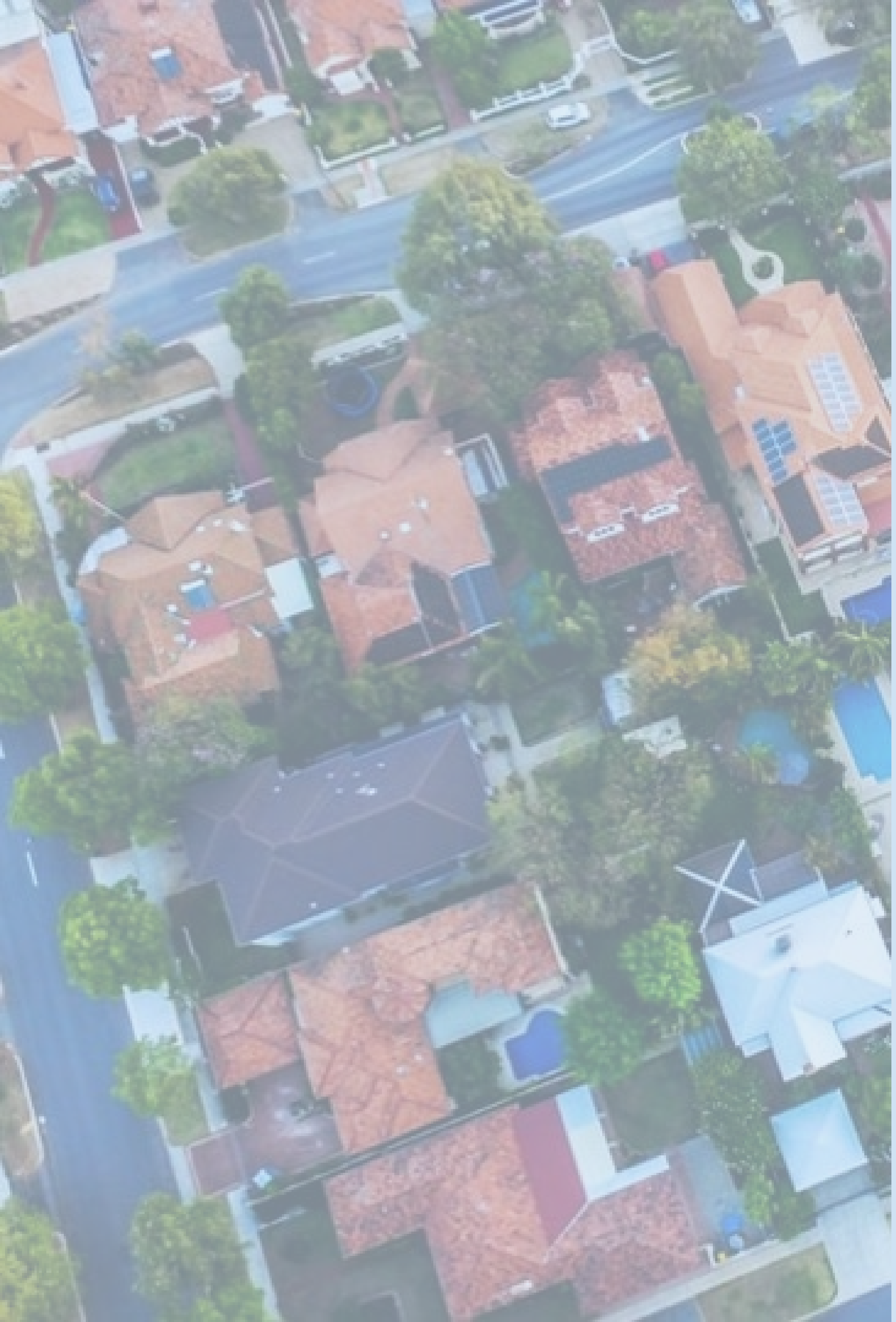

HydroEUROPE 2023

The Impact of Urbanization Growth and Development due to Climate Change on the Increase of Flooding Phenomena

Presentation WEEK 1

Presented by TEAM 4:

Cara Peetz
Daniel Felipe Babativa Guio
Lana Tarroun
Mahel Belakdim
Maja Wierzbicka
Marie Chabriel
Mathis Maissa
Mélanie Delom
Omar Andrés Rodríguez Murillo
Robin Nguyen
YoungChan Ju

EUROAQUAE+

HYDROEUROPE
Hydroinformatics for water resources and water related hazards management in Europe

1. Specific topic: Green Infrastructure

Challenge: With increasing urbanization and climate change flood events occur more frequently.

Tervuren: often affected by urban stormwater flooding events

Solution?

- European and (inter)national policies promote green infrastructure such as **NBS** and **LID**
- **Multifunctional green infrastructures**
  e.g. rain gardens, porous pavements and green roofs

➡ **How can we use green infrastructure effectively?**

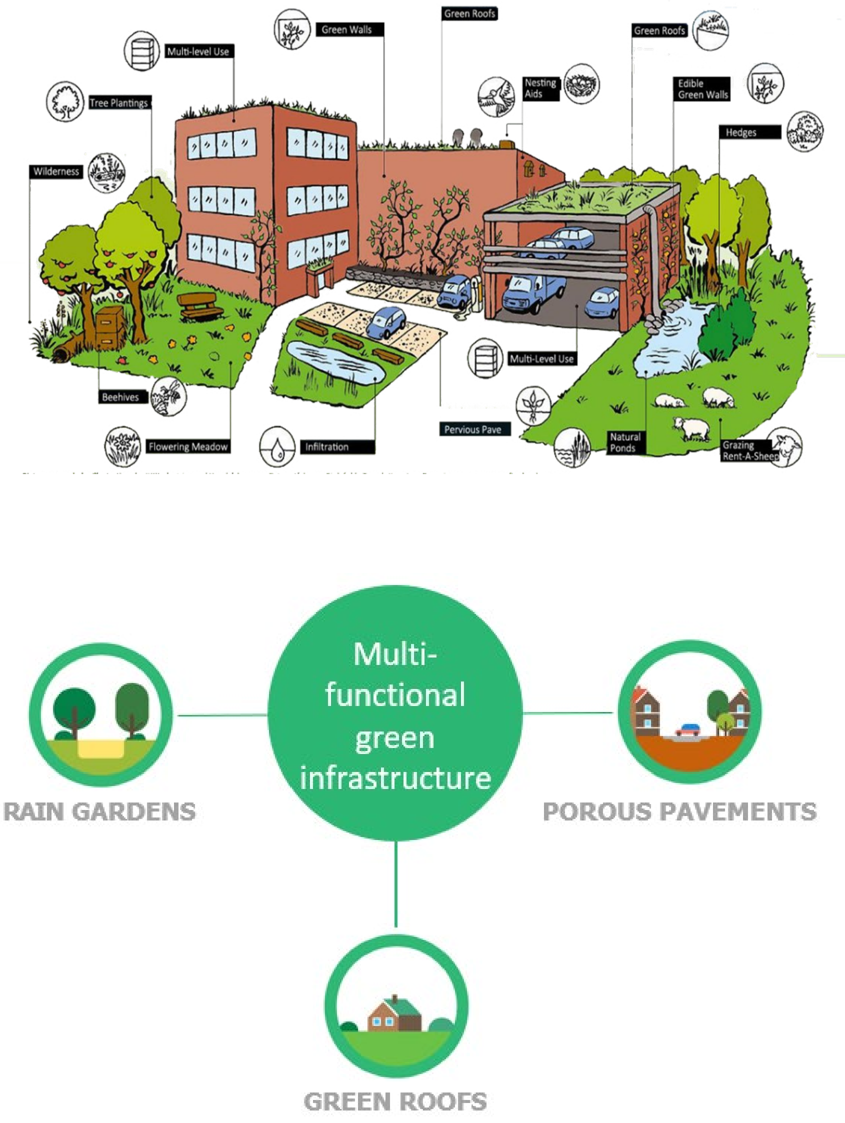

Figure 2: Green infrastructure

1. Specific topic: Rain Garden

Principle (also called bio retention)
- Stores and treats polluted runoff water
- Reduces the loads for combined sewer systems
- Improves urban landscapes
- Acts as a source of food and habitat for small animals

Consist of
- Deep-rooted plants, often aquatic
- Natural or artificial soil

Advantage
- Reduces heat island effect
- Improves water quality
- Localized flood control
- Enhances biodiversity
- Reduces irrigation requirements

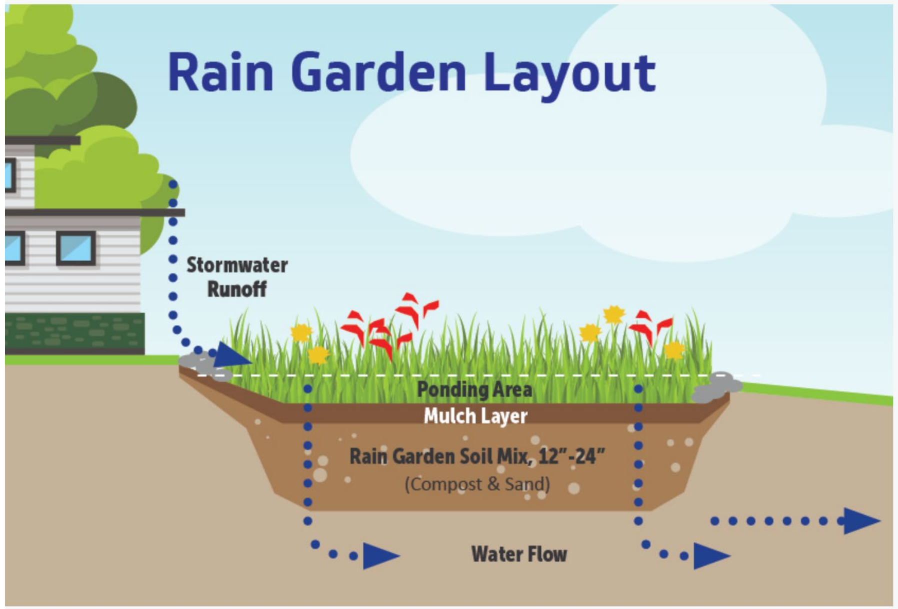

Figure 3: Function of a Rain Garden (Hillsborough County, 2022)

2. Case study: Tervuren Catchment

- **TERVUREN CATCHMENT**
  - **Area**: 33 km², located in Belgium
  - **Urbanized catchment (32%)**: ↘ Infiltration, ↗ surface runoff
    ➡ faster and higher peak flows during rainfall events
  - **Forested and agricultural land**: ↗ evapotranspiration and infiltration (due to the soil type)
    ➡ ↘ amount of water available for runoff

- **HYDROLOGICAL CONDITIONS**
  - **Temperate Maritime climate**: high precipitation levels
    → Possible **flooding** during heavy rainfall events
  - **Complex,** influenced by factors:
    → land use, topography, climate

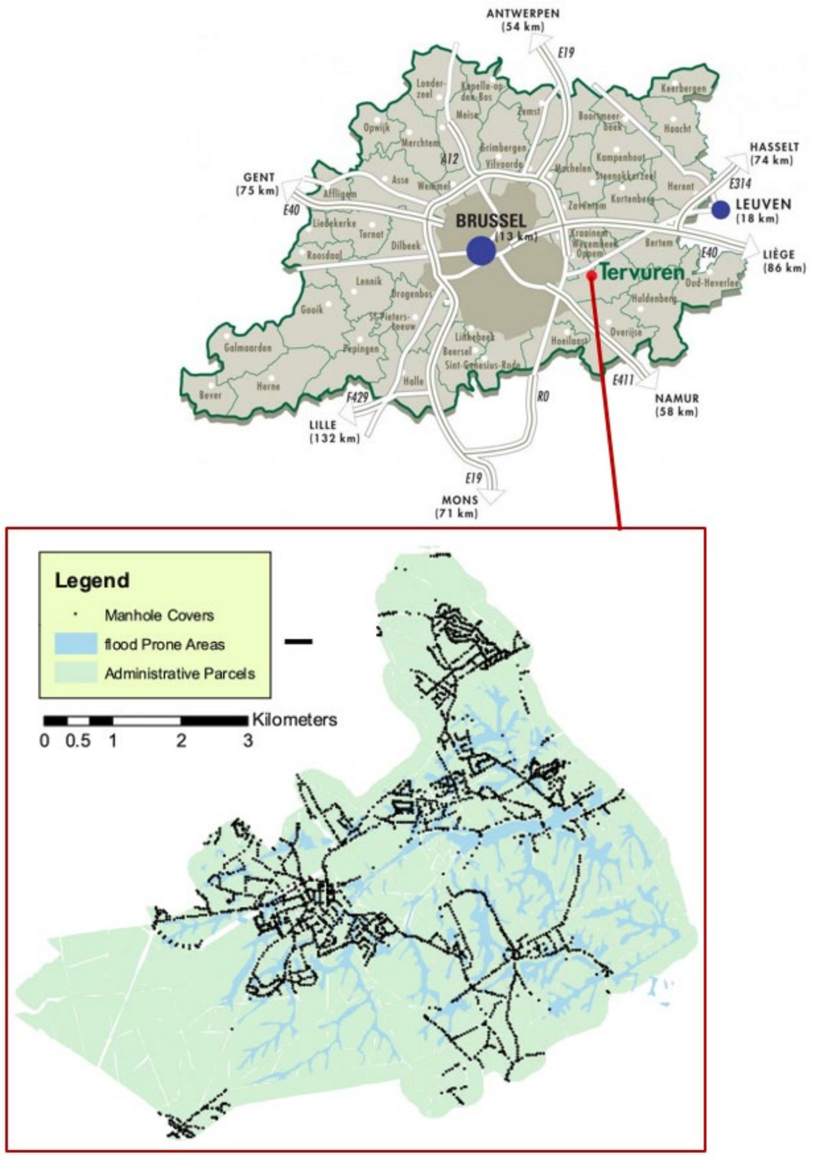

Figure 1: Map of Tervuren, Belgium
(Sources: bitagreen.io and visittervuren.be)

3. GIS Analysis

- Calculating the percentage of rain gardens in each sub-catchment
- Selecting rain gardens in sub-catchments within the threshold

Figure 4: Rain Gardens in Tervuren Sub-catchment (map created on QGIS)

4. SWMM

Parameter	Soil type			
	Silt Loam	Sandy Loam	Loam	Loamy Sand
Berm Height (mm)	50	50	50	50
Porosity (Vol. fraction)	0.5	0.453	0.463	0.437
Field Capacity (Vol. fraction)	0.285	0.19	0.232	0.105
Wilting Point (Vol. fraction)	0.135	0.085	0.116	0.047
Conductivity (mm/hr)	0.26	0.43	0.13	1.18
Suction Head (mm)	6.69	4.33	3.5	2.4

Conceptual Approach

- schematic rain gardens added as subcatchments
- pervious depressional storage 225 mm

Physical Approach

- 4 runs with varied soil parameters for the rain gardens
- rain gardens added to 150 subcatchments

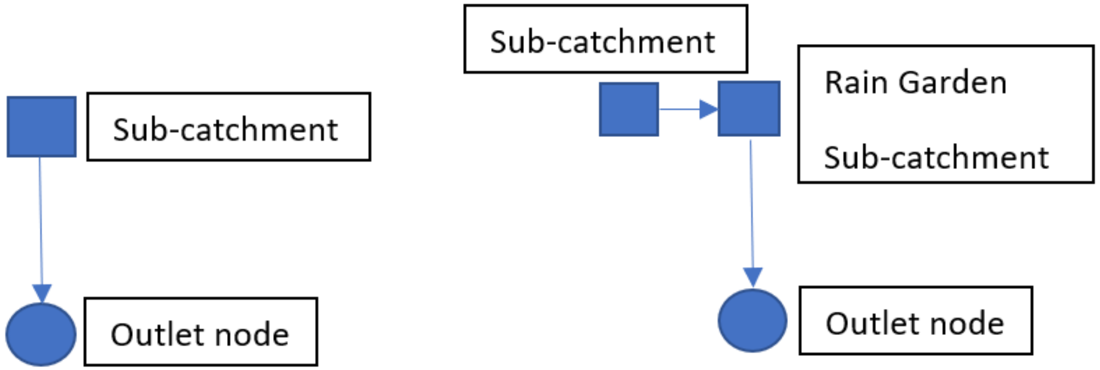

Figure 5: Conceptual approach diagram

5. Results

Physical Approach

Parameter	Depth (mm)				
	Initial Condition	Sandy Loam	Loamy Sand	Loam	Silt Loam
Surface Runoff	46.86	46.74	45.67	47.52	47.12
Final Storage	1.92	6.71	7.07	6.50	7.26
External Outflow	420.04	420.93	411.67	427.68	428.26
Final Stored Volume	11.10	11.03	10.99	11.04	11.01

- Only 0.04% of total Area was modified
- Thus, a more extensive application is required in order to have more effective results

Conceptual Approach

Outlet Node	Initial Condition	Conceptual Condition	
	Total Inflow volume 10^6 liters	Total Inflow volume 10^6 liters	Percentage Change [%]
N-K000343766	8.94	8.29	-7.3%
N-K000342280	7.9	7.67	-2.9%
N-K000342277	8.58	8.26	-3.7%
N-K000343675	0.283	0.192	-32.2%
N-K000341379	7.07	6.99	-1.1%
N-K000342276	0.0729	0.00132	-98.2%

Parameter	Volume hectare-m	
	Initial Condition	Conceptual Condition
Final Storage	1.651	1.814

Conclusions

- Rain gardens rely on the soil's ability to infiltrate runoff. Soils with higher conductivity values should be used to maximize potential flood reduction.
- The "pool" effect in rain gardens using perimeter berm elevations to create planter boxes should be maximized as construction conditions allow to increase the storage capacity.
- The conceptual approach can be used at the initial stages of the model development when soils information is not available.
- The physical approach requires much more knowledge about the properties of the engineered soil that will be used for constructing the rain gardens.
- The implementation of gardens as flood control structures, require a detailed analysis of the catchment soil properties, in order to prevent the aggravation of the original flood conditions.

Thank you for your attention!