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CONE

Adaptation and mitigation strategies for cities

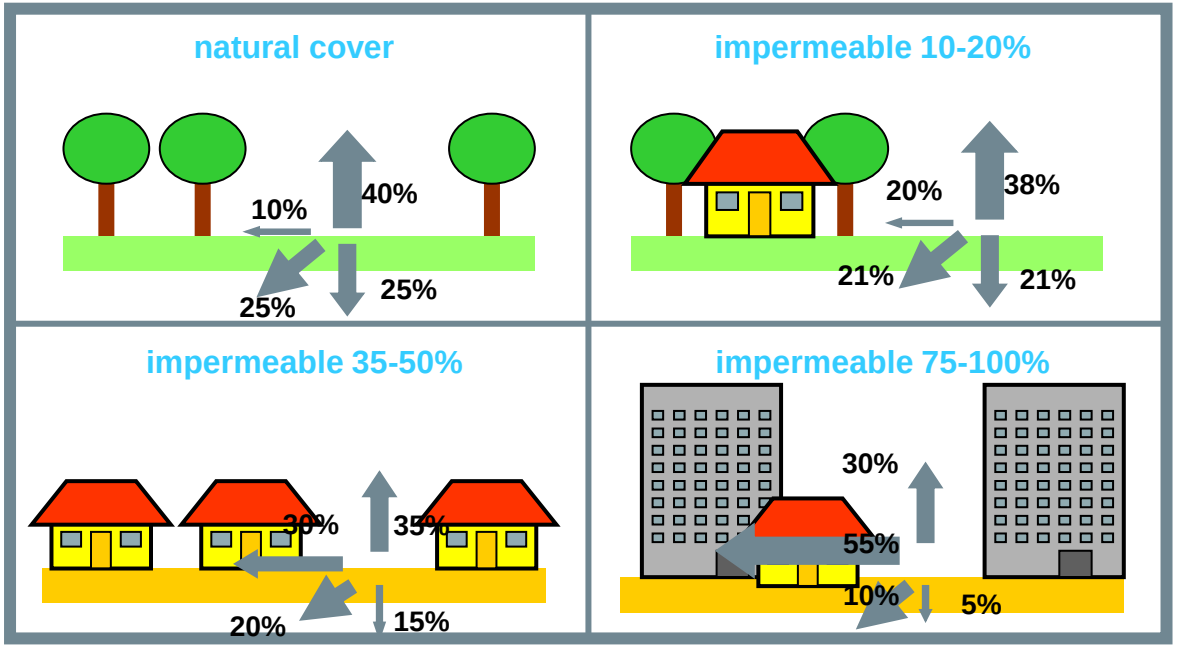
CONE – 1st Workshop - Training of trainers

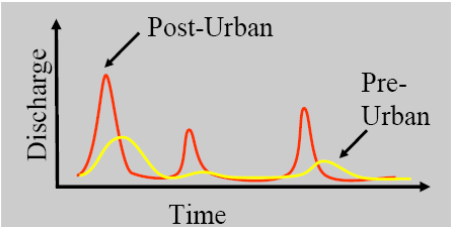
ONLINE | 3 of March 2025

Presenter: Magdalena Gajewska

HOW URBANISATION AFFECTS STORMWATER RUNOFF?

evapotranspiration runoff infiltration underground outflow





FLOODS in Gdańsku






2001 10 h -> 130 mm






2016 16 h -> 160 mm

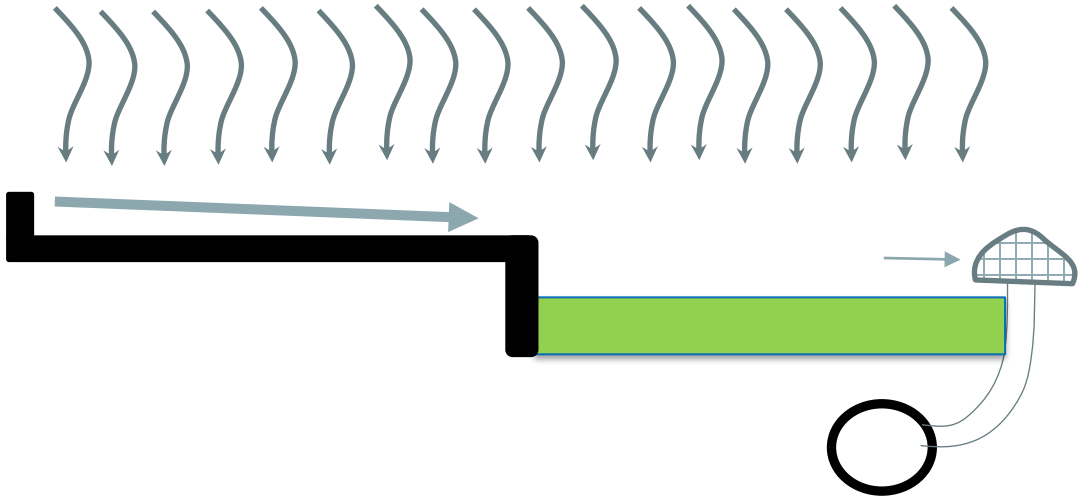
Changes in the approach to stormwater management

Rainwater drainage system (design recommendations), GDANSK but …..:

1. retaining 30–60 mm of rainfall in urban green areas
2. rainwater storage tanks
3. urban rainwater drainage system

Current approach in Gdańsk City

Integrating green infrastructure for water retention before the storm drain system since 2018 volume 200 000m^3 of precipitation in rain gardens and bioswales etc, REQUIRED 30mm to be keep in green or 60mm if there is no grey system



Adaptation of existing urban space

Technical solutions for managing stormwater from:

- **roofs – relatively good quality stormwater**
- **parking lots – e.g. petroleum products**
- **streets – heavily polluted runoff, e.g. heavy metals**

Possible to implement in existing urban space:

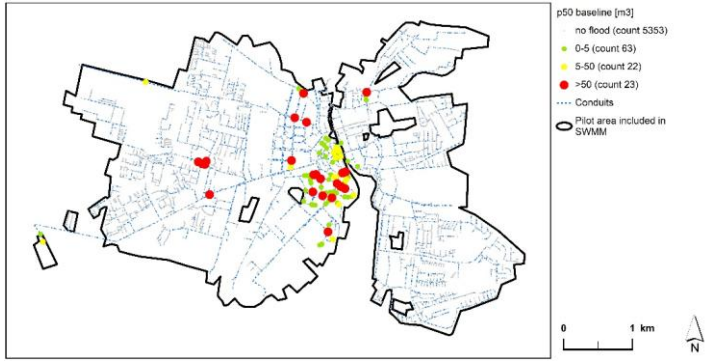
- **residential areas**
- **old town**
- **main intersections in the city centre**

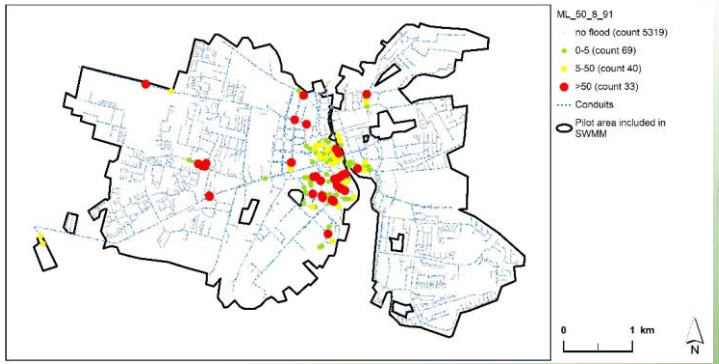
Implementation of EWL in Słupsk
NOAH project

Extreme Weather Layer (EWL) method enables various types of flood risk visualization

- flood risk classes based of the flooding flow rate:

Probability	Scenario	Classes - total flooding [m3]		
		0-1	1-10	>10
50%	**Current**	**63**	**22**	**24**
	RCP 4.5 2051-2060	**60**	**26**	**26**
	RCP 4.5 2091-2100	**68**	**27**	**29**
	RCP 8.5 2051-2060	**70**	**32**	**30**
	RCP 8.5 2091-2100	**69**	**40**	**34**
5%	Current	**89**	**46**	**51**
	RCP 4.5 2051-2060	**91**	**47**	**53**
	RCP 4.5 2091-2100	**94**	**45**	**55**
	RCP 8.5 2051-2060	**103**	**43**	**60**
	RCP 8.5 2091-2100	**102**	**42**	**64**





- Identification of flood-prone locations
- Determination of flood risk classes
- Selection of areas for NBS implementation

Holistic approach to stormwater management and treatment *NOAH PROJECT*

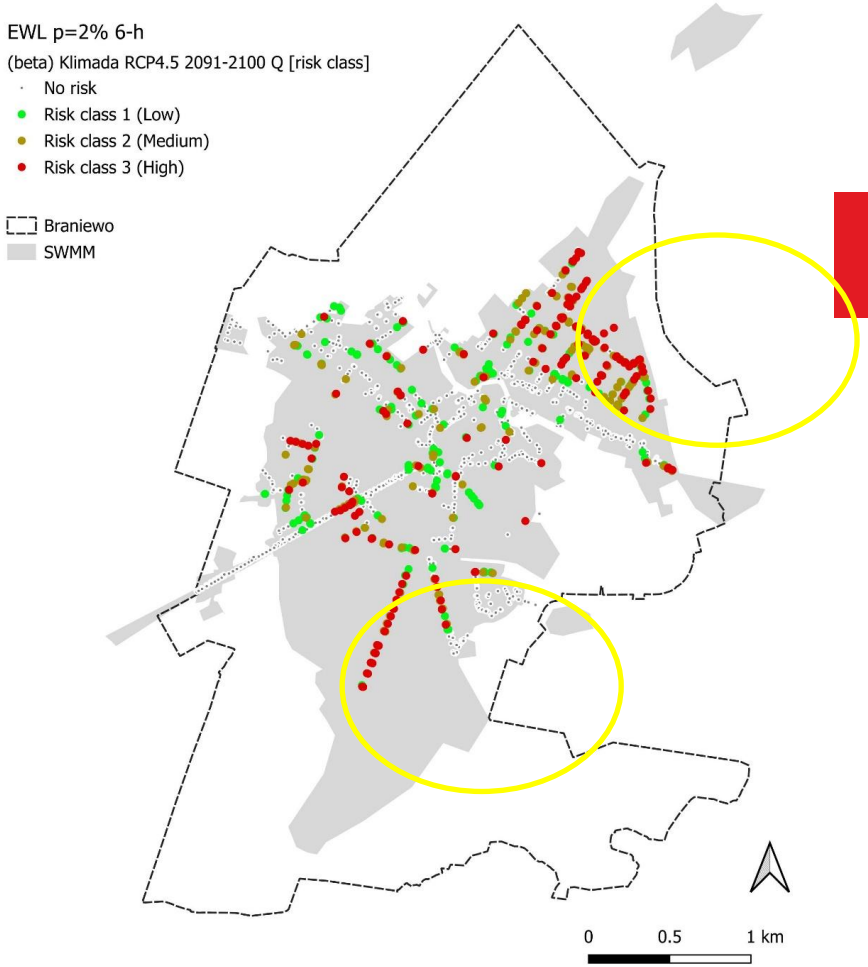
Słupsk pilot area – NOAH project activities:

- ✓ Development of **E**xtreme **W**eather **L**ayer – a spatial planning method as a part of adaptation to climate change strategy in the city of Słupsk
- ✓ Stormwater runoff quality monitoring

Probability	Scenario	Decrease in the flooding volume [%]	
		Total flooding in Słupsk	Overflow to the Słupia River
50%	Current	79	100
	RCP 4.5 2051-2060	76	100
	RCP 4.5 2091-2100	73	100
	RCP 8.5 2051-2060	71	100
	RCP 8.5 2091-2100	67	100
5%	Current	57	84
	RCP 4.5 2051-2060	55	79
	RCP 4.5 2091-2100	54	75
	RCP 8.5 2051-2060	52	69
	RCP 8.5 2091-2100	50	60

EWL

- **FUTURE TRENDS**
- **RCP 4.5 Klimada horizon 2091-2100**



Adaptation of existing urban space

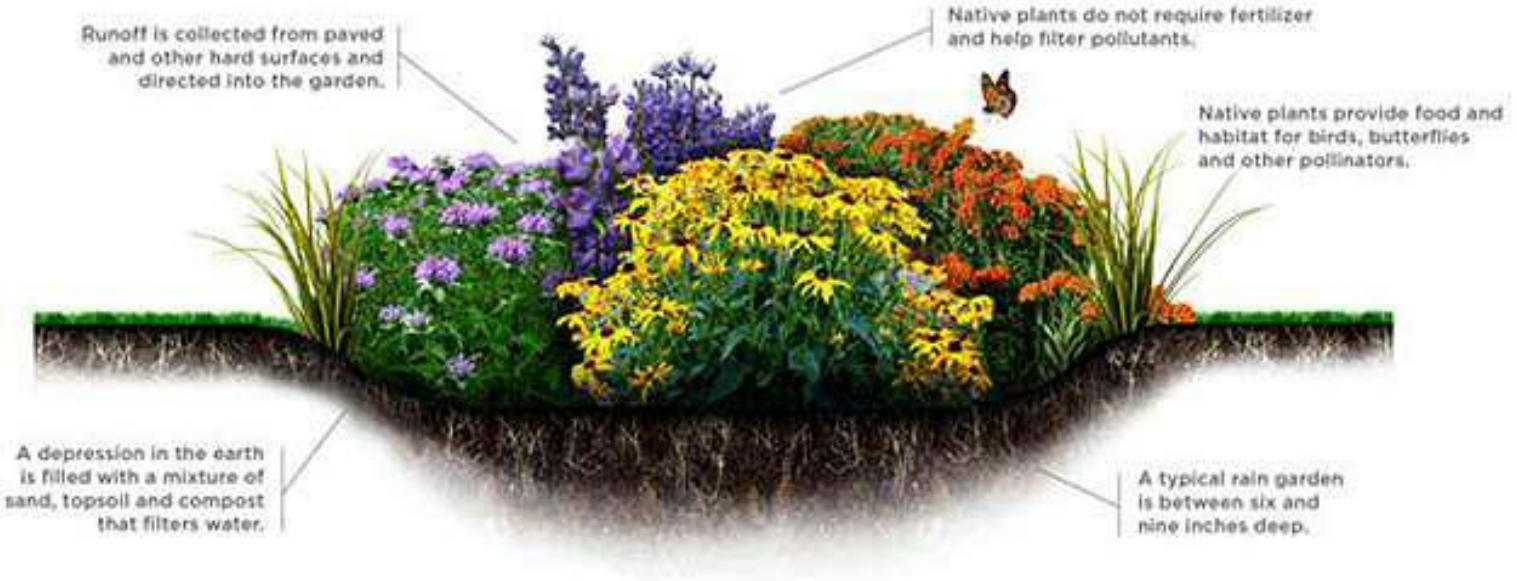
Benefits:

- Prevention of local flash floods
- Improvement of microclimate
- Mitigation of the urban heat island effect
- Increase in biodiversity
- Tailored approach to the specific catchment area, including technical solutions to improve the quality of stormwater

https://www.urbangreenup.eu/solutionsnn/water-interventions/rain-gardens.kl

What is a Rain Garden?

Nature's Water Filter: Rain gardens are shallow landscaped depressions that capture, clean and absorb stormwater runoff from roofs, parking lots and roads.

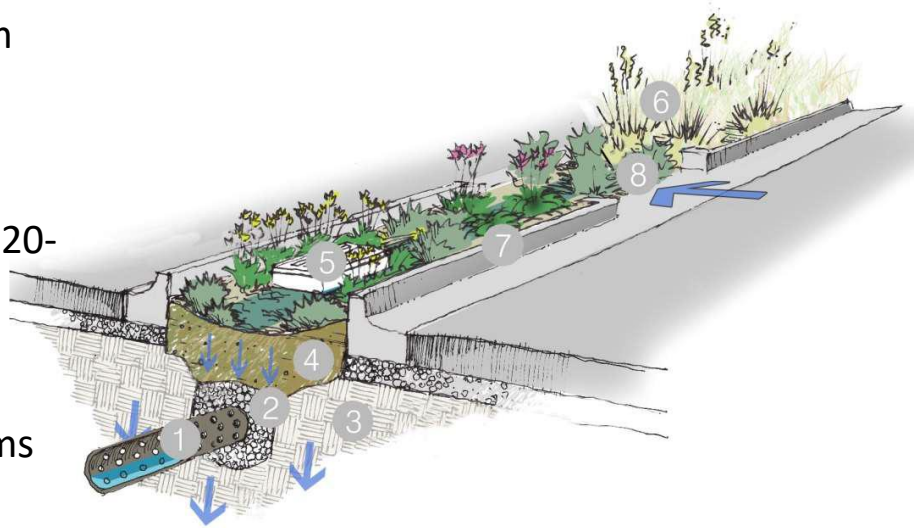


https://www.urbangreenup.eu/solutionsnn/water-interventions/rain-gardens.kl

- A rain garden is a bioretention shallow basin designed to collect, store, filter andtreat water runoff. To optimise its functions, it must include a porous soilmixture, native vegetation and some hyperaccumulator plants, capable of phytoremediation.

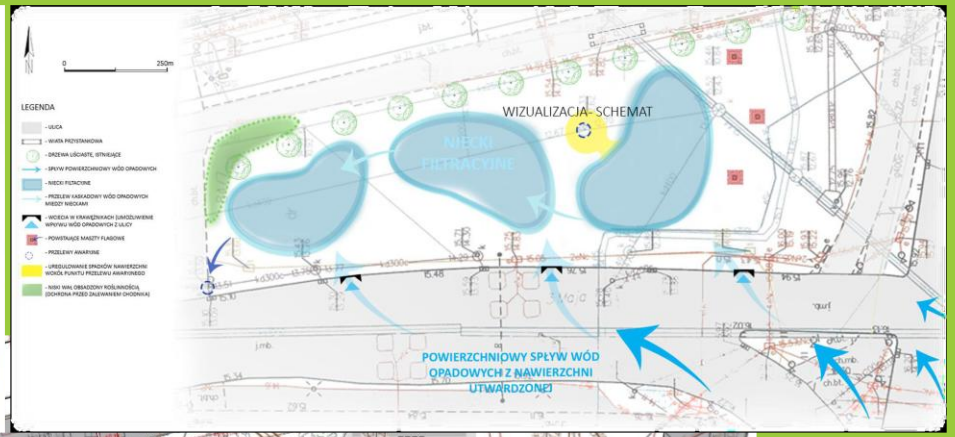
The rain gardens are built with:

- A perforated pipe connecting to basin or stream outlet. (1)
- Gravel pipe bed. (2)
- Native soil. (3)
- Soil mixture of 50% sand, 20-30% compost and 20-30% topsoil. Sand
- creates a draining soil. (4)
- Overflow control structure. (5)
- Vegetation. Native plants with deep root systems that absorb runoff and
- pollutants. (6)
- Curb and gutter. (7)
- Curb cut to allow water to enter the rain garden. (8)

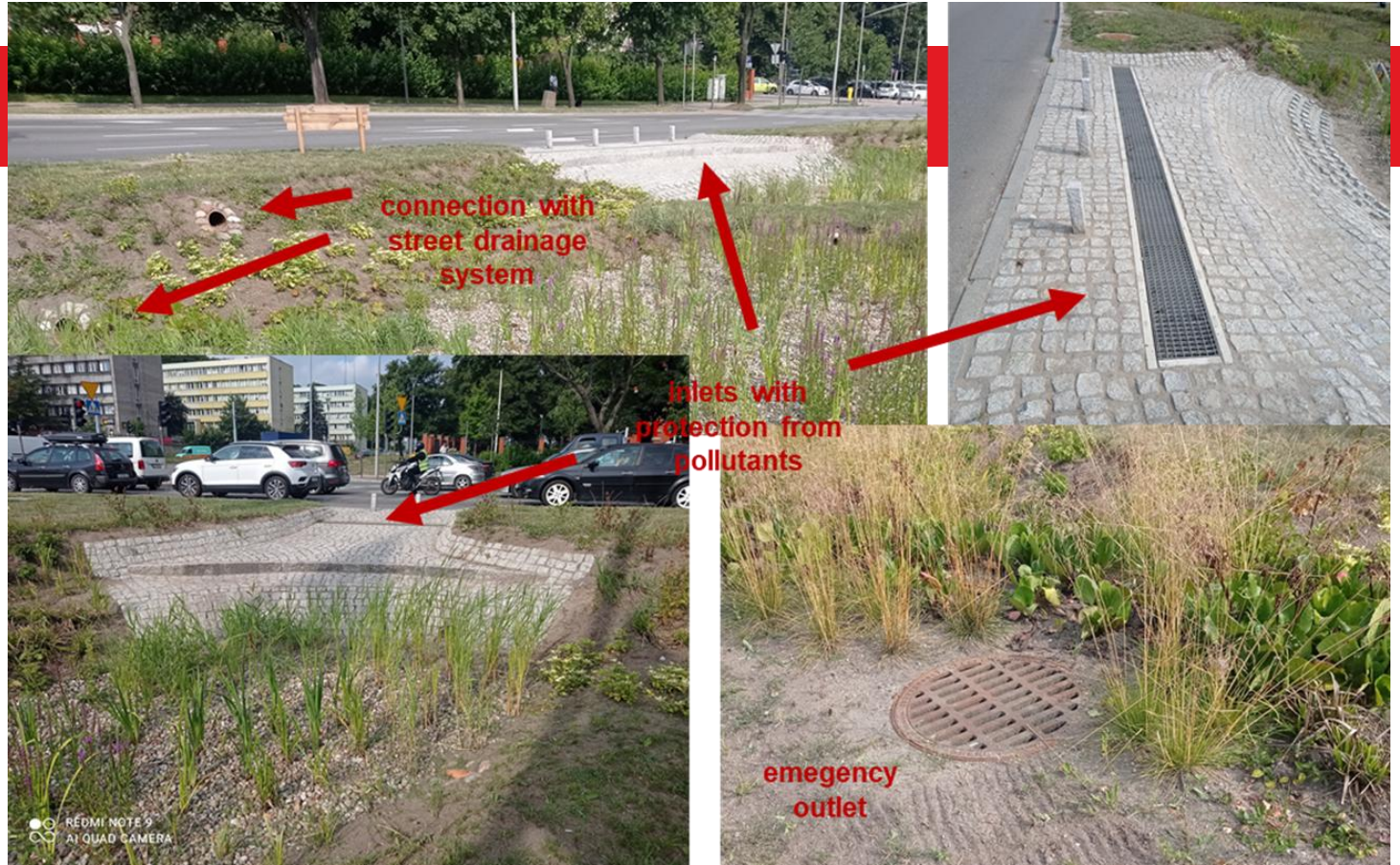


By URBAN GreenUp

The Development of the Rain Garden Concept

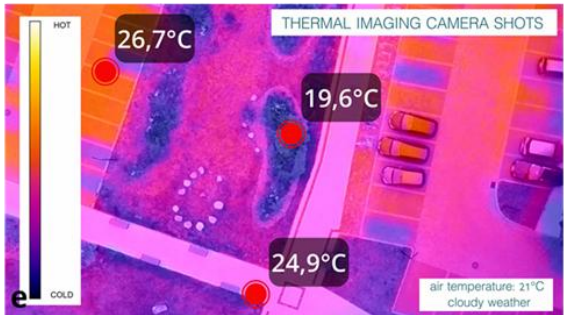


How ?


connection with street drainage system
inlets with protection from pollutants
emegency outlet
REDMI NOTE 9
AI QUAD CAMERA

HEAT ISLAND, 3 Maja St , Rain Garden

Rain Gardens in Gdańsku



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

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

HIGHLIGHTS

- Rain gardens as a smart tool for climate city adaptation
- High variation in infiltration rate between monitored rain gardens
- Infiltration rate of emptying to contribute to less flooding and drought mitigation
- Variety of technical solutions tailored for a different types of urban runoff
- Rain gardens as a unit for building system recovery in an urban circular economy

GRAPHICAL ABSTRACT

Results for biodiversity - existing rain gardens

Rain garden	3 Maja St.	O'Rourke Square	eMOCja Center	Lastadia st.	Kaczeńce
Dominant plant species	• Iris pseudacous • Glyceria maxima • Phalaris arundinacea • Acorus calamus • Phragmites australis	• Iris sibirica • Hemerocaliss • Anemone hybrid • Hosta sieboldiana • Darmera peltata	• Deschampsia caespitose • Lysimachia nummularia • Hemerocaliss • Myosotis scorpioides • Glyceria maxima	• Lysimachia nummularia • Iris sibirica • Deschampsia caespitose • Carex muskingumensis • Myosotis scorpioides	• Phragmites australis • Phragmites humilis • Rosa `Rugby` • Glyceria maxima • Iris sibirica
Total species number (S)	**41**	**34**	**25**	**47**	**34**
Total plant number (N)	**4654**	**3913**	**783**	**4107**	**1248**

Rain garden	Shannon Evennes index (D)	Shannon Diversity index (H)
3 Maja St.	0.837	3.110
O'Rourke Square	0.909	3.205
eMOCja Center	0.963	3.100
Lastadia st.	0.943	3.631
Kaczeńce	0.929	3.275

usually 1.5 - 3.5.

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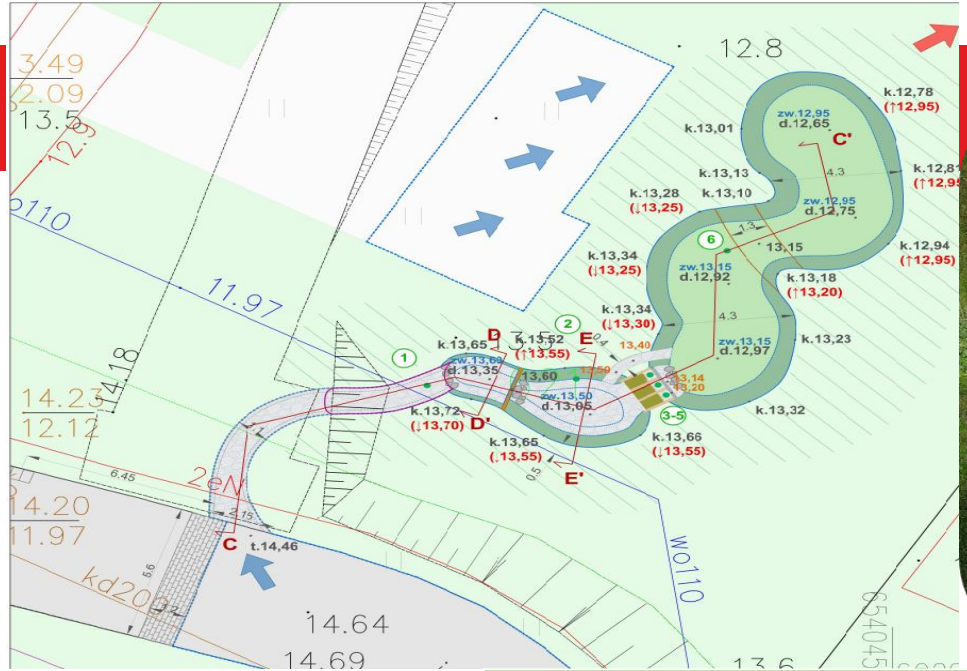
Gdeńsk Tech – URL 9, NICE H2020, rain garden 2.0



Ecosystem services			
Provisioning	**Regulating**	**Cultural**	**Supporting**
☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆

Solutions , parking lot

GDANSK

Connection to Drenage system

GDANSK

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INICJATYWA DOSKONAŁOŚCI

How ? In a box ?

GDANSK

Technical aspects - inlets

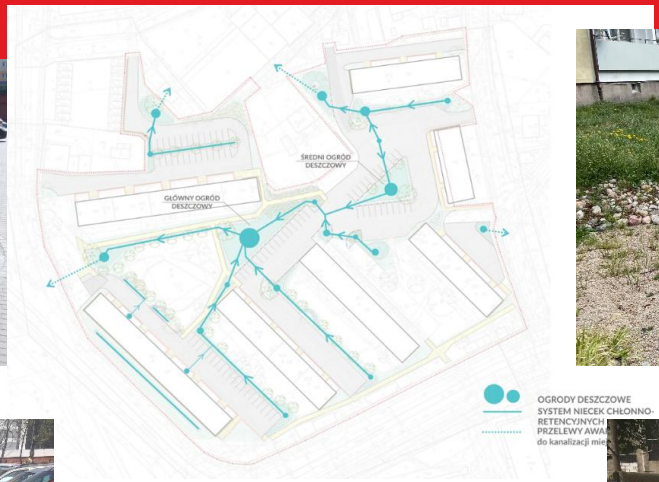
Enabling rainwater to flow into rain gardens, for example by:

- Concrete channels
- Drainage curbs
- Lower curbs
- Lower pavement

GDANSK

GDANSK, 2016year

Rain garden system of 1.6 ha on Stogi Stryjewskiego, Wrzosy and Skiba - most likely the largest system in Europe



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Technical aspects - inlets

GDANSK, 2022

Technical aspects -overflow

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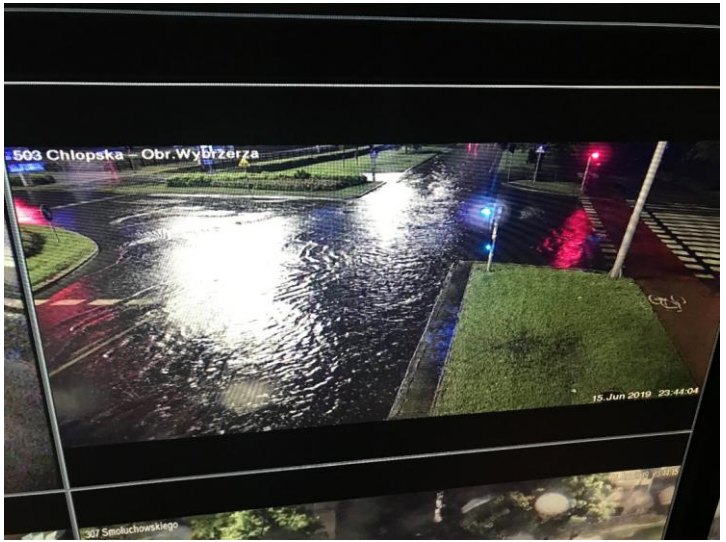
Gdańsk, street Peasant / Rot. Wybrzeże, 15/06/2019 at 23.44 III degree heavy rain, Gdańsk Brzeźno Station 21.7 mm in 30 minutes



Technical aspects - inlets

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ROAD , rainwater retention- pokets


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WROCŁAW, POLAND
Street reconstruction towards rainwater retention and shadow

BEFORE PIPE

HOUSING ESTATES WITHOUT RAINWATER DRAINAGE – 60 mm of rain, GDANSK

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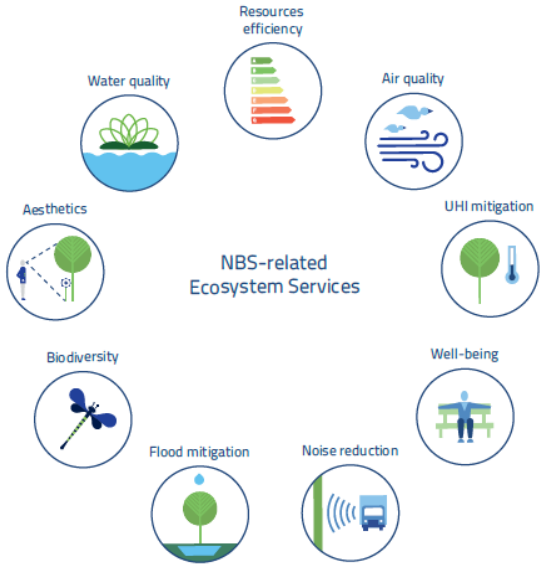
Idea is to support as many as possible benefits

Modern storm water system with green infrastructure (NBS)



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CONCLUSIONS

Summing up:

Integrated Urban Water Management (IUWM)- wastwater, rainwater, indastrial ww, others …….reuse,

- ✓ **Treatment of waste not longer single purpose BUT multifunctional with manufacturing of product : water, N, P, K, soil conditioner (compost, humic substances), heavy metals**
- ✓ **Closing and reconnecting loop, direct or indirect reusue**
- ✓ **Resilient, robust and flexible as well as attractive**
- ✓ **Treatment in place with as many as possible ecosystem service**
- ✓ **A lot of has been done so far but still there is a lot of possibilities and challenges**

Nature Based Solutions meet these criteria

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Rain gardens exaples in Gdańsk

3 maja:
https://www.youtube.com/watch?v=sICzWUGgZ-w

Zielony południk:
https://www.youtube.com/watch?v=BPEZBHEz2RU

Stogi:
https://www.youtube.com/watch?v=7bPUNOn3BCc

Lastadia:
https://www.youtube.com/watch?v=Z2Jv7DPYPh0&t=11s

Plan Biskupa O'Rourke:
https://www.youtube.com/watch?v=sDbKg2rPw1Y

Thank you

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