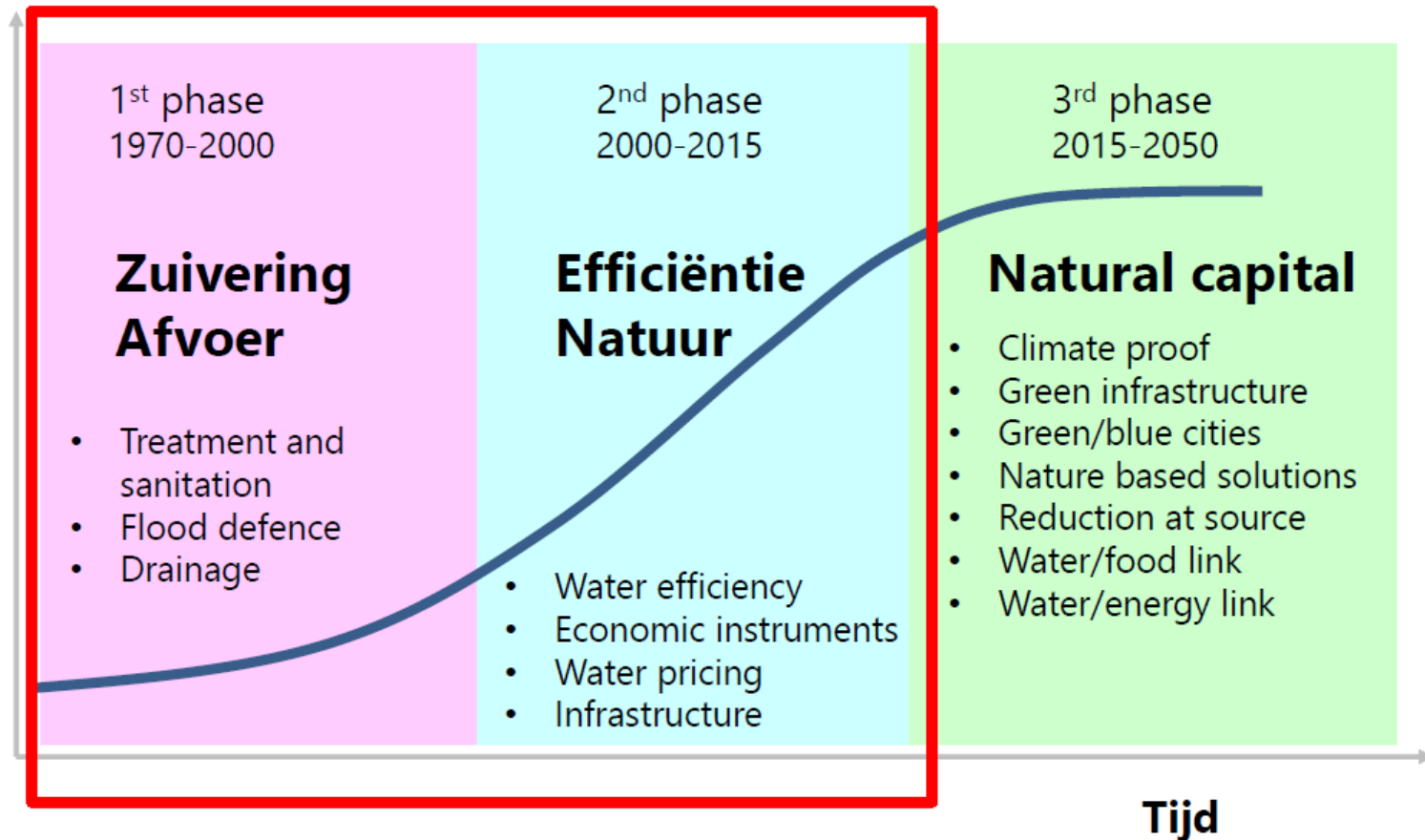
## Re-meandering

In [#ScherpenheuvelZichem](#) en [#Diest](#) starten maandag de voorbereidingen voor het aantakken van de eerste Demermeander in de [#Demervallei](#). Een boost voor de natuur en een troef om overstromingen te voorkomen!  
[bit.ly/2TEjdHO](https://bit.ly/2TEjdHO) [#LifeBelini](#)



# SUDS: Make use of natural capital

Trend in water management:

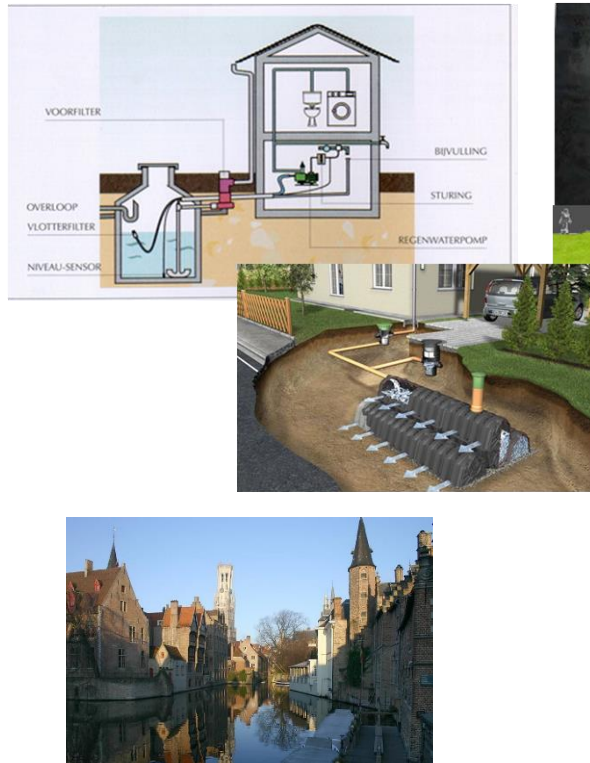




# SUDS design: step-wise approach

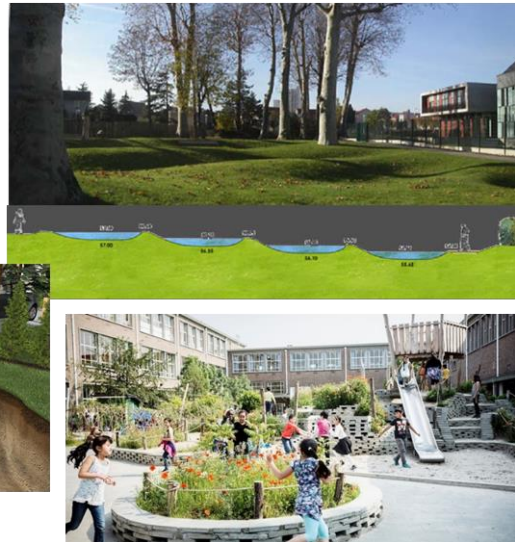
1

Reuse of rain water



2

Blue-green solutions

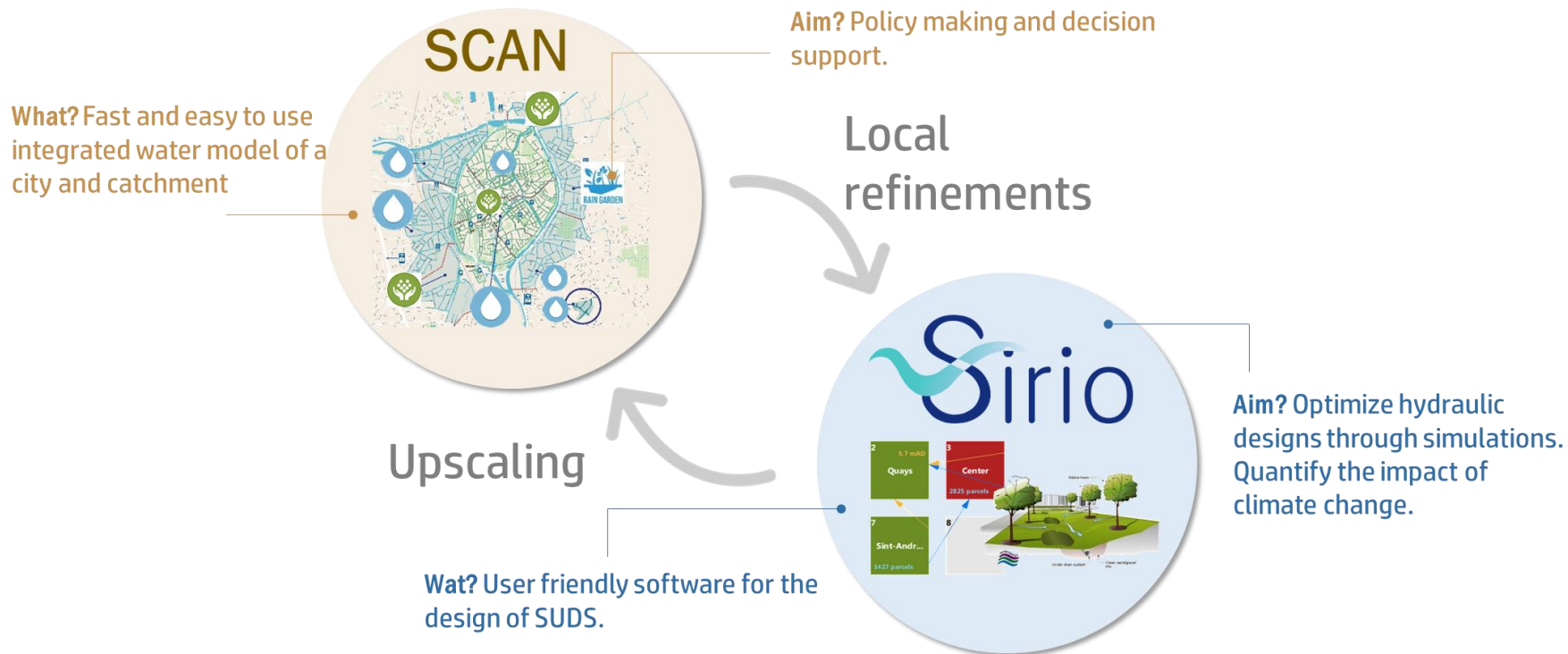


3

Water robust streets



# Integrated water planning tools



## Designed for cities & industry

- Design SUDS & quantify their effect
- Simulate 100 years in seconds
- See the impact of climate change

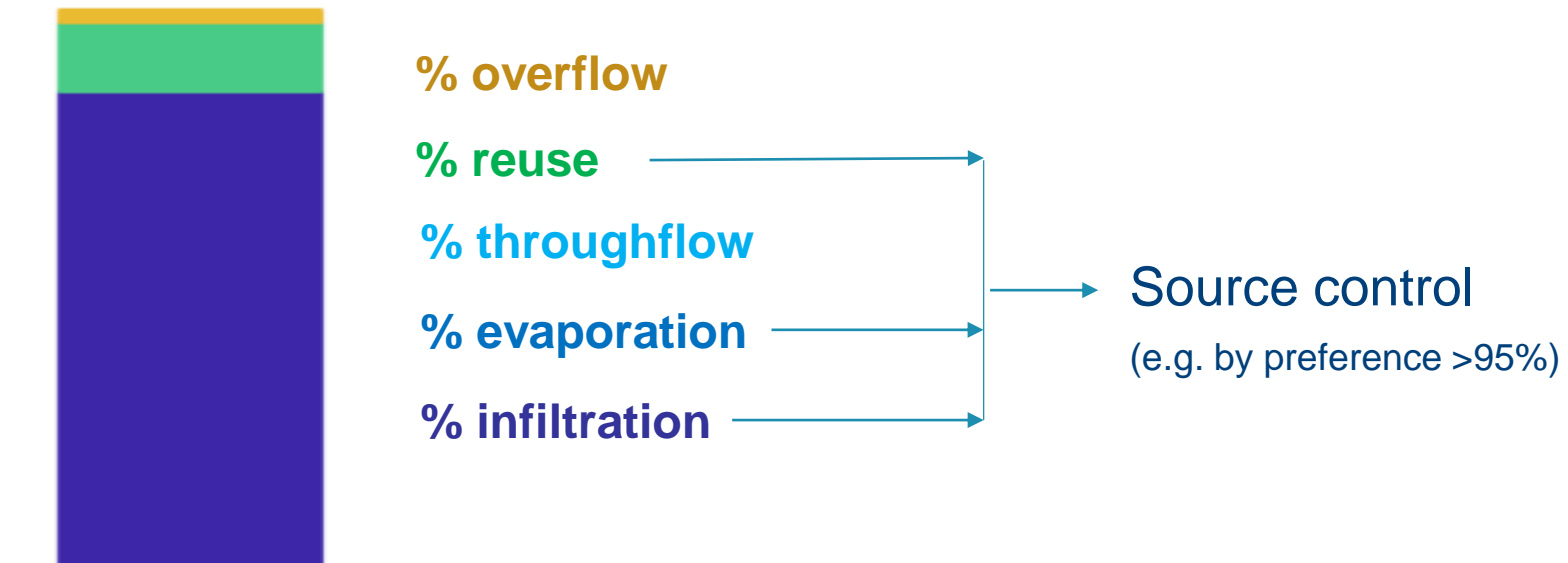


# Climate & water proof design

based on long-term simulations

(100 years 10-minutes rainfall in conceptual model of SUDS)

rain water “runoff” report:



# Climate & water proof design

based on long-term simulations

(100 years 10-minutes rainfall in conceptual model of SUDS)

rain water “runoff” report:



**% overflow**

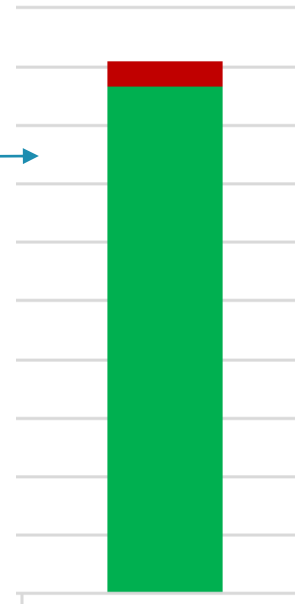
**% reuse**

**% throughflow**

**% evaporation**

**% infiltration**

rain water “demand” report:



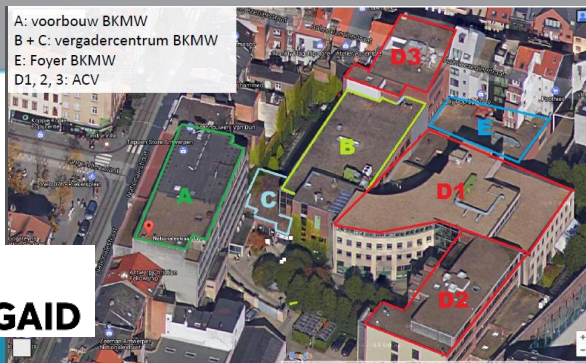
**% deficit**

**% reuse**

(e.g. by preference >95%)

**V = 30 m<sup>3</sup>**

# “Smart” greenroof



Antwerp living lab:



Rainfall forecast



Real-time regulation



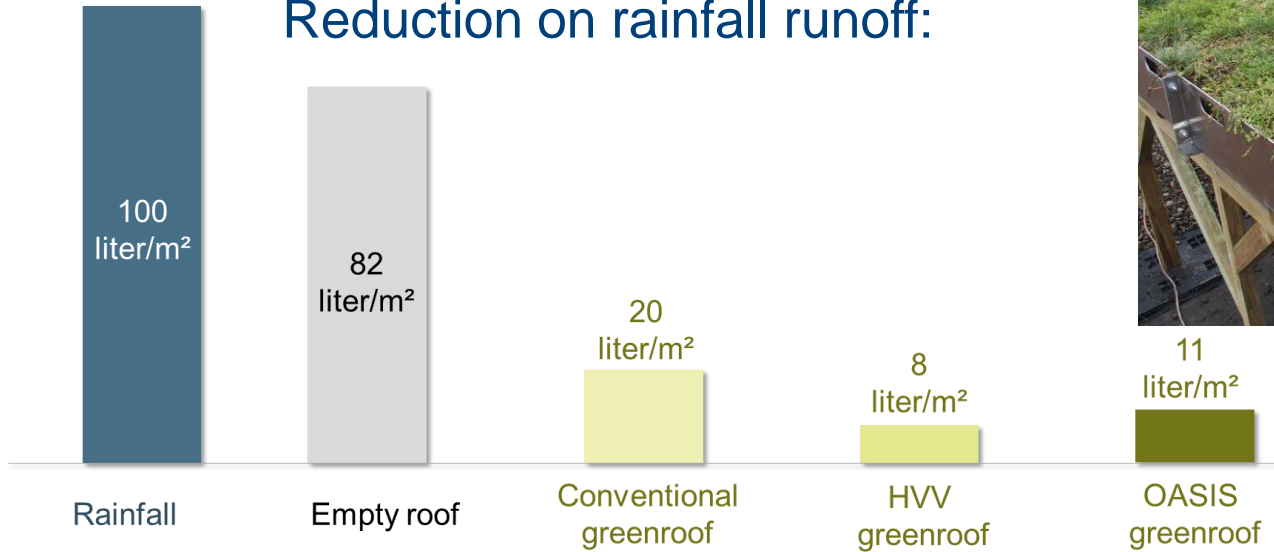
Sewer impact reduction  
(also based on sewer sensors)



KU LEUVEN

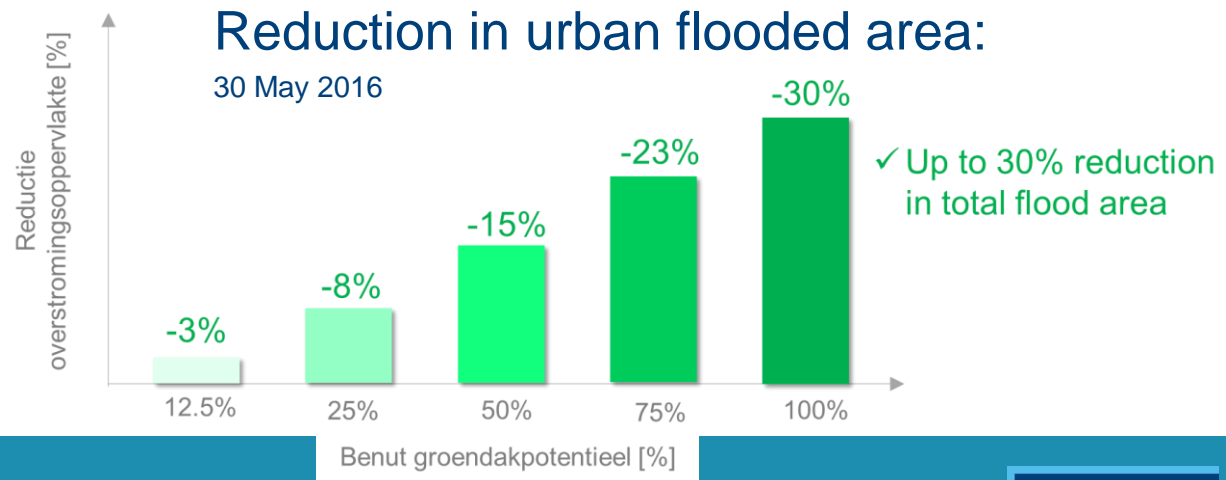
# “Smart” greenroof

Reduction on rainfall runoff:



Reduction in urban flooded area:

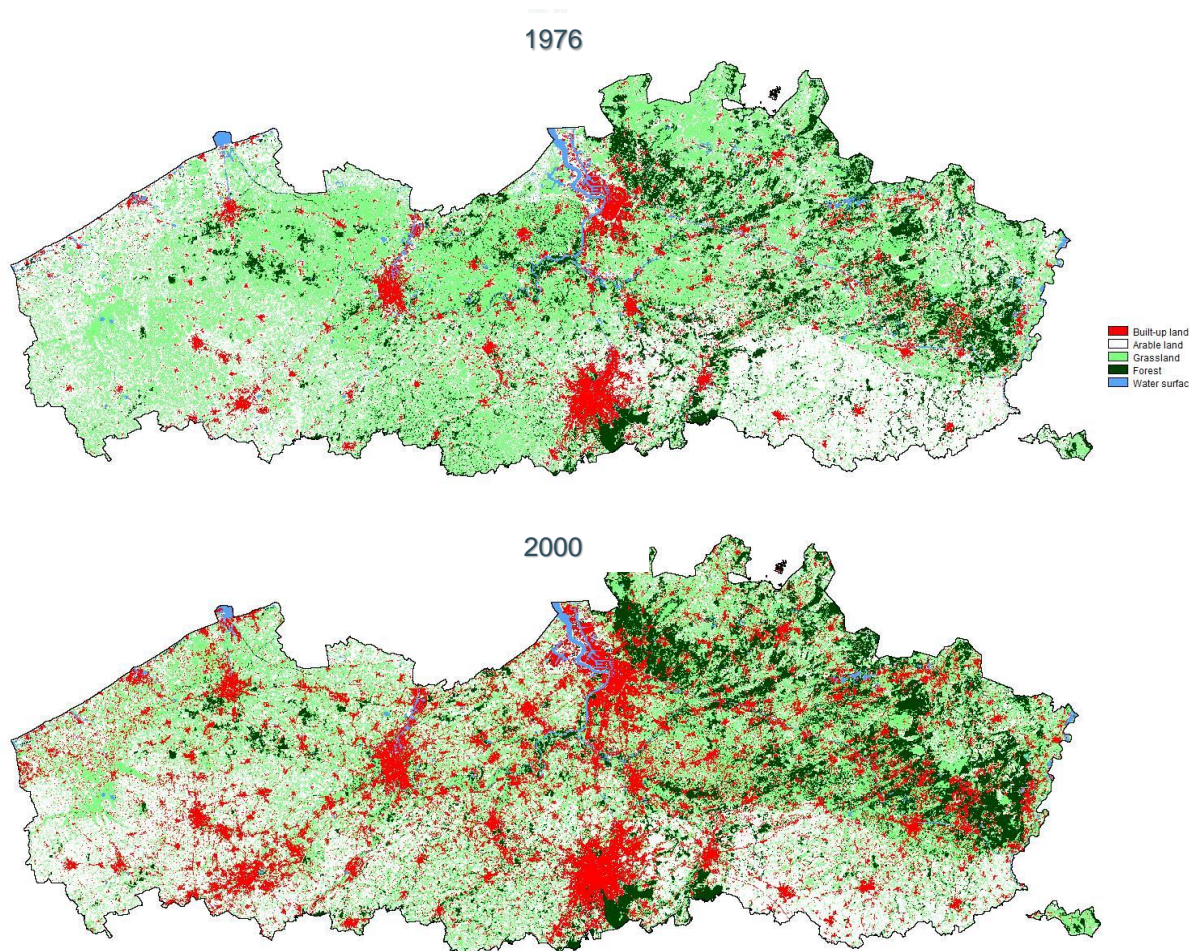
30 May 2016





# Urbanization -> Soil sealing

Increase in build-up areas and pavements:



*Flanders and Brussels:*

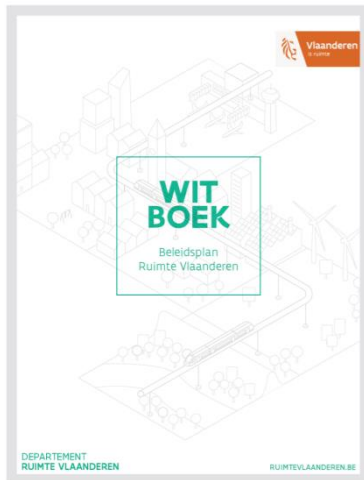
*1976: 4 – 5% paved*



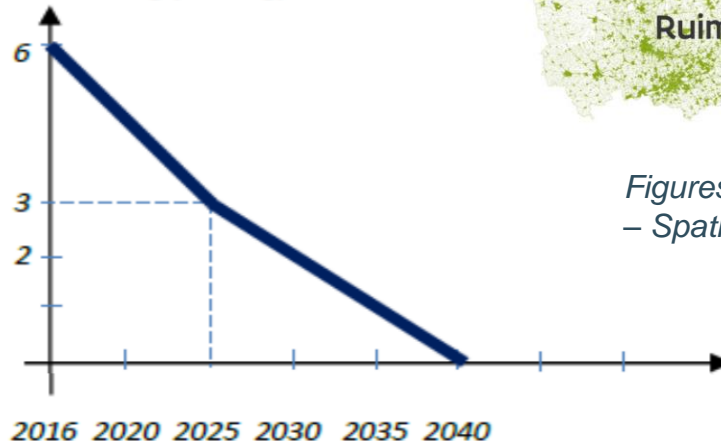
*2018: 14,5% paved*

# “Stop the soil sealing” plan

Flanders’ new White Book Spatial Planning (BRV):



ruimtebeslag (ha/dag)



*Figures: Authorities of Flanders  
– Spatial Planning Dept.*

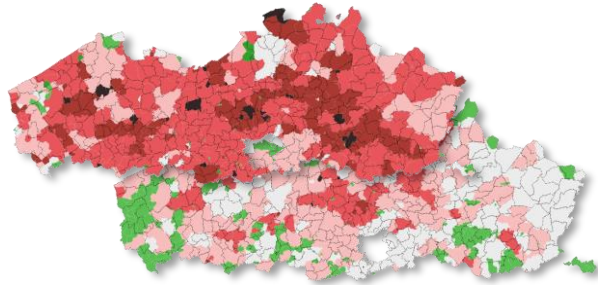
Two types of actions:

- Preserve the open spaces / urban expansion as an exception
- Increasing the spatial efficiency (densification in urban areas, but with attention for the quality of life)

# Economic benefits of SUDS

Impact on urban water planning (recent study for **VLARIO**):  
OVERLEGPLATFORM

Scenarios on land use & population density:



Source control measures:



**Sirio**

<https://www.sumaqua.be/sirio>



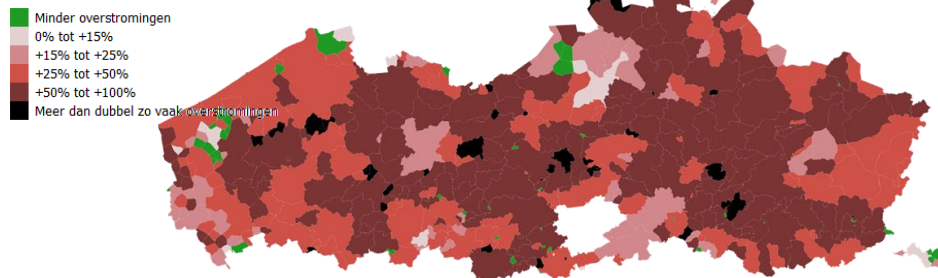
# Economic benefits of SUDS

Impact on urban water planning (recent study for **VLARIO**):  
OVERLEGPLATFORM

## Changes in flood frequency:

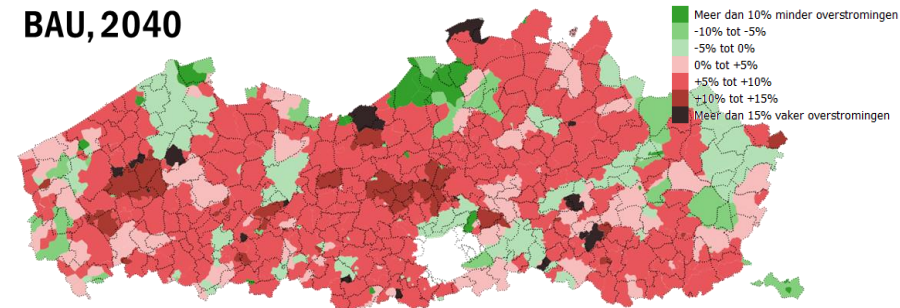
without source control measures:

**BAU, 2040**

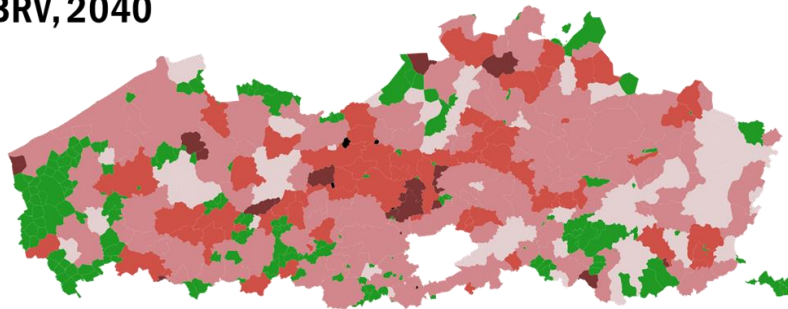


with source control measures:

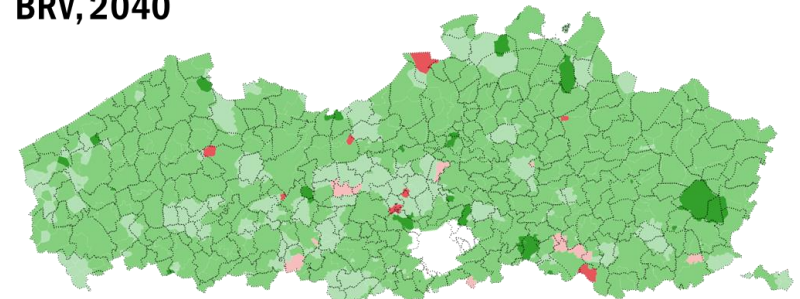
**BAU, 2040**



**BRV, 2040**



**BRV, 2040**



Economic benefits for urban drainage management:

**urban water planning cost in Flanders reduces from 3,4 to 1,8 billion €**  
(non-private investments)



*patrick.willems@kuleuven.be*