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nôva TECH

Filtres plantés de roseaux avec matériaux adsorbants pour le traitement des eaux pluviales urbaines : enseignements du projet LIFE ADSORB

Treatment wetlands with adsorbent materials for urban rainwater treatment: lessons learned from the LIFE ADSORB project

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Life, Life Adsorb, Ville de Paris, leesu laboratoire eau environnement systemes urbains, Cerema, ecoBiRD Bureau d'Ingénierie Recherche & Développement, Global Wetland Technology

The Life ADSORB project

- Context and challenges
  - Urban stormwater runoff from heavily trafficked roads contributes significantly to pollution due to the micropollutants it contains and is difficult to treat: particularly the dissolved fraction
  - Project duration: 2018–2025
- Main objective
  - Demonstrate the applicability of a nature based solution (treatment wetland) enhanced with adsorbent material to effectively reduce pollutant loads (TSS, metallic and organic micropollutants) from runoff water in a natural area (Bois de Boulogne park, Paris)

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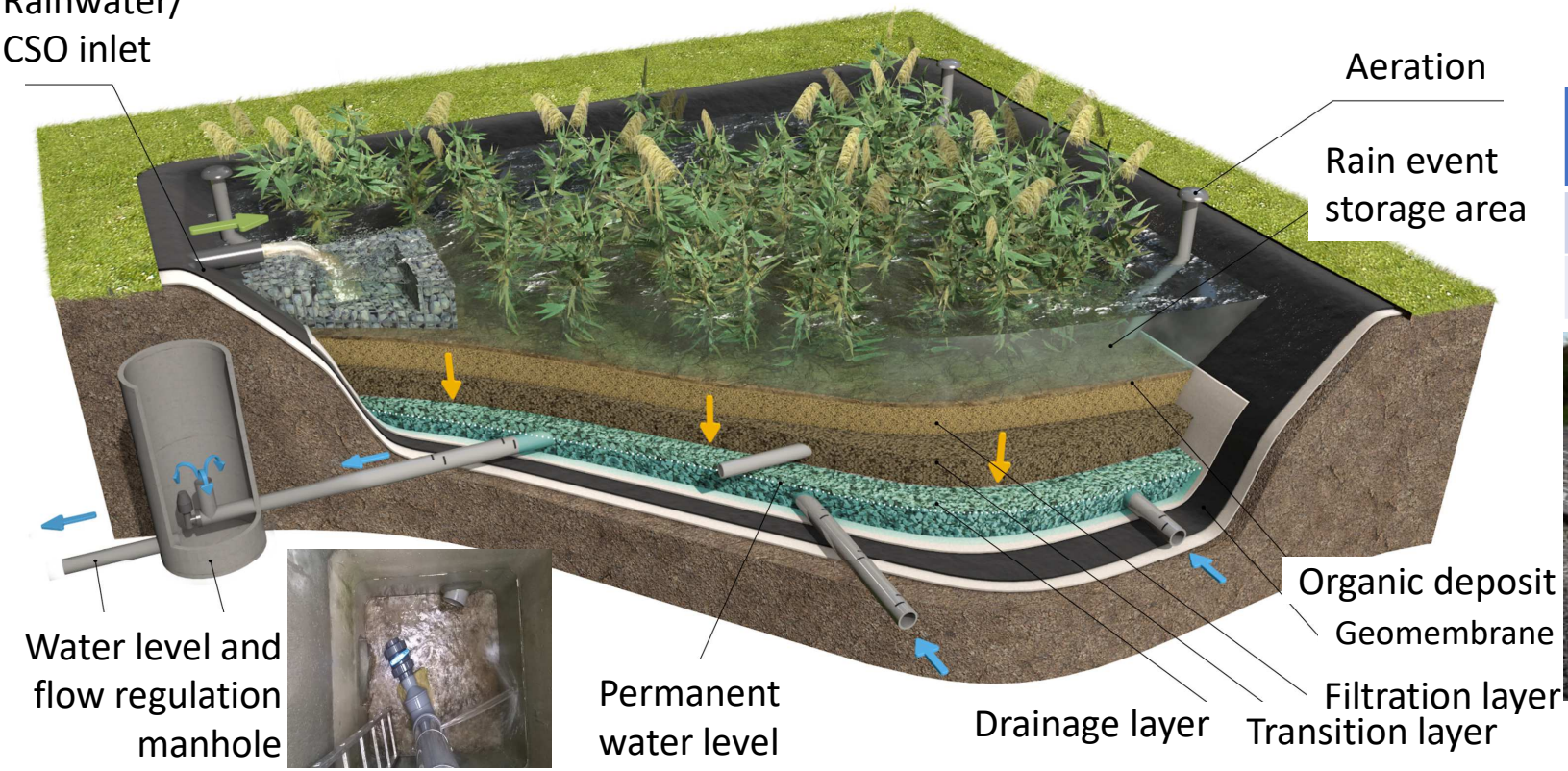
The HYDR'EPUR® System
Nature-based solution for runoff and CSO



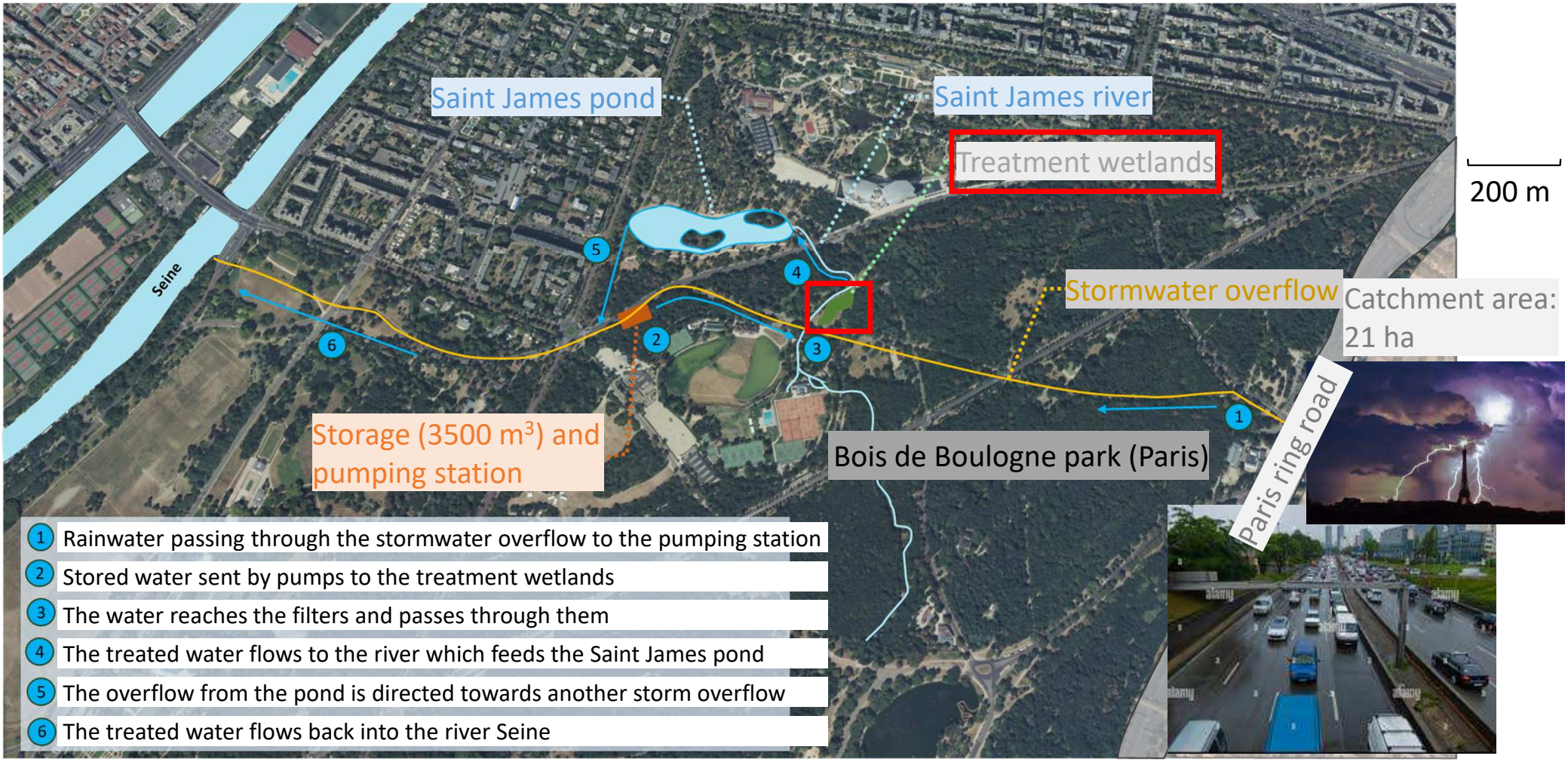
Outflow controlled by a throttle outflow

20 references in France

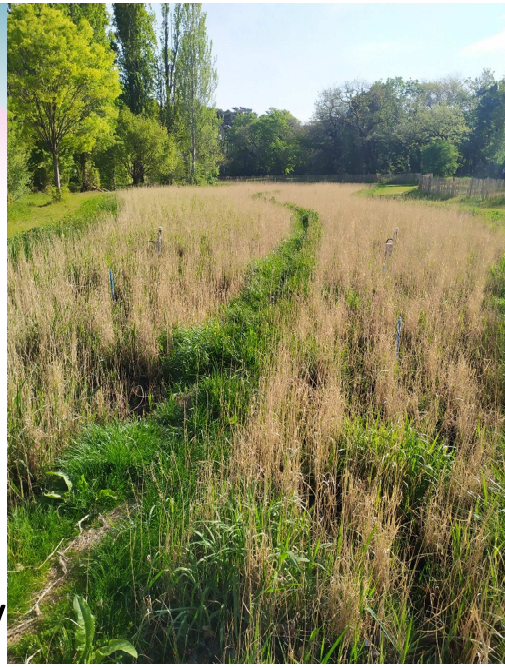
	Removal efficiency (%)	Concentration out (mg/L)
DCO	60	50
MES	90	20

https://ecobird.fr/

The Life ADSORB experimental site, in Paris



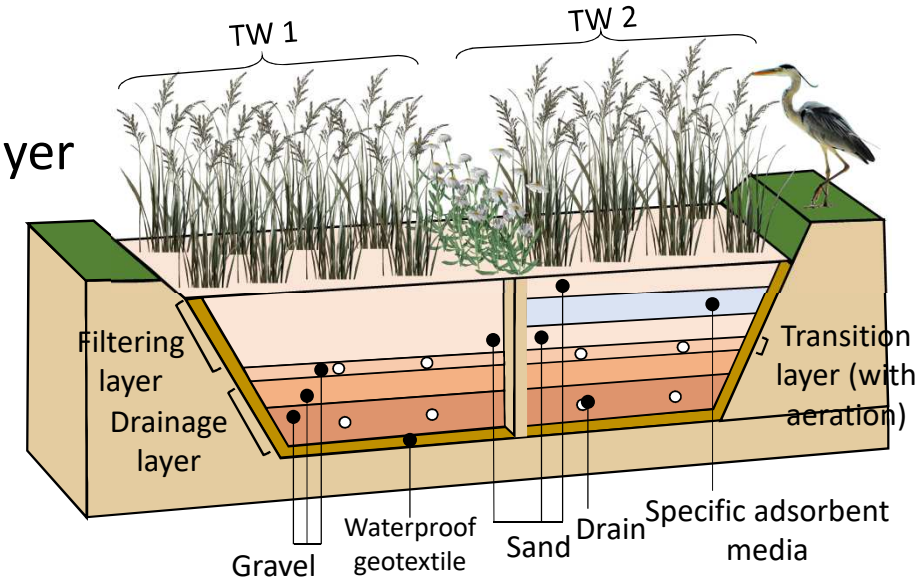
The treatment wetland pilots



- 2 pilot TWs of 600 m^2
- Treatment of runoff water; Metallic and organic micropollutants
- Similar configuration (100 m long, 1 m deep) and operation
  Alternation every month
- Transition layer (10 cm) + drainage layer (50 cm) - 30 cm permanently saturated with water
- Single difference between the two pilots:
  composition of the filtering layer

TW1: only sand (40 cm)

TW2: layer of specific adsorbent material (micropollutants, Rainclean®, 20 cm) between two layers of sand (10 cm each)

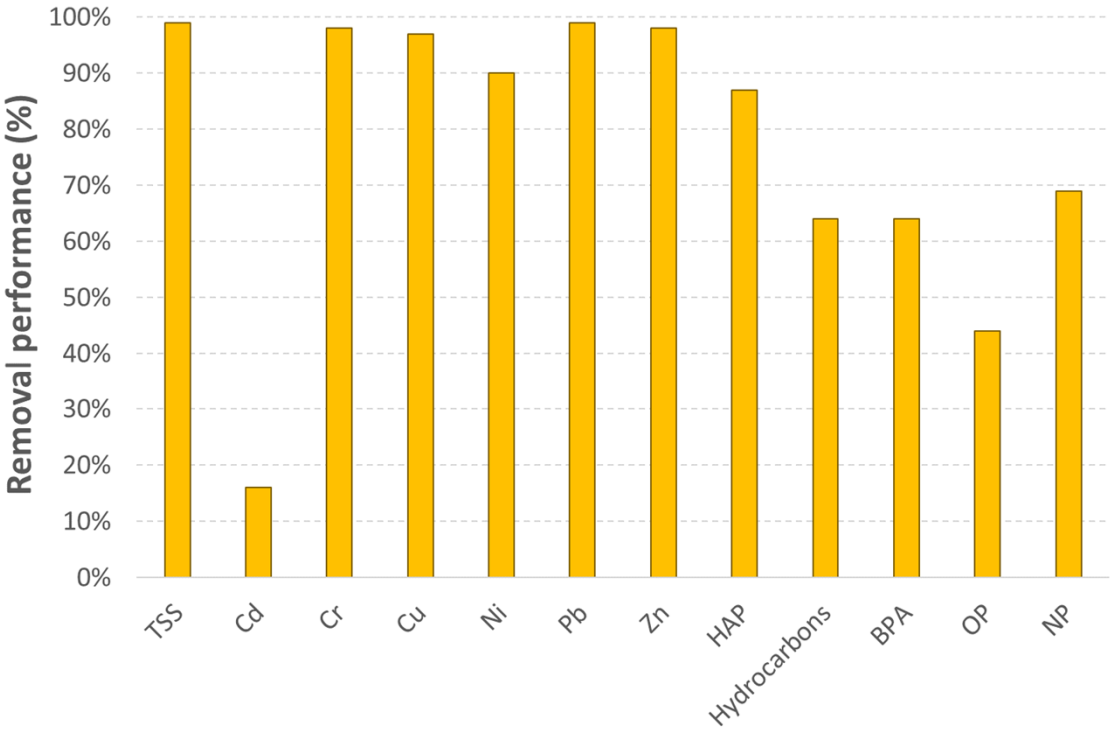


Monitoring the operation and Performance

- Evaluation of the effectiveness of the filters: quantification of micropollutant concentrations, removal and their fate in the filters
  - TSS, Micropollutants – metallic: Cd, Cr, Cu, Ni, Pb, Zn – organic: BPA, OP, NP
  - Sampling points: inflow, outflow, sediments (surface)

Global treatment performances

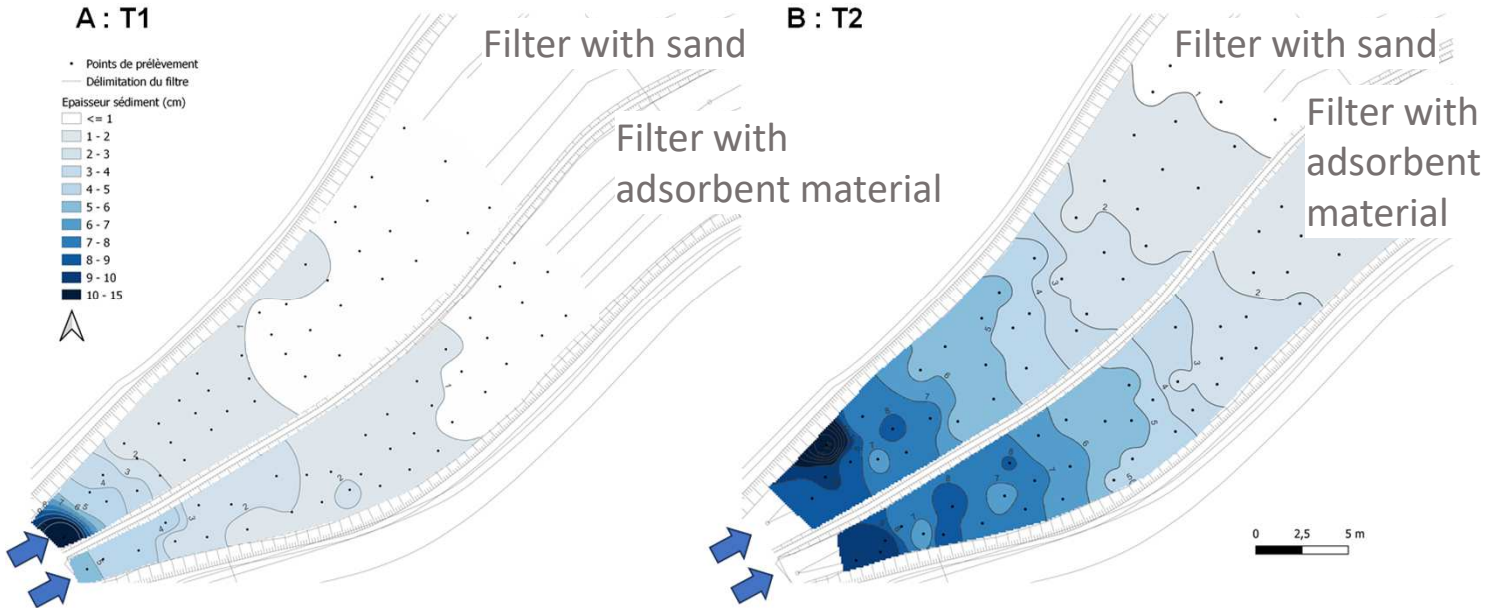
- For the sand filter and the filter with adsorbent material (median values)



- **No difference between the two filters**
- High performance despite relatively low inlet concentrations → due to **retention of the particulate fraction**
- Little or no retention of the dissolved phase in the adsorbent material (inlet concentrations too low)
- The adsorbent material did not demonstrate any significant advantage

The fate of micropollutants trapped in the filters

- **Micropollutants are permanently retained in the filters**
  Over 2.7 years of monitoring:
  - 10.4 tons of suspended solids trapped (~4 tons/year)
  - Accumulation mainly in the first few meters of the filter
  - Trapping of particles in surface sediments: primary role



The fate of micropollutants trapped in the filters

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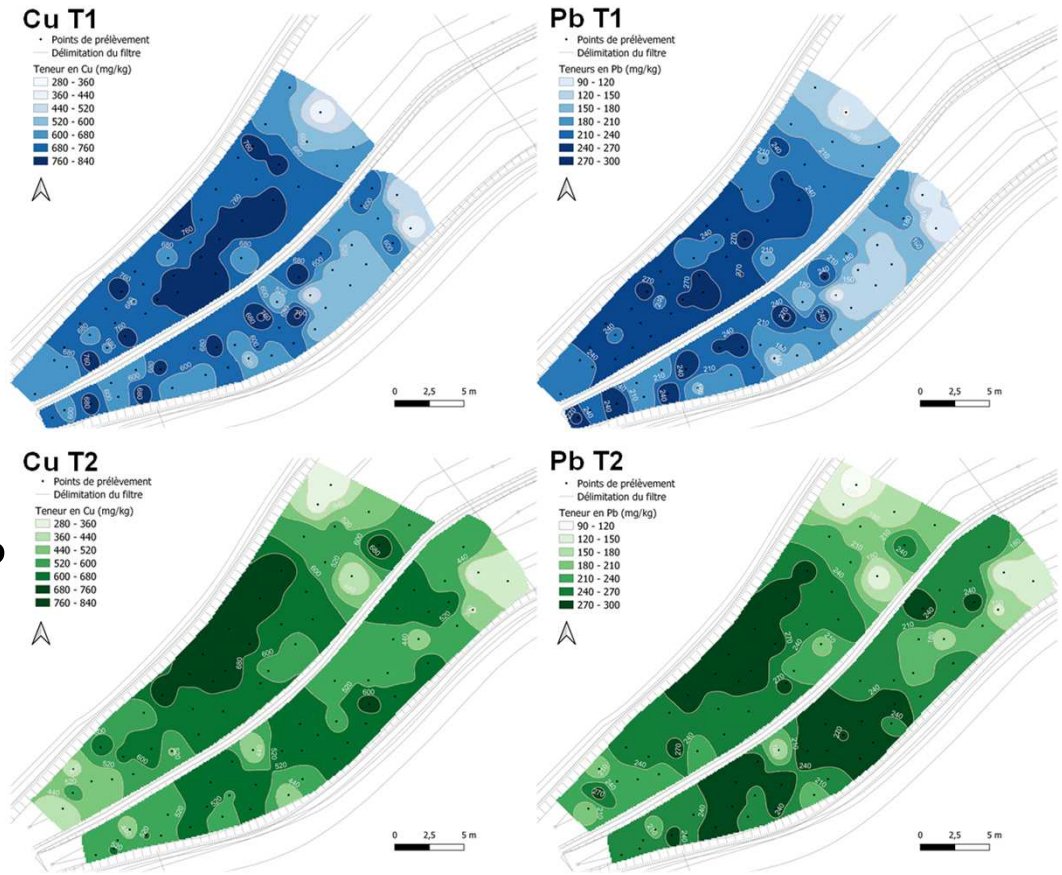
  Over 2.7 years of monitoring:
  - Accumulation mainly in the first few meters of the filter
  - Trapping of particles in surface sediments: primary role
  - Average annual accumulations:
    - Metals: 17 kg of Zn, 7 kg of Cu, 4 kg of Ni, 4 kg of Cr, and 3 kg of Pb
    - Organics: 51 g of NP, 4 g of BPA, 2 g of NP

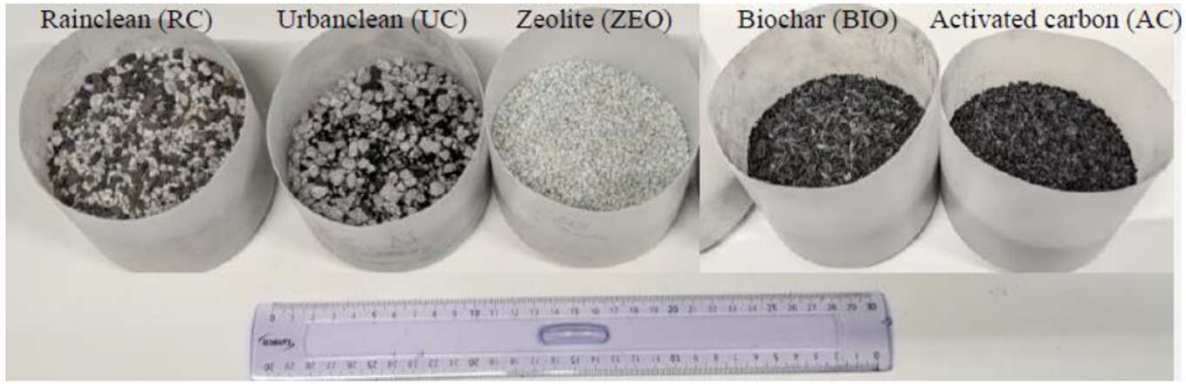


Laboratory evaluation of adsorbent materials

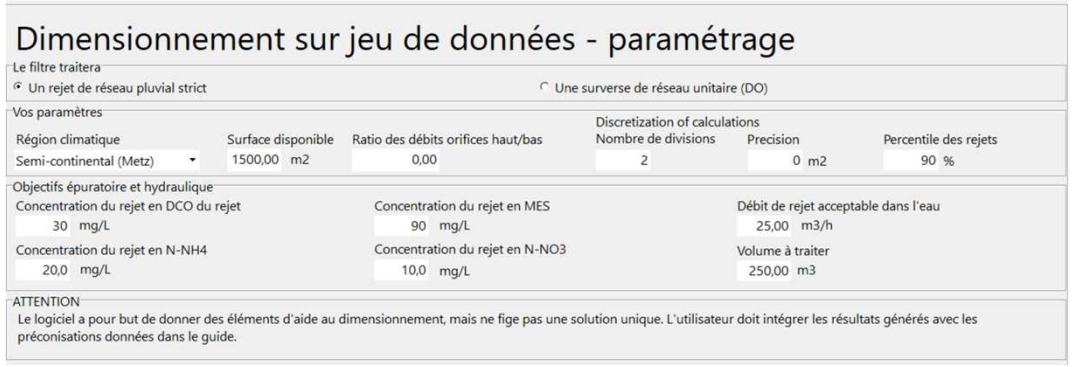
- Characterization of Rainclean®
  - High-performance adsorbent in laboratory tests (high inlet concentrations)
  - Column tests show a good ability to adsorb a wide range of metallic and organic micropollutants / But not very effective for nickel (Ni) and chromium (Cr)
- Characterization of various adsorbent materials

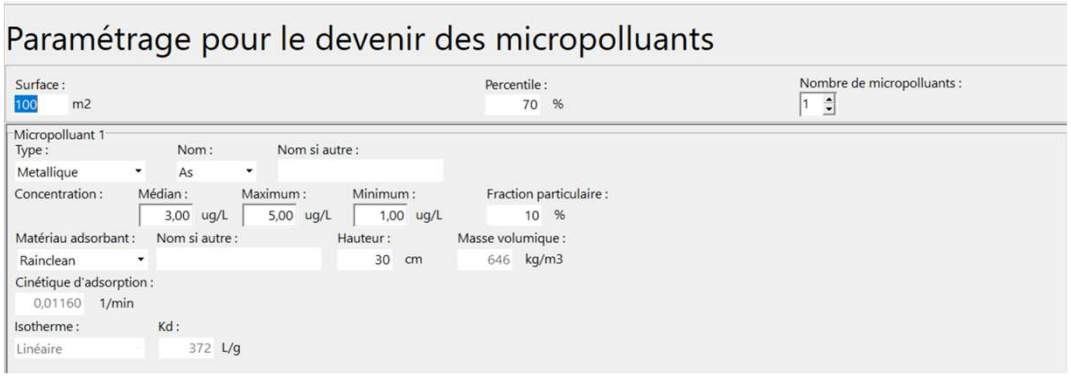
  No tested material can effectively remove all metallic and organic micropollutants → no universal adsorbent material

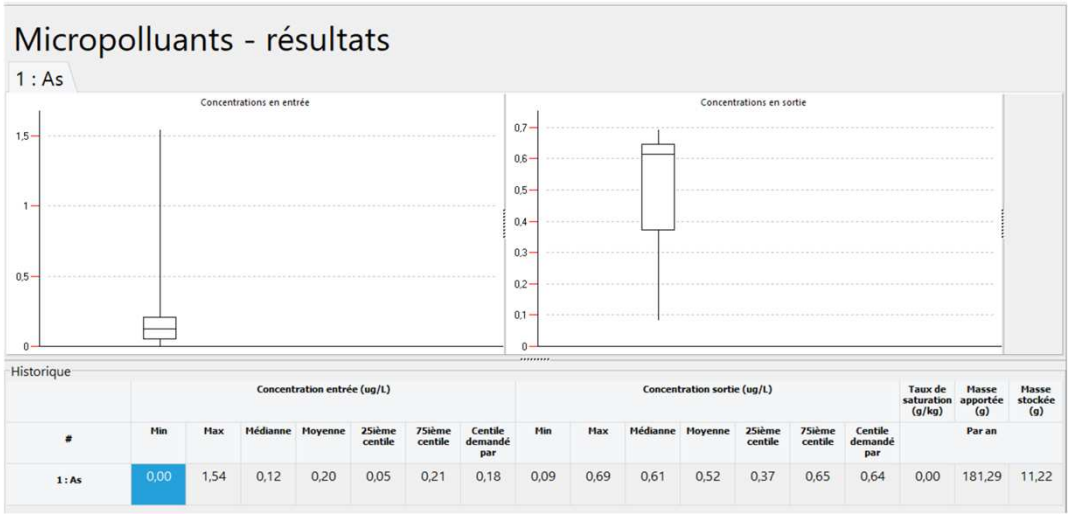
  Choice of adsorbent material must be based on:
  - The target pollutants
  - Cost
  - Lifespan
  - Operating conditions



From the Laboratory to Design: Micropollutants module in the ORAGE software







ORAGE as a decision-making tool:

- sizing tool
- material selection tool

Facilitates the transfer to other municipalities

Replicability, Transferability, and Socioeconomics

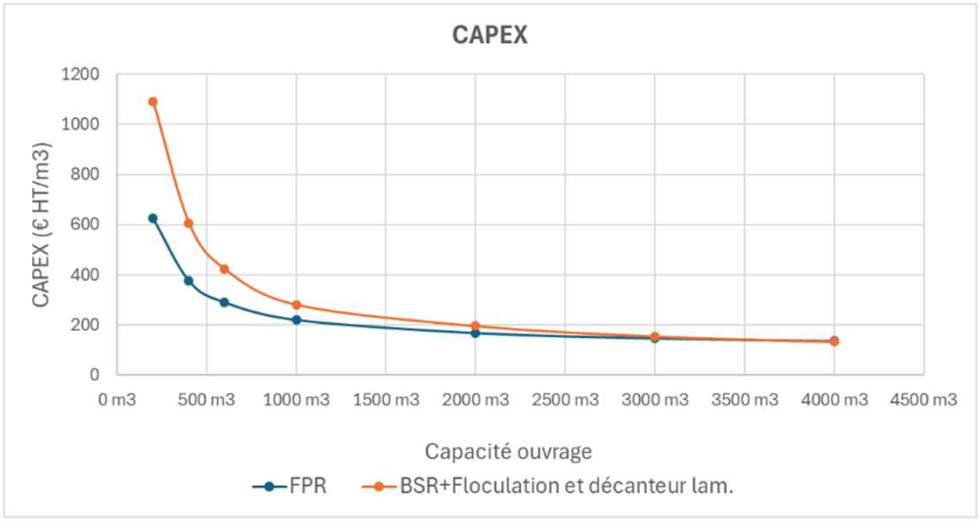
- **The solution is replicable.** The principle can be applied in many contexts:
  - Road networks
  - High-traffic roads
  - Parking lots
  - Industrial areas

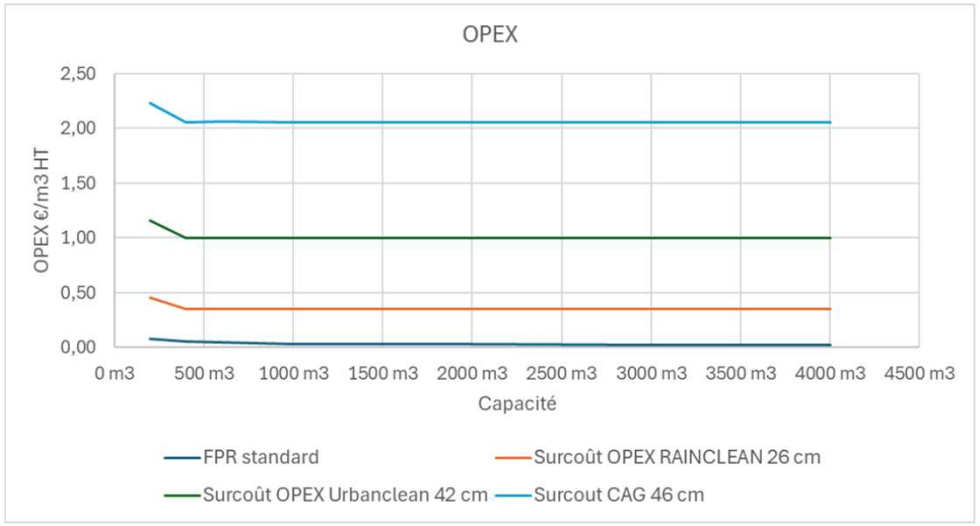
As long as the following are available:

- sufficient space
- hydraulic storage
- an appropriate power supply

Replicability, Transferability, and Socioeconomics

- **Costs remain controlled:**
  - Maintenance is minimal
  - Operating costs are low (low energy consumption)
  - Little sediment/sludge to be removed
  - Solution competitive compared to other treatment techniques (settling, filtration, activated carbon, coagulation/flocculation, etc.)





Conclusions

1. Treatment wetlands are a robust and effective solution for treating stormwater runoff from roads with no identified environmental impact, and they offer benefits associated with nature-based solutions (good landscape integration, low energy consumption, and minimal maintenance)
2. The effectiveness and benefits of an adsorbent depends on the context and the targeted micropollutant(s)
3. No single material is optimal for all applications: the addition of an adsorbent is only relevant in contexts where dissolved micropollutants pose a significant challenge
4. The project produced an innovative design tool: the micropollutants module of the ORAGE software, which facilitates the transferability of results and is particularly useful for designing treatment wetlands on a case-by-case basis

Merci – Thank you

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