

2024 DANUBE WATER FORUM

RIDING THE WAVE

Water Sector Innovations for a new Climate Reality

29 - 30 May 2024, Braşov, Romania



Flowing with Nature: Sustainable wastewater solutions

Alenka Mubi Zalaznik

LIMNOS Company for applied ecology

Danube Water Forum

Braşov, 30.5.2024

Messages to convey

Circularity, sustainability

- Multipurpose
- No / low energy consumption
- Enhancing biodiversity
- Local resources used

- Interdisciplinary
- User communication

Circular
economy

Environment
protection

Biodiversity
support

Water
retention

Purification/
treatment



Nature-based solutions

1. Wastewater and leachate treatment
2. Stormwater management
 - Revitalisation
 - Mitigation measures
 - Reuse of resources

Constructed wetlands (CW) for wastewater treatment

Purification/
treatment

Environment
protection

SUBSTRATE

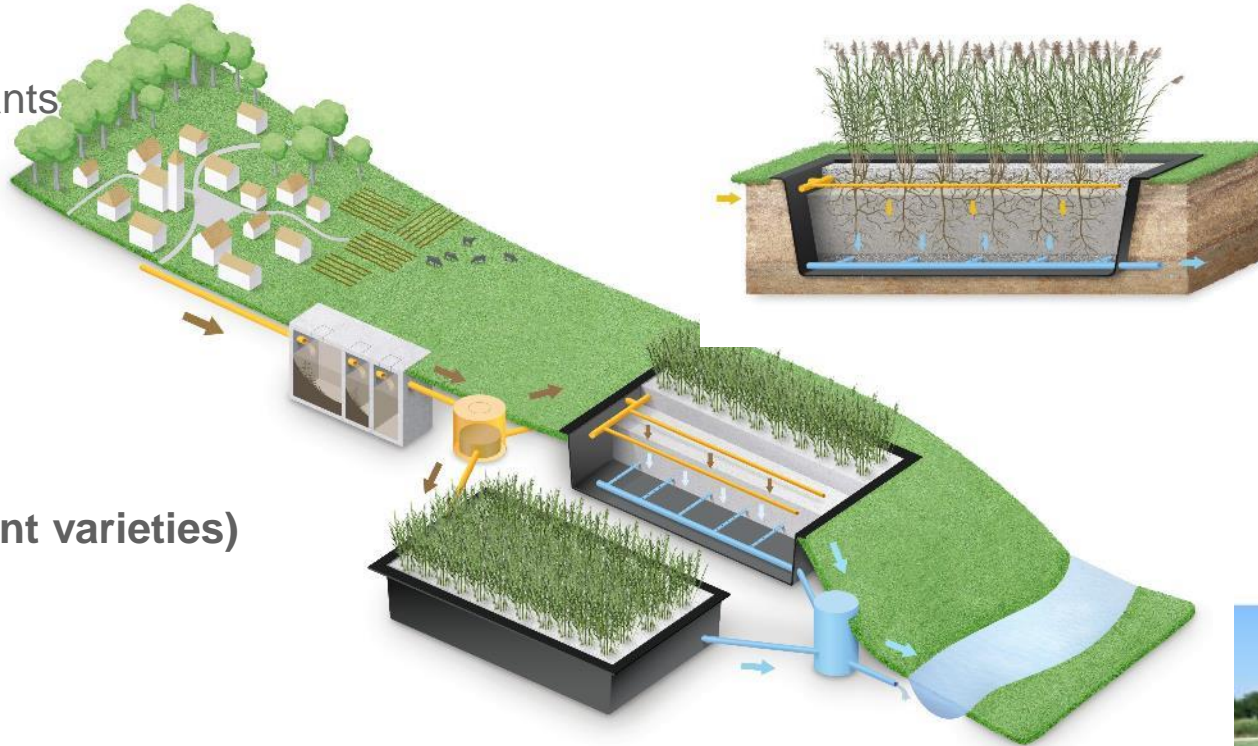
- Filtration, adsorption of pollutants
- Base for plants
- Surface for microorganisms

MICRO-ORGANISMS

- Pollutant removal

MACROPHYTE PLANTS (different varieties)

- Area for micro-organisms



Scouts' camp (15 PE)



Kaštelir Croatia (1.900 PE)



Village Bazga (500 PE)



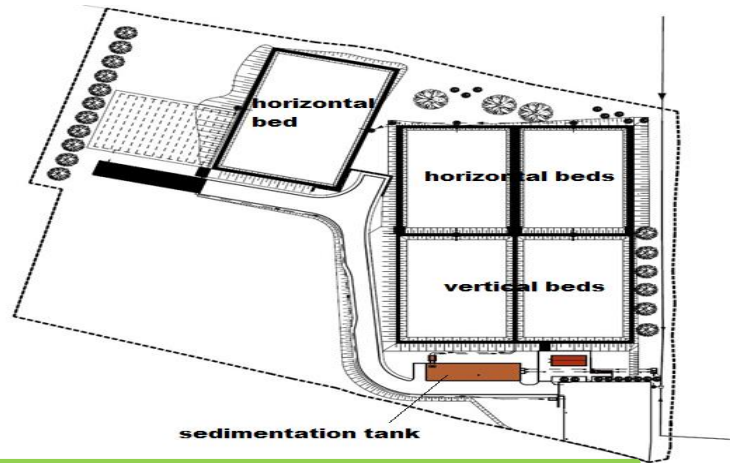
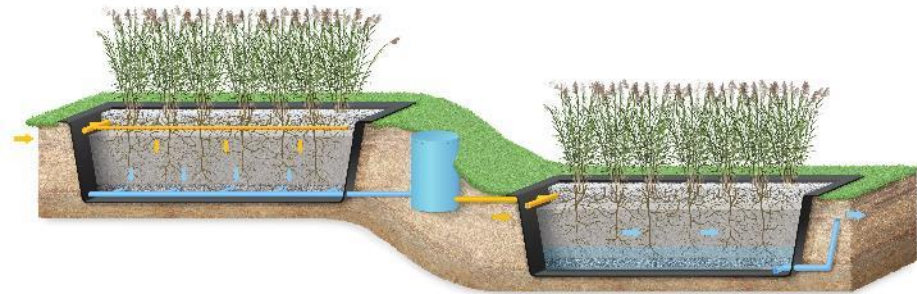
Mountain cabin (70 PE)



Petrol-pumping station (10 PE)

Constructed wetland 1.900 PE (Kašteliir, Croatia)

In operation since 2016



Source type	domestic wastewater
Design	
<i>Inflow rate (m³/day)</i>	285
<i>Population equivalent (PE)</i>	1.900
<i>Area (m²)</i>	4.800
<i>*PE area (m²/PE)</i>	2,93
Beds	
<i>Vertical flow</i>	2 x 897 m ²
<i>Horizontal flow</i>	2 x 897 m ²
	1 x 1269 m ²
<i>Sludge drying reed bed</i>	3 x 240 m ²

- At the moment O&M costs of public utility for the whole WWTP (incl. RB) with sewerage system are low (3.600 €/Y)
- Tasks performed by operator:
 - Weekly walkabout / inspection
 - Sludge application to RBs
 - During summer (touristic season): every two months
 - Rest of the year: every three months.
 - January: plant harvest (2 weeks, 8 person job)
- Costs:
 - Energy (automatic coarse screen, pump for water distribution)
 - Telephone (data)

Purification/
reatment

Environment
protection

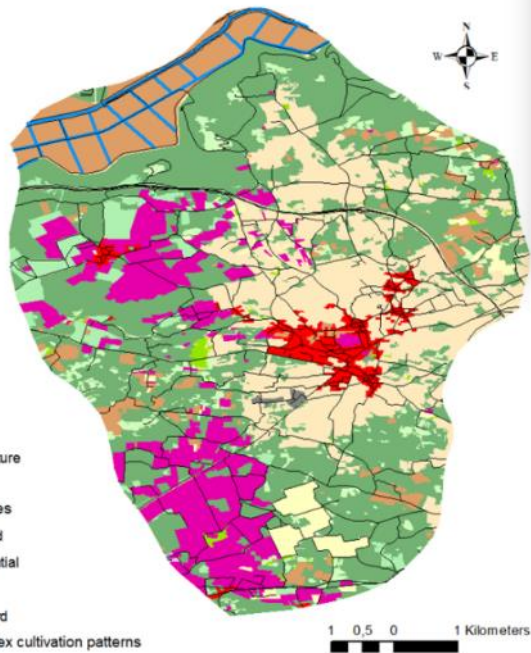
Circular
economy

Existing water tariff (2,34 €/m³) is affordable (CRO): The share of expected income spent on water bill is *less than 3 % of average disposable household income*

- **Waste water treatment: 0,66 €/m³**
- **Waste water collection: 0,66 €/m³**

Resource efficiency

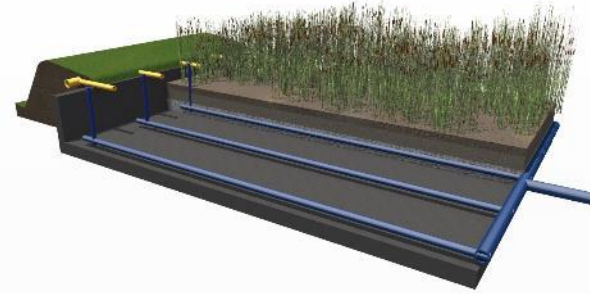
- Water reuse in 2022
- Sludge reuse – pending (analysis)
- Harvested biomass is composted and used in agriculture



Land use for Kastelir- Labinci Municipality



Sludge drying reed beds



- Reliable sustainable technology for sludge drying and stabilization
- Microbial mineralization of organic matter - volume reduction
- Biosolids reuse – Phosphorus is a critical mineral.

EFFECTIVE VOLUME REDUCTION

- The final product contains from **25 to 40% of dry matter**
- Volume reduction by **95 %**
- Due to mineralization up to **40 % less organic matter**

ENERGY SAVINGS - Passive technology

- Pump for sludge distribution
- Pump for returning drained water to WWTP



Treatment wetlands in the WB region

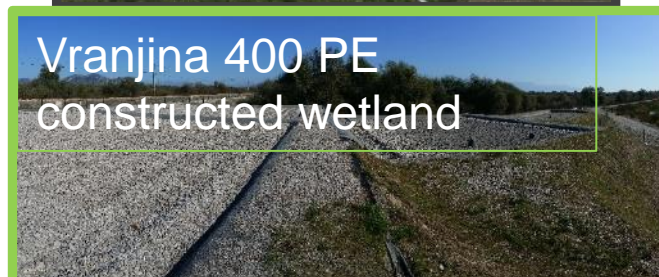
Sludge treatment in CROATIA:



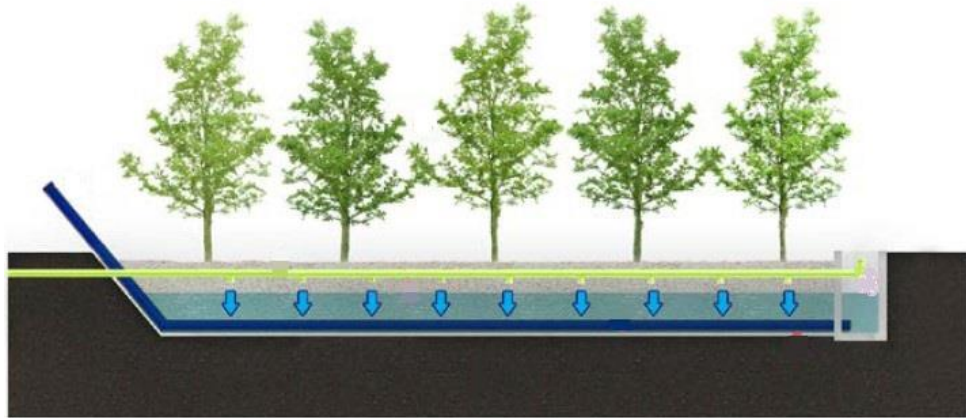
Source: Drin Corda



CW in Montenegro



Flexibility and availability of solutions !!



Source: Istenič, Arias

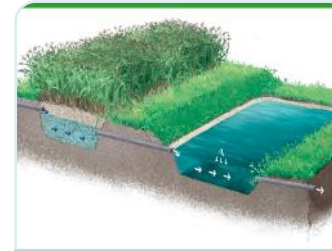


Biomass production

Zero leachate treatment



Facultative pond + Free water surface flow constructed wetland



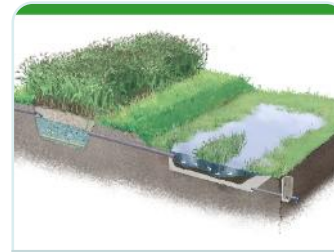
Horizontal flow treatment wetland + maturation pond



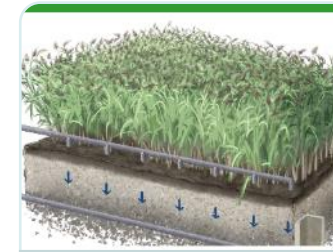
Free water surface treatment wetland



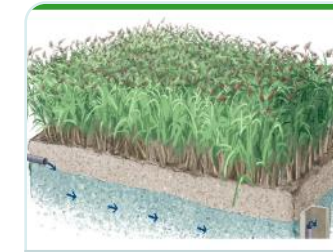
Reactive media in treatment wetland



Aerated + free water surface wetland



French vertical flow treatment wetland

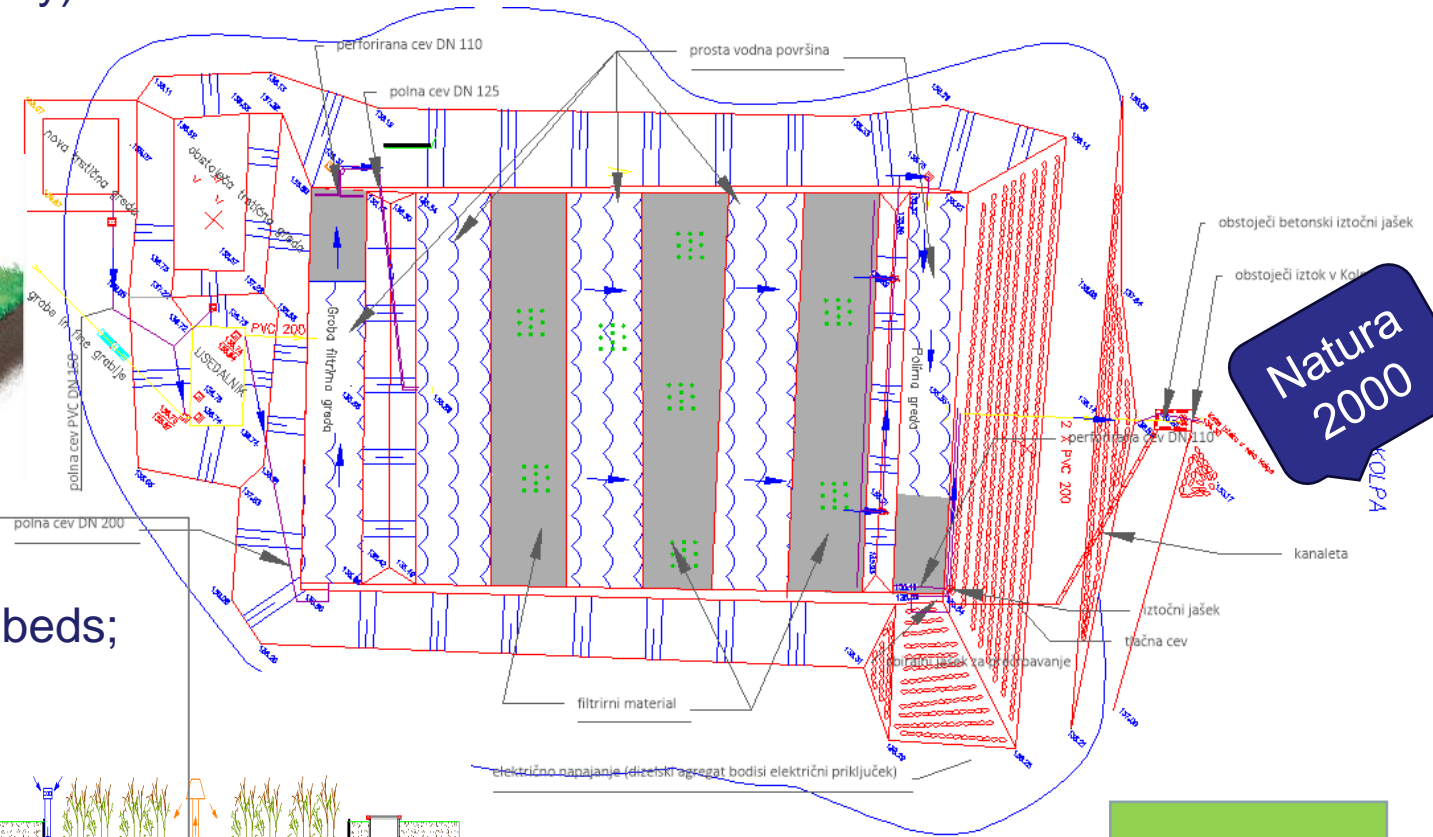
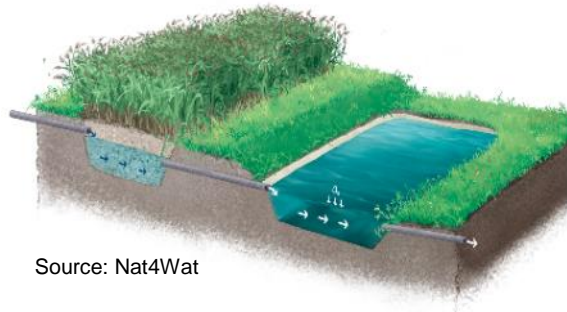
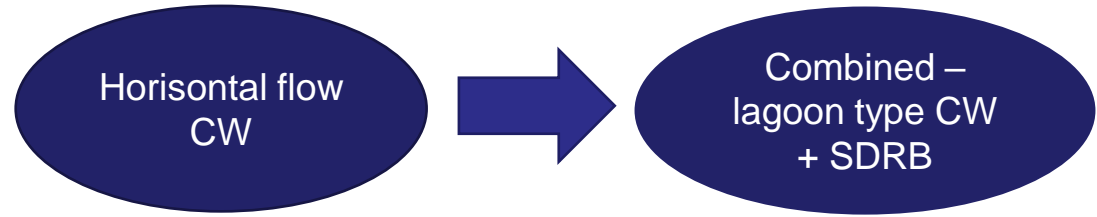


Horizontal flow treatment wetland

[Source: nat4wat.icradev.cat/list-of-technologies](http://nat4wat.icradev.cat/list-of-technologies)

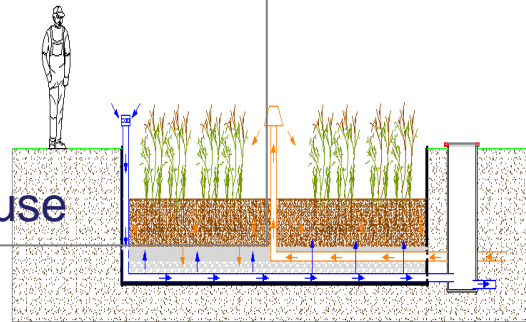
CW reconstruction (250 PE)

- Constructed in 1995
- Reconstruction required due to climate change adaptation (floods), increase in population (to 450 PE) and regulatory amendment (efficiency)
- Location is the same
- Still no energy required for operation



+ Sewage sludge treatment (sludge drying reed beds; nutrient reuse):

- Dewater, stabilize and mineralize sludge
- Advantages: zero energy, low OM costs, reuse



Biodiversity support	Purification/ treatment	Protection of environment
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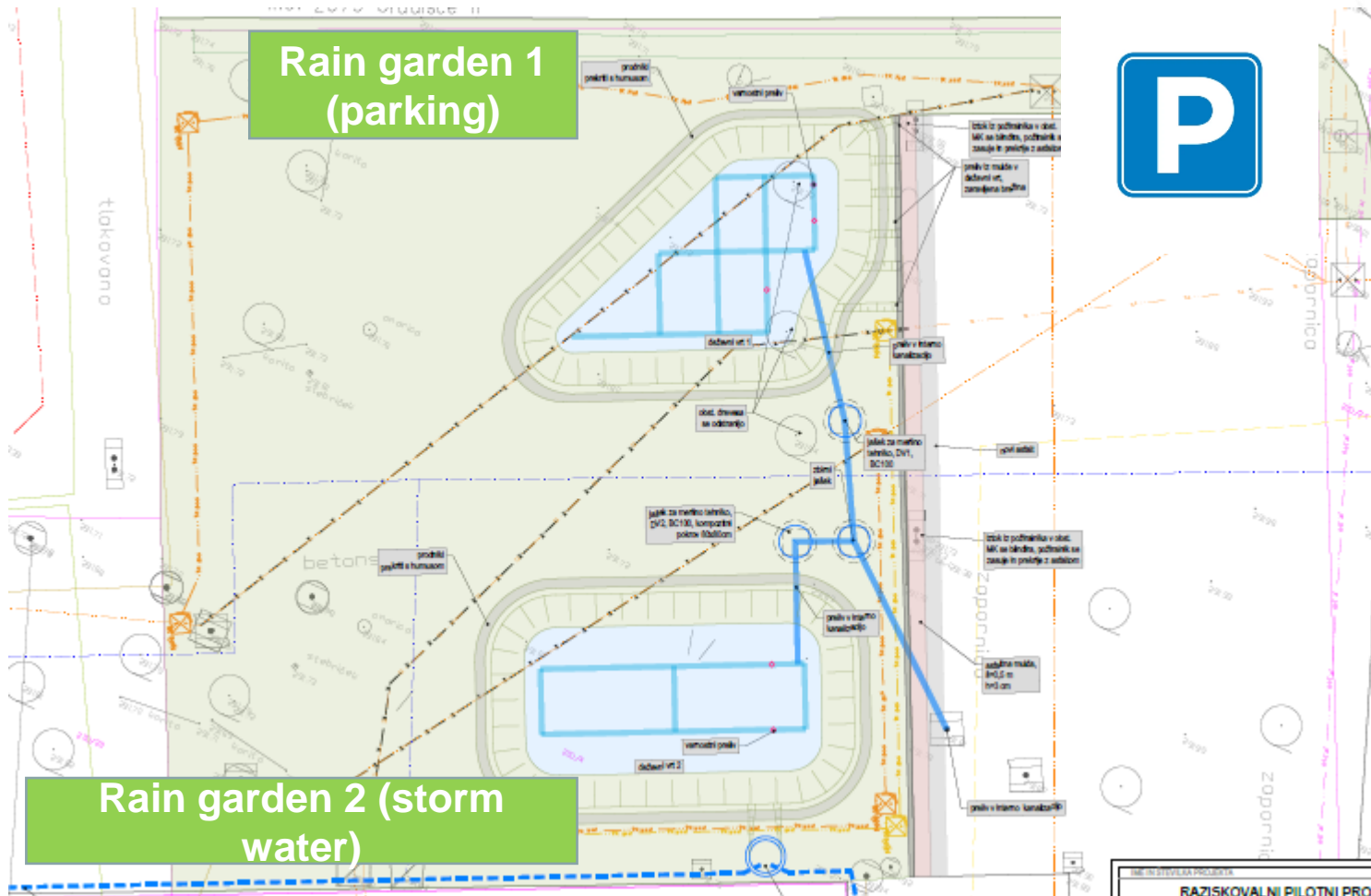
Stormwater management

Rain garden, Ljubljana

Retention

Purification

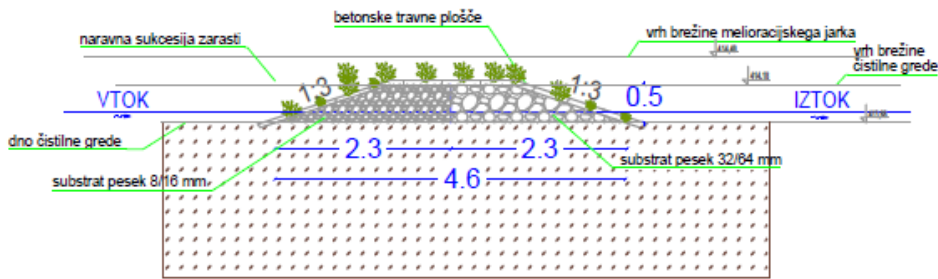
Biodiversity



- Pilot system (next to the Faculty of Civil Engineering)
- Measurements
- Knowledge transfer (students, interdisciplinary cooperation)

Stormwater management + Protection of Natura 2000

- Two-stage drainage ditch
- Mitigation measure - detention basin: replacing wet meadow
- Small pond (retention basin): habitat creation
- Filtration – treatment bed



Natura 2000

UKINITEV OSUŠEVALNEGA JARKA IN UREDITEV DRENAŽE

POLIRNO-ČISTILNA GREDA

SONARAVNA UREDITEV MOKREGA ZADRŽEVALNIKA (MLAKE)

SONARAVNA UREDITEV RAZLIJNIH POVRŠIN - SUHI ZADRŽEVALNIK Z MOČVIRJEM

Retention

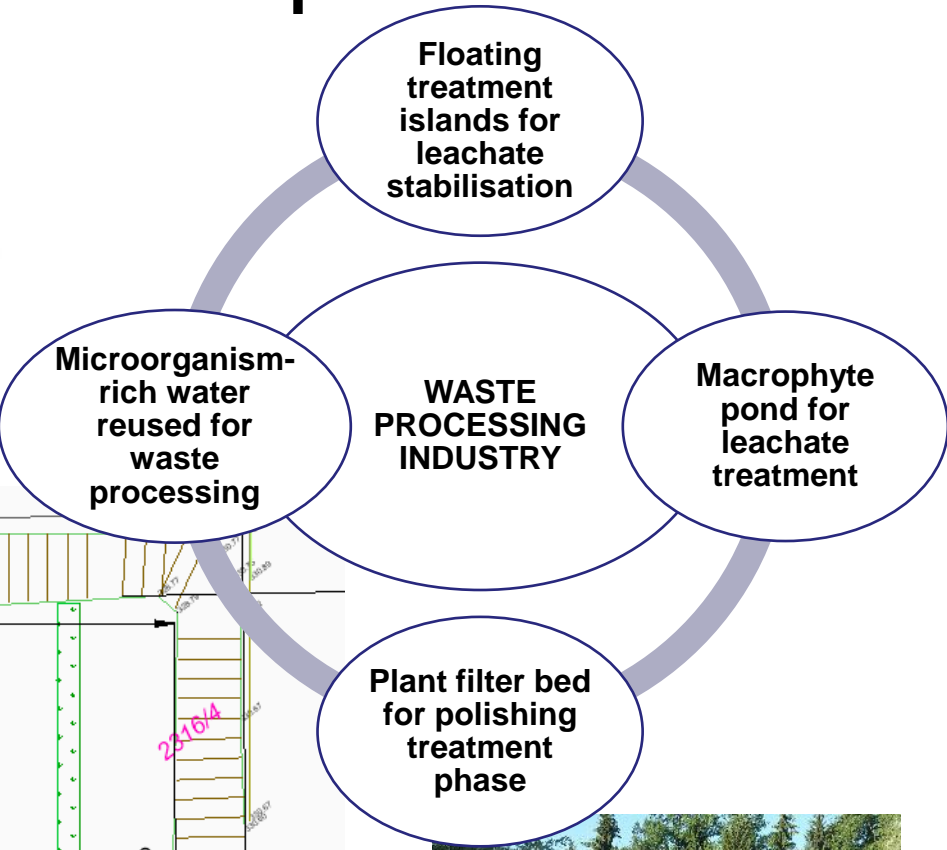
Purification

Biodiversity

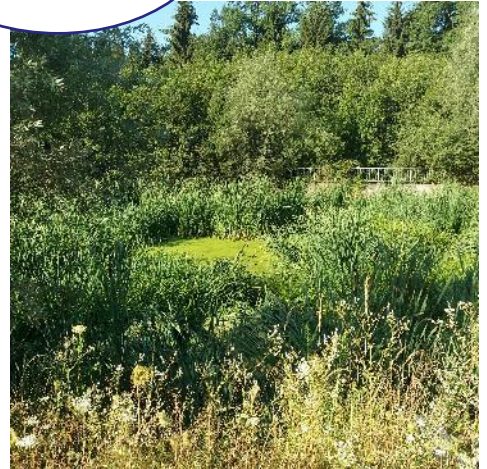
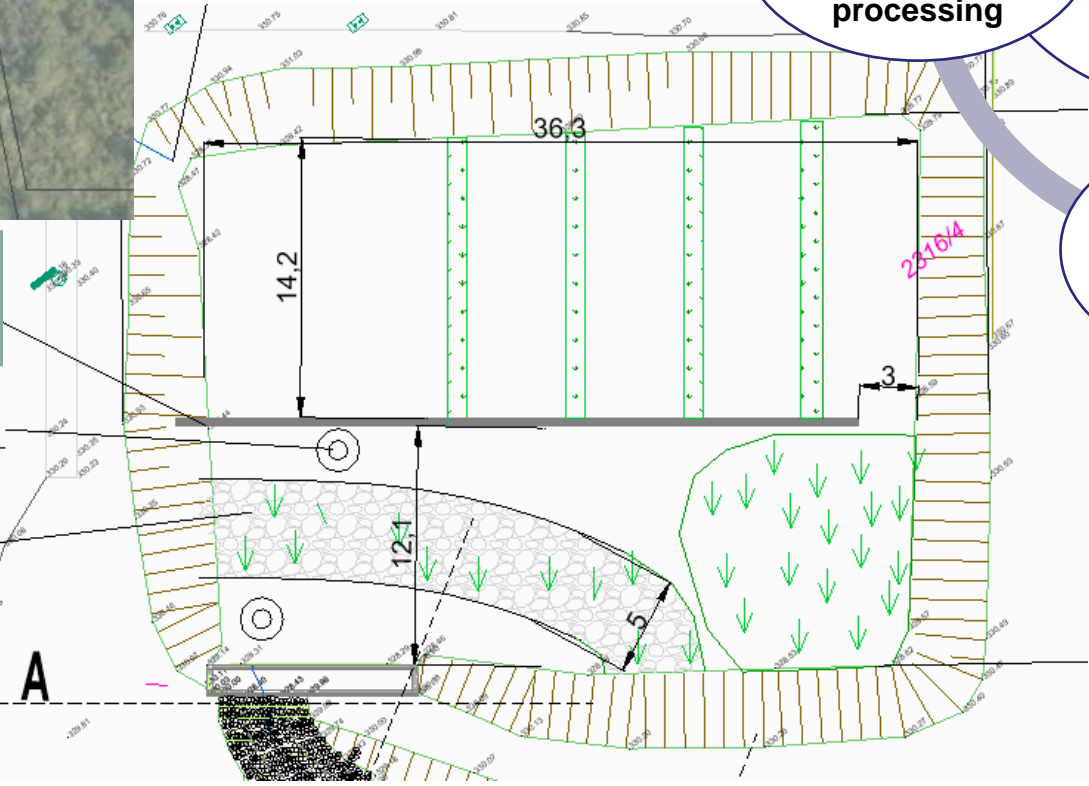
Protection



Stormwater management in industrial park



- Water retention
- Purification/treatment
- Biodiversity support
- Reuse
- Protection of environment



Landfill leachate treatment

Water retention

Purification/ treatment

Protection of environment

Reuse

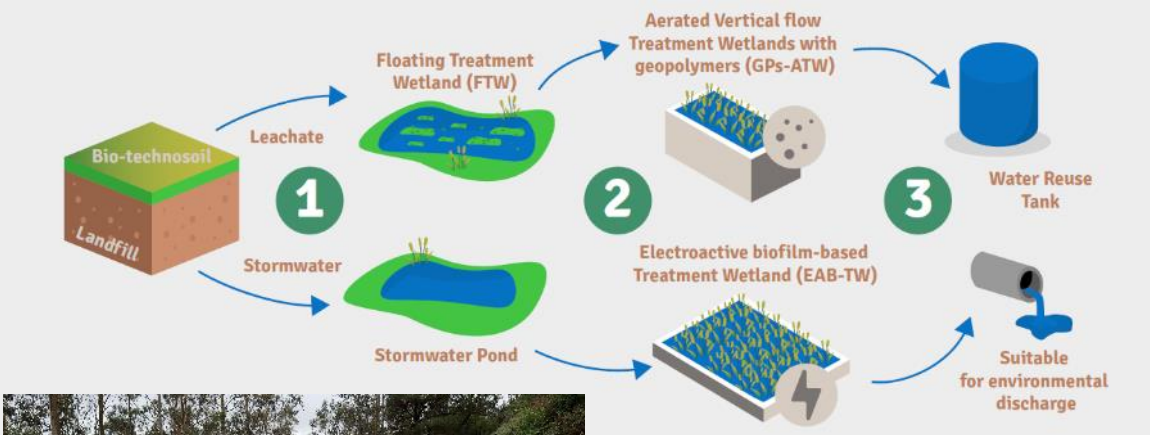
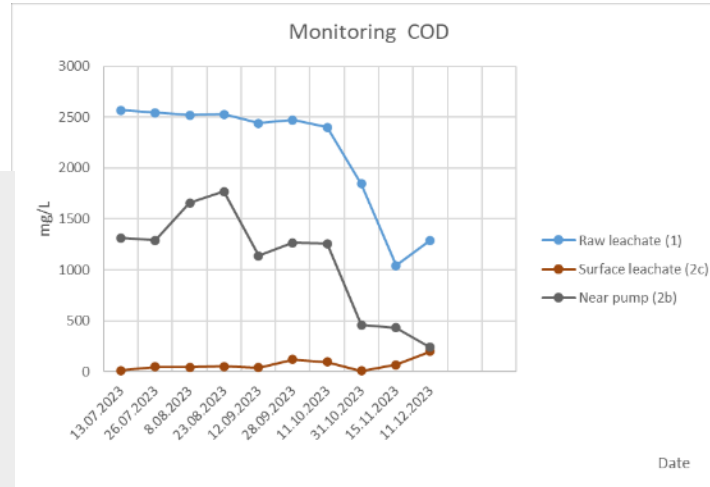


Increasing the resilience of landfills



Green and Nature Based Solutions for climate change-resilient waste infrastructure

XILOGA LANDFILL (La Coruña, Spain)



Thank you for attention!

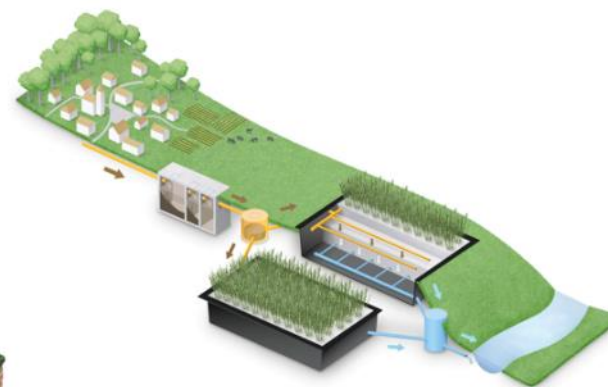
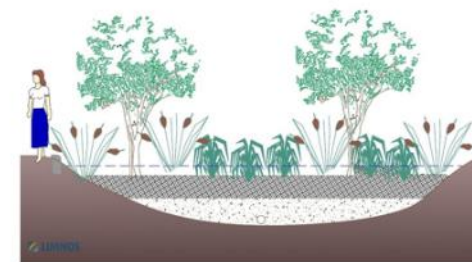


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Working with nature to protect the environment