MULTIDIMENSIONAL NBS SYSTEMS

Kerta Kõiv
Nils Kändler

Interreg
Co-funded by the European Union
Central Baltic Programme
MUSTBE

URBAN WATER SYSTEMS

International Workshop Best practices of nature-based solutions for urban runoff management and treatment and pilots in Tallinn, Viimsi, Pori, Riga and Soderhamn

06.03.2024 Tallinn

KEY POINTS

- What is multidimensional nature-based solution (NBS)
- Survey on NBS multidimensionality
- **Example**: How to apply multidimensionality on planning of urban NBS

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MULTIDIMENSIONAL NBS

Multidimensional in planning and implementing NBS means that except solving the primary benefit also receipt of co-benefits has been considered.

1) Co-benefits for human health and well-being;
2) integrated environmental performance (e.g., the provision of ecosystem services);
3) trade-offs and synergies to biodiversity, health or economy;
4) potential for citizen’s involvement in governance and monitoring

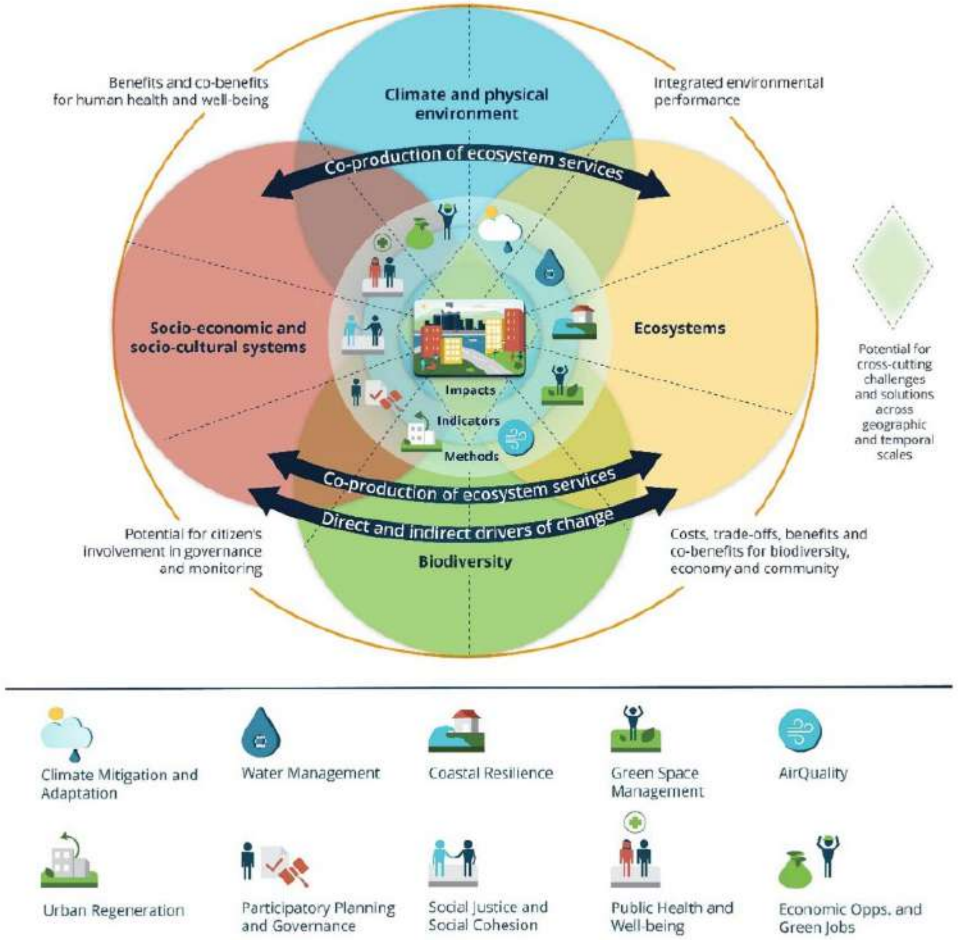

Figure 1: Four dimensions what are influenced by implementing NBS.

Source:A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas, 2017 https://doi.org/10.1016/j.envsci.2017.07.008

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MULTIDIMENSIONAL NBS IN URBAN AREAS

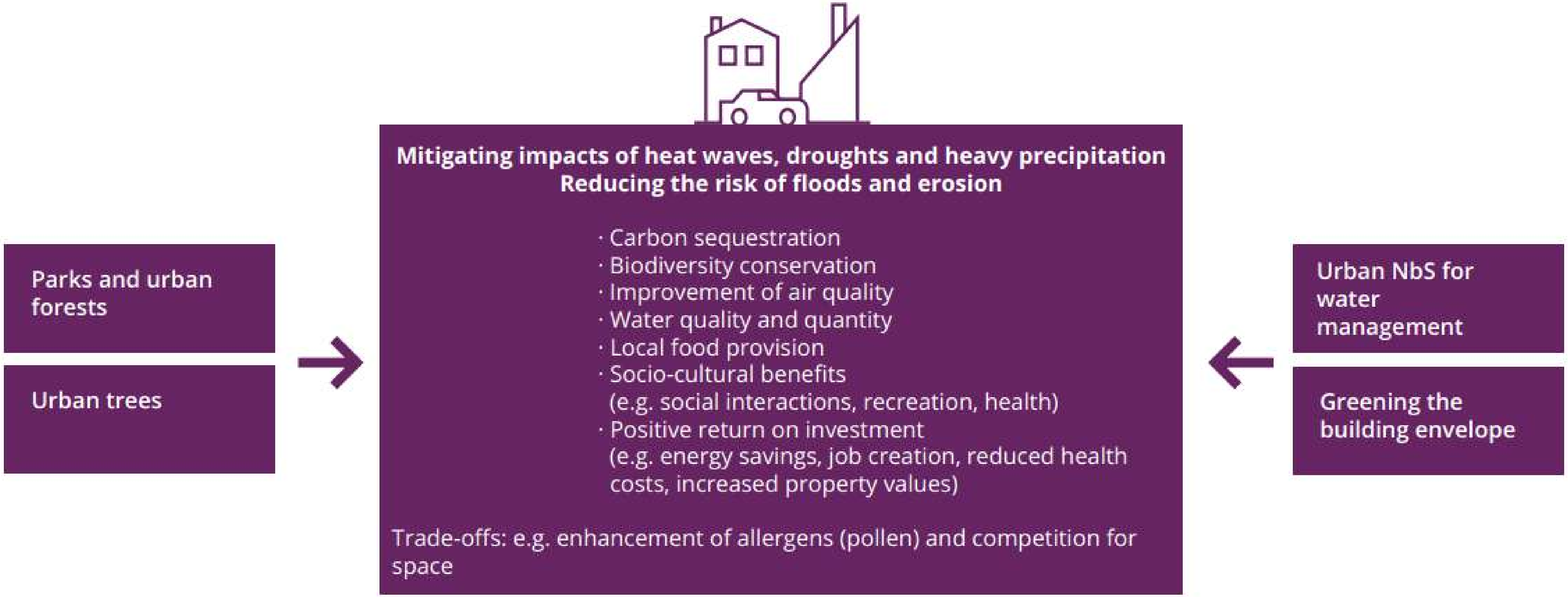

Figure 2: Key NBSs for addressing climate change impacts in urban areas and their multiple benefits and trade-offs

Source: EEA report 2021, https://www.eea.europa.eu/publications/nature-based-solutions-in-europe

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PLANNING MULTIDIMENSIONAL NBS

- **Selecting benefits** for multidimensional analysis NBSs -> **main and co-benefits**
- **Various valuation methods**
- **The relationships between NBS measures** and benefits should be characterized

Prioritizing significant co-benefits, characterizing their relationships with NBS measures, and applying appropriate valuation methods, a comprehensive multidimensional analysis of NBS benefits can be conducted to inform **decision-making processes** in flood risk management.

TOOLS:

- GIS analysis (Spatial Analysis)
- Stormwater system modelling

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ANALYSIS OF PILOT CASES

Preliminary work:

Key performance indicators were determined.

Key performance indicator (KPI)	Definition
Flood risk	Rainfall intensity exceeding infiltration capacity (pluvial flooding) and high-water levels in river channels exceeding bank heights and/or causing dyke breach (fluvial flooding).
Biodiversity & green space provision	Decreasing biodiversity loss (restoration of the habitat of a specific species) by increasing green space land use instead of grey areas.
Public health and well-beingn	Providing green areas like parks where people can walk and spend free time (run, walk, picnic, etc)
Safety of operations	Operational safety is defined as the absence of unacceptable risks, injury or harm to the health of humans, whether direct or indirect, resulting from damage to equipment or the environment.
Urban heat	Reduce the average air temperature in the urban areas.
Environmental protection	Ensure better water, air and soil quality.
Material Efficiency	NBS implementation in the built environment: green building materials, systems for the greening of buildings, and green urban sites.
GHG emissions	Reduce (carbon dioxide Co2, metahne CH4 and nitrous oxide N2O) GHG emission. Primary sources of GHG are electricity and heat (31%), transportation (15%), agriculture (11%), manufacturing (12%) and forestry (6%).
Social use & cohesion	Social cohesion refers to the strength of relationships and the sense of solidarity among members of a community.

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ANALYSIS OF PILOT CASES

Preliminary work:

Interviews and surveys conducted with the developers of the previous 23 pilot projects in four temperate climate zone countries of Europe, we have identified the primary and co-benefits.

	Primary benefit								
Project	Flood risk	Biodiversity & green space provision	Public health and well-beingn	Safety of operations	Urban heat	Environmen-tal protection	Material Efficiency	GHG emissions	Social use & cohesion
% off total project number	69.6	39.1	21.7	26.1	0.0	43.5	8.7	17.4	13.0

	Co-Benefit								
Project	Flood risk	Biodiversity & green space provision	Public health and well-beingn	Safety of operations	Urban heat	Environmen-tal protection	Material Efficiency	GHG emissions	Social use & cohesion
% off total project number	30.4	60.9	78.3	39.1	78.3	47.8	34.8	13.0	65.2

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ANALYSIS OF PILOT CASES

Preliminary work:

MUSTBE pilot project primary and co-benefits.

Primary benefit									
Project	Flood risk	Biodiversity & green space provision	Public health and well-benign	Safety of operations	Urban heat	Environmental protection	Material Efficiency	GHG emissions	Social use & cohesion
Estonia –Viimsi	1								
Estonia - Tallinn						1			
Finland - Pori						1			
Finland - Kempinte						1			
Sweden - Borberg	1								
Sweden - Söderhamn						1			
Latvia - Riga						1			
% off total project number	28.6	0.0	0.0	0.0	0.0	71.4	0.0	0.0	0.0

Co-Benefit									
Project	Flood risk	Biodiversity & green space provision	Public health and well-benign	Safety of operations	Urban heat	Environmental protection	Material Efficiency	GHG emissions	Social use & cohesion
Estonia – Viimsi		1	1			1			1
Estonia - Tallinn	1		1						1
Finland - Pori	1	1							
Finland - Kempinte	1		1						1
Sweden - Borberg		1	1						
Sweden - Söderhamn	1		1						
Latvia - Riga	1		1		1				1
% off total project number	71.4	42.9	85.7	0.0	14.3	14.3	0.0	0.0	57.1

TALLINN CASE

Main targets

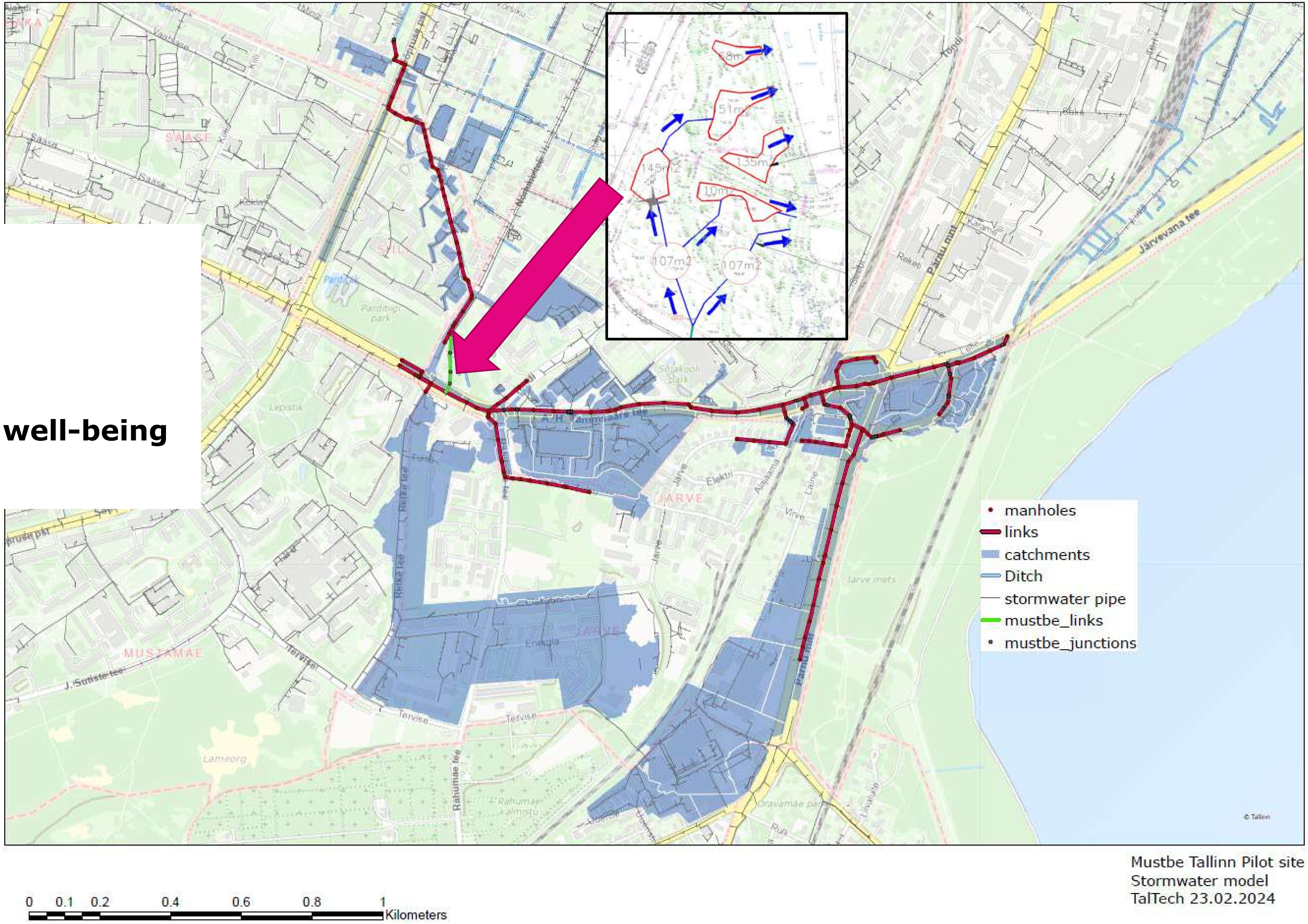
(1) **Flooding risk**

(2) **Water quality**

co-benefits:

(3) **Public health and well-being**

(4) **Urban heat**



Mustbe Tallinn Pilot site
Stormwater model
TalTech 23.02.2024

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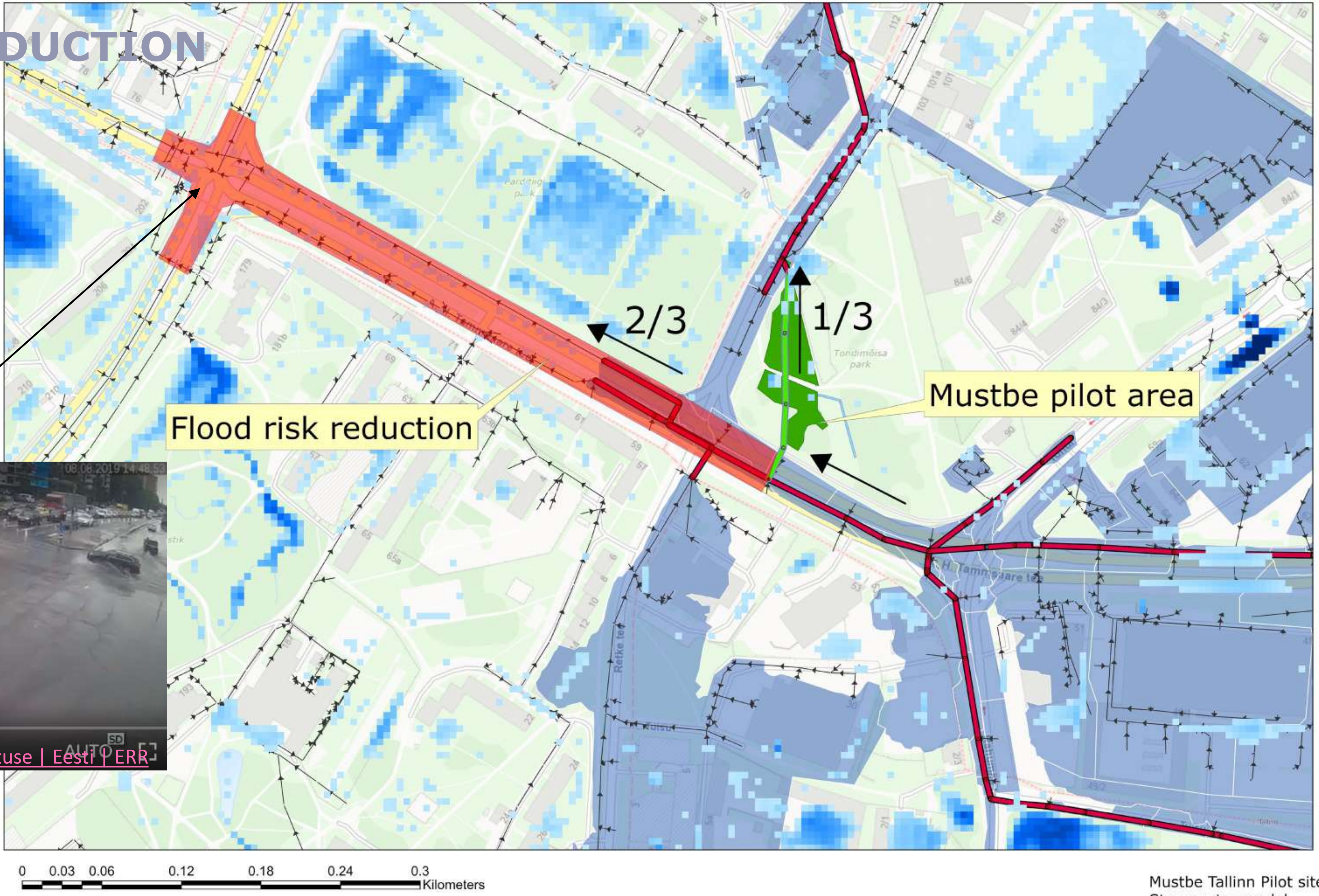
FLOOD RISK REDUCTION



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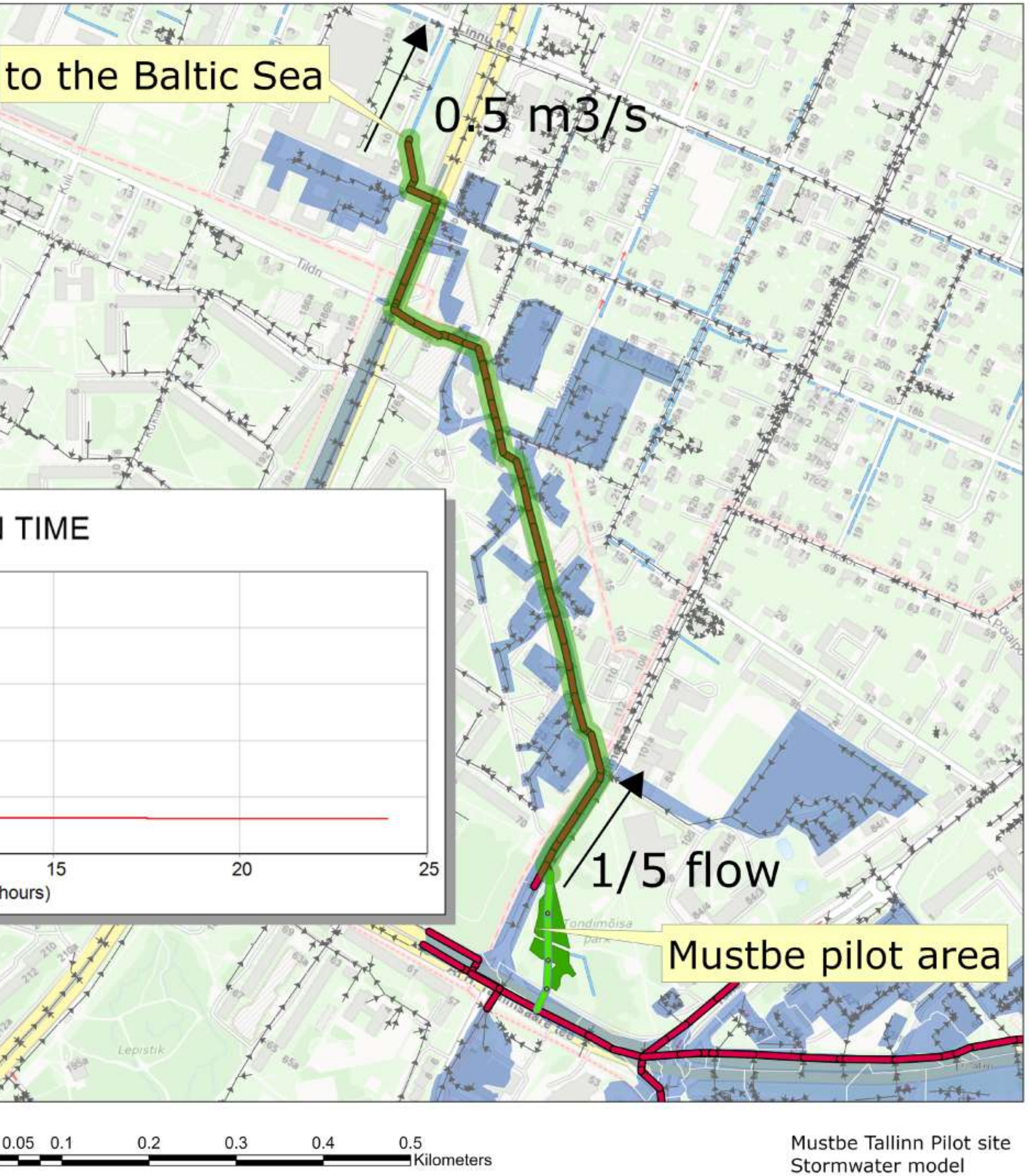
WATER QUALTY IMPROVEMENT

Land use	Suspended solids (mg/l)	Total Nitrogen (mg/l)
Mixed green area	43	1
Grass area	36	1.1
Parking areas	140	1.6
Industrial area	100	1.8
Asphalt surface	110	2
Residential area	45	1.8
baseline value	**98**	**1.8**
target value	**39**	**1.2**

60% SS and 30% N removal



Good quality

Bad quality

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PUBLIC HEALTH AND WELL-BEING

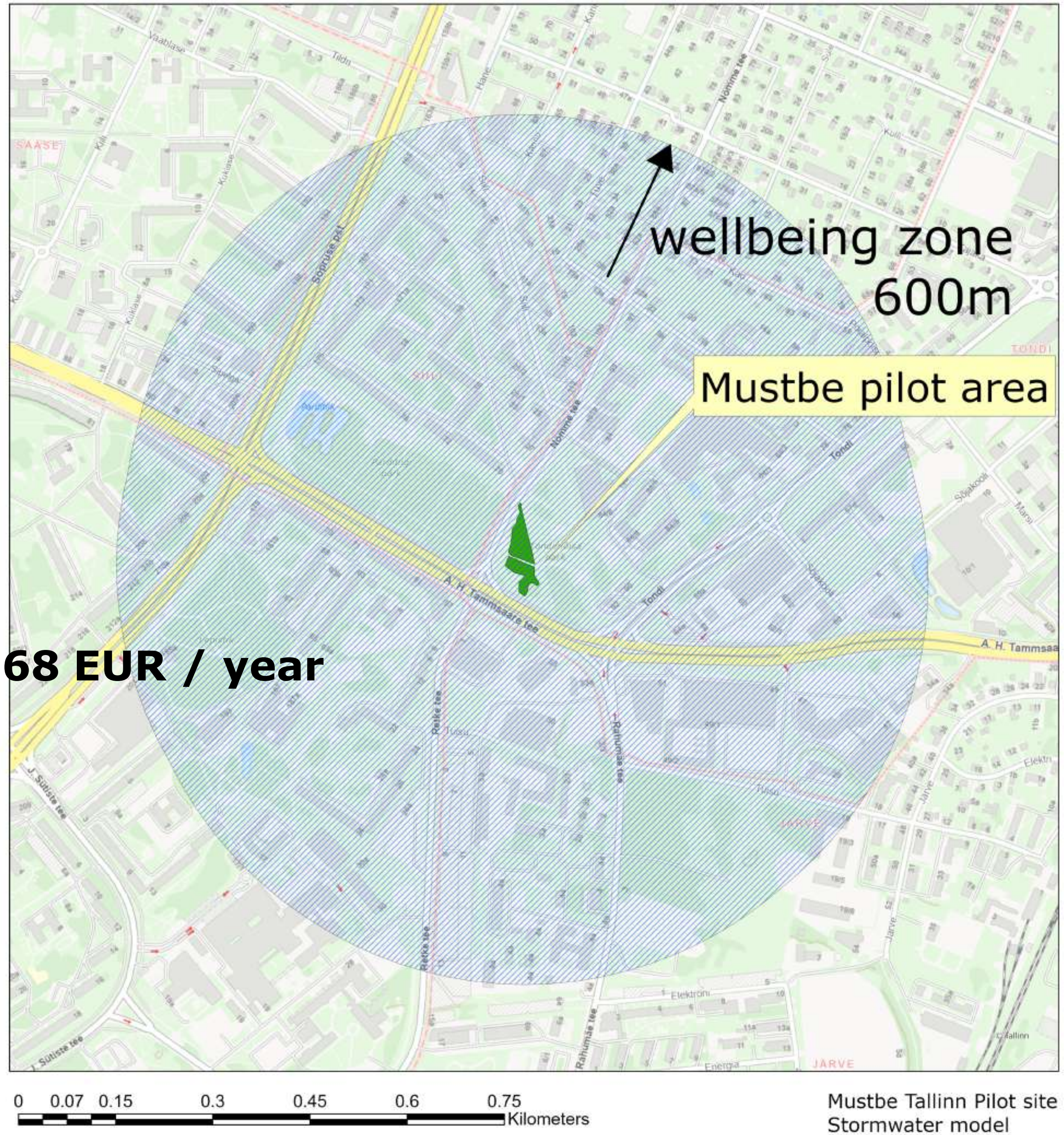
Green space positive associations to physical activity and indirect to health at distances of 1100 m or less, with a peak at **600 m** for most indicators
https://doi.org/10.1016/j.envres.2023.117605

Health expenses per persion 124.4 EUR/year

Affected persons 645*

Health h expenses impacted by Mustbe pilot **80,168 EUR / year**

(*) WHO green area availability suggestion 9 m²/person



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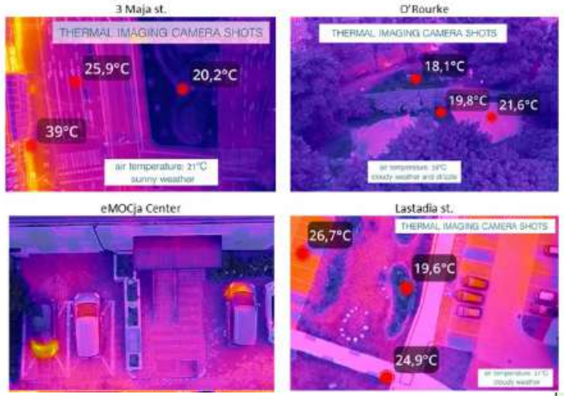
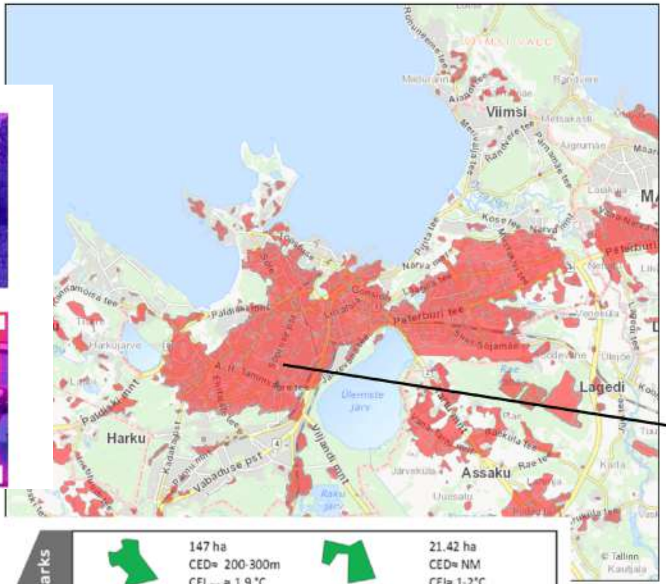
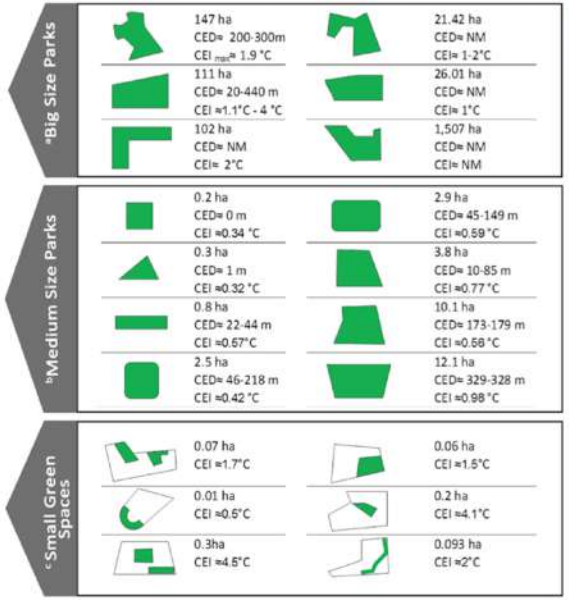
HEAT ISLANDS



Technical solutions and benefits of introducing rain gardens – Gdańsk case study

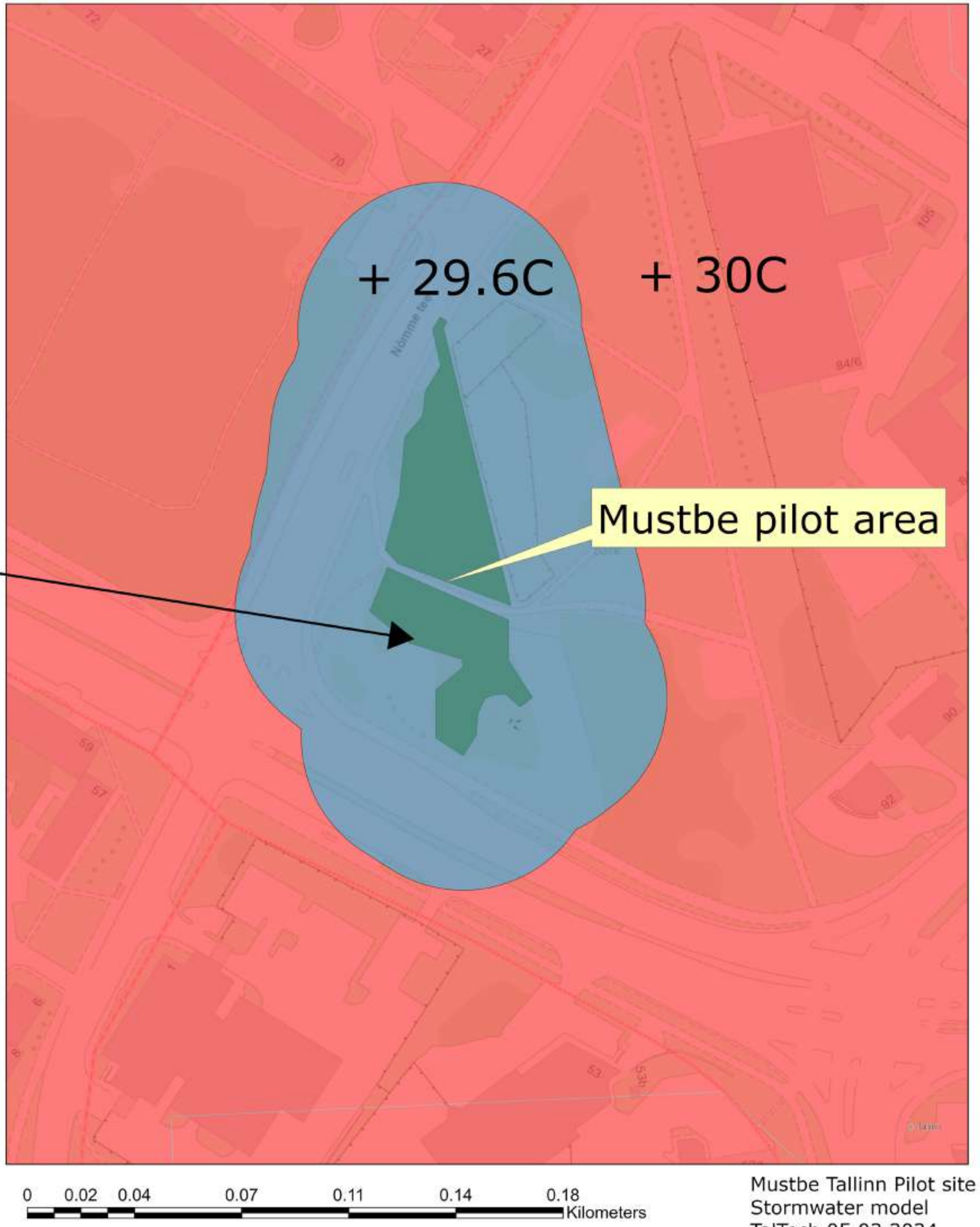
Magda Kasprzyk [a,b,*], Wojciech Szpakowski [c,d], Eliza Poznańska [c], Floris C. Boogaard [e,f], Katarzyna Bobkowska [b,g], Magdalena Gajewska [a,b]





cooling effect intensity (CEI) and cooling effect distance (CED)

https://doi.org/10.1016/j.heliyon.2019.e01339



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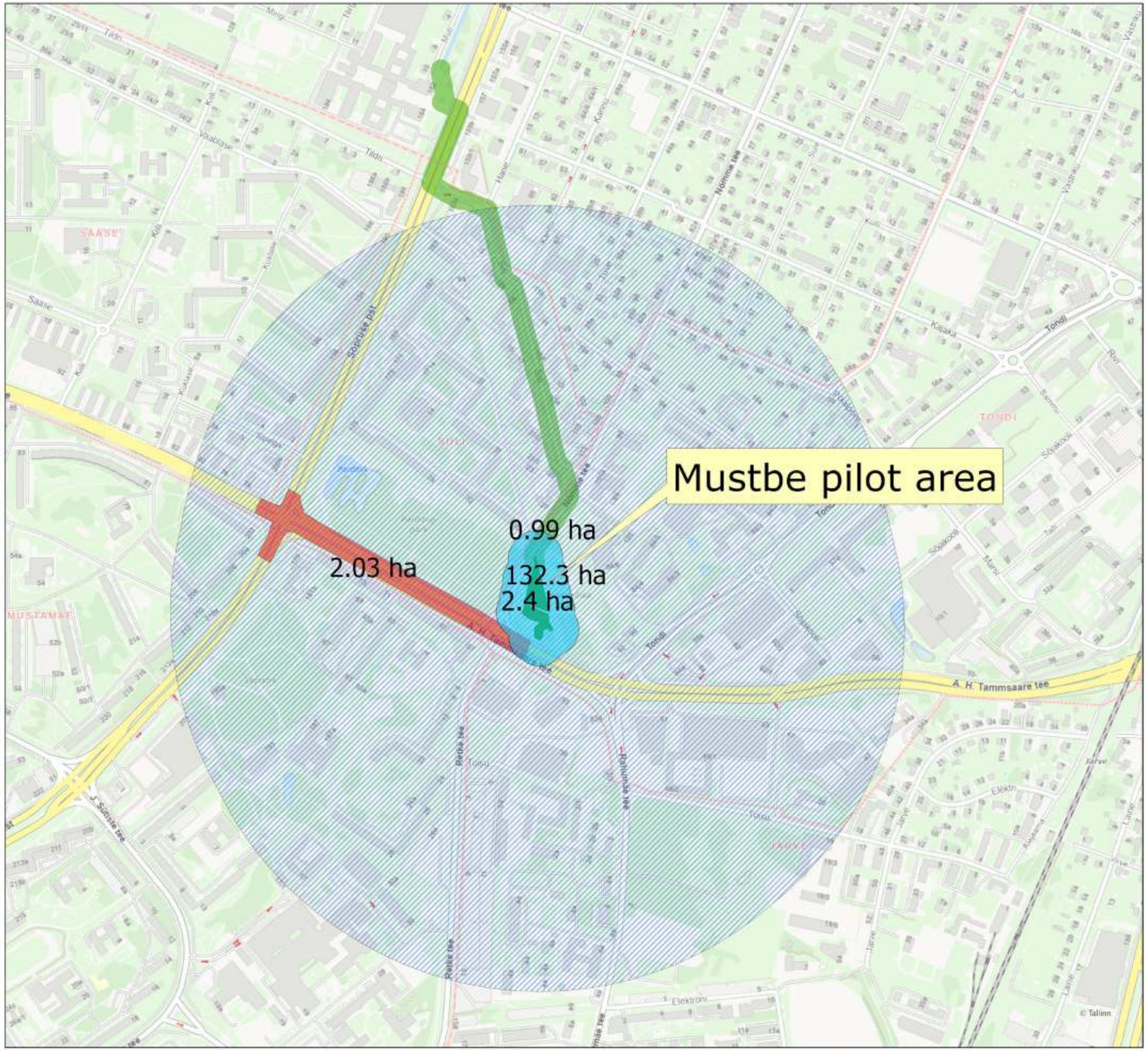
MULTI-OBJECTIVE ANALYSIS

- **Pilot site = 0.5 ha**
- **Impact area = 132 ha**

	impact_area	scale	importance
flood	**2.03**	**1**	**2.030**
quality	0.99	1	0.990
wellbeing	132	0.01	1.320
heat	2.4	0.1	0.240

Legend
- cooling
- wellbein
- quality
- flood



0 0.07 0.15 0.3 0.45 0.6 0.75 Kilometers

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DISCUSSION

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