

# Intensified nature-based solutions for preventing groundwater pollution: Besòs case-study

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(Understanding groundwater Pollution to protect and enhance WATERquality)



# Besòs Case study: Location



Mediterranean climate with water scarcity and frequent severe droughts

# Besòs Case study

The **BESÒS DELTA AQUIFER**, close to Barcelona city, is a **key element for the urban development** but currently Besòs river water is highly polluted.

**GROUNDWATER (GW) USES** are for industrial supply, urban supply and public parks irrigation.

The **limiting factor** for the potential use of this water as drinking water is its quality



# Current situation in Besòs case study:

## Recharge

- ... from **polluted surface waters**
- ... from **industrial areas**
- ... of **urban waters** (runoff / wastewater)

## ‘Traditional’ pollutants

- Nutrients (ammonium, nitrates...)
- Metals (iron and manganese), PAHs,
- Pesticides, pathogens, ...

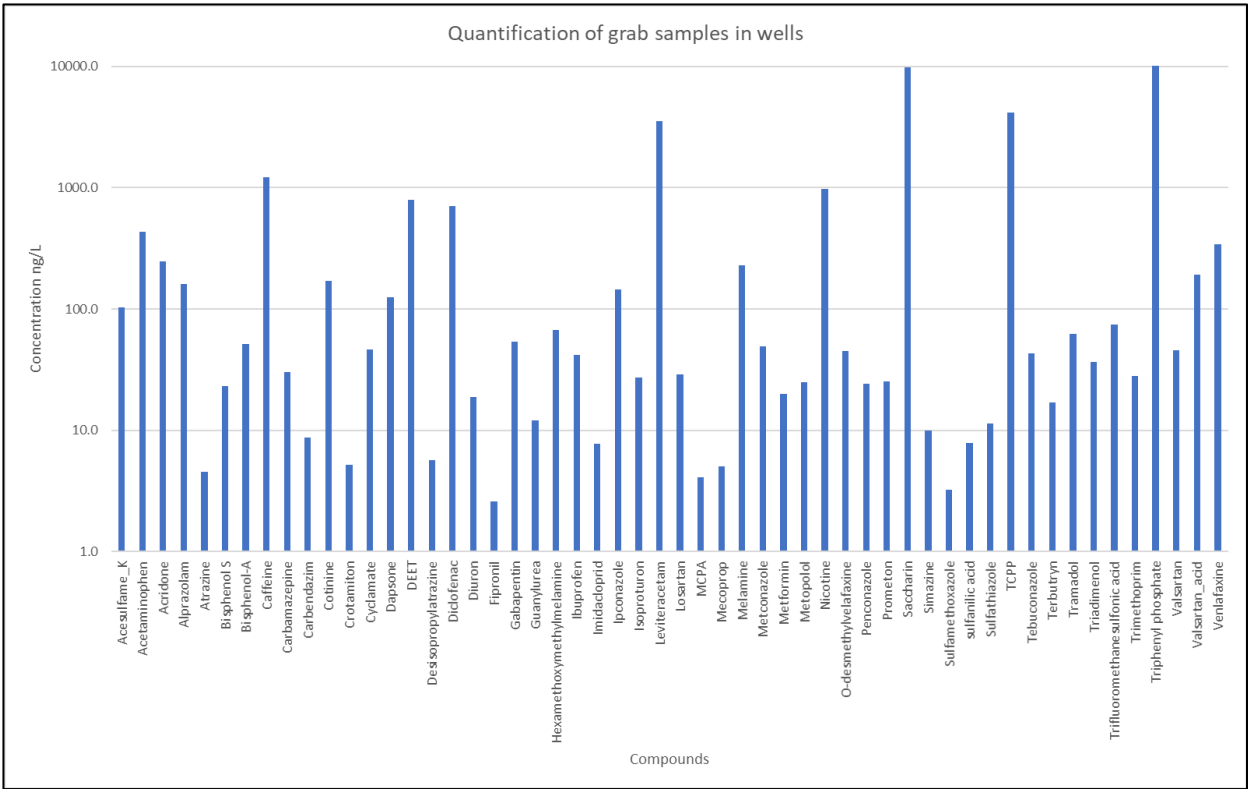
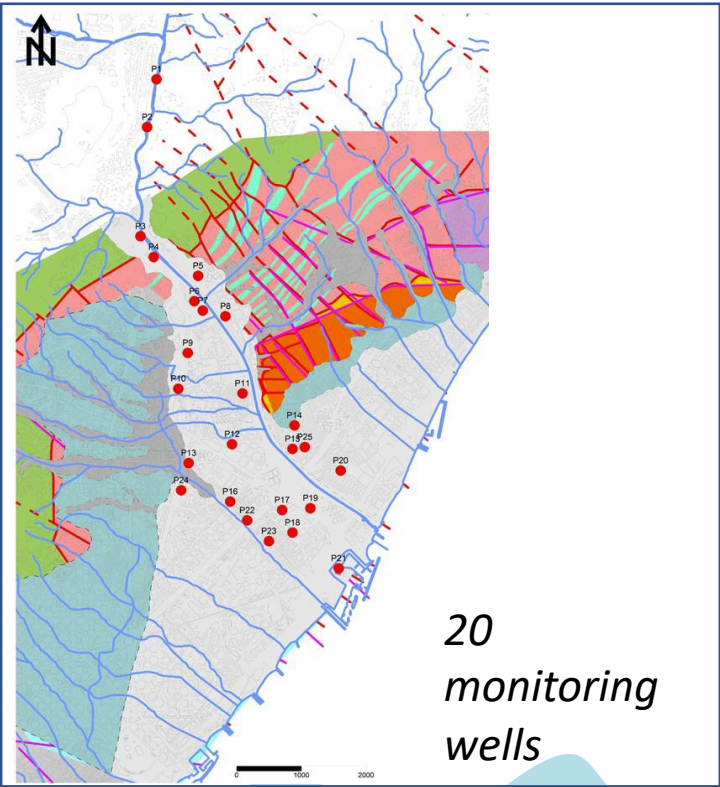
## Contaminants of emerging concern (CEC)

- Chemicals associated with urban activities,
- Plasticizers, halogenated compounds,
- Pharmaceuticals, personal care products, ...



# Current situation in Besòs case study:

## Emerging pollutants



# Problem to solve

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## Problem

Polluted Groundwater in a Metropolitan Area (Barcelona, Spain): Unsuitable for Drinking Water Despite High Demand

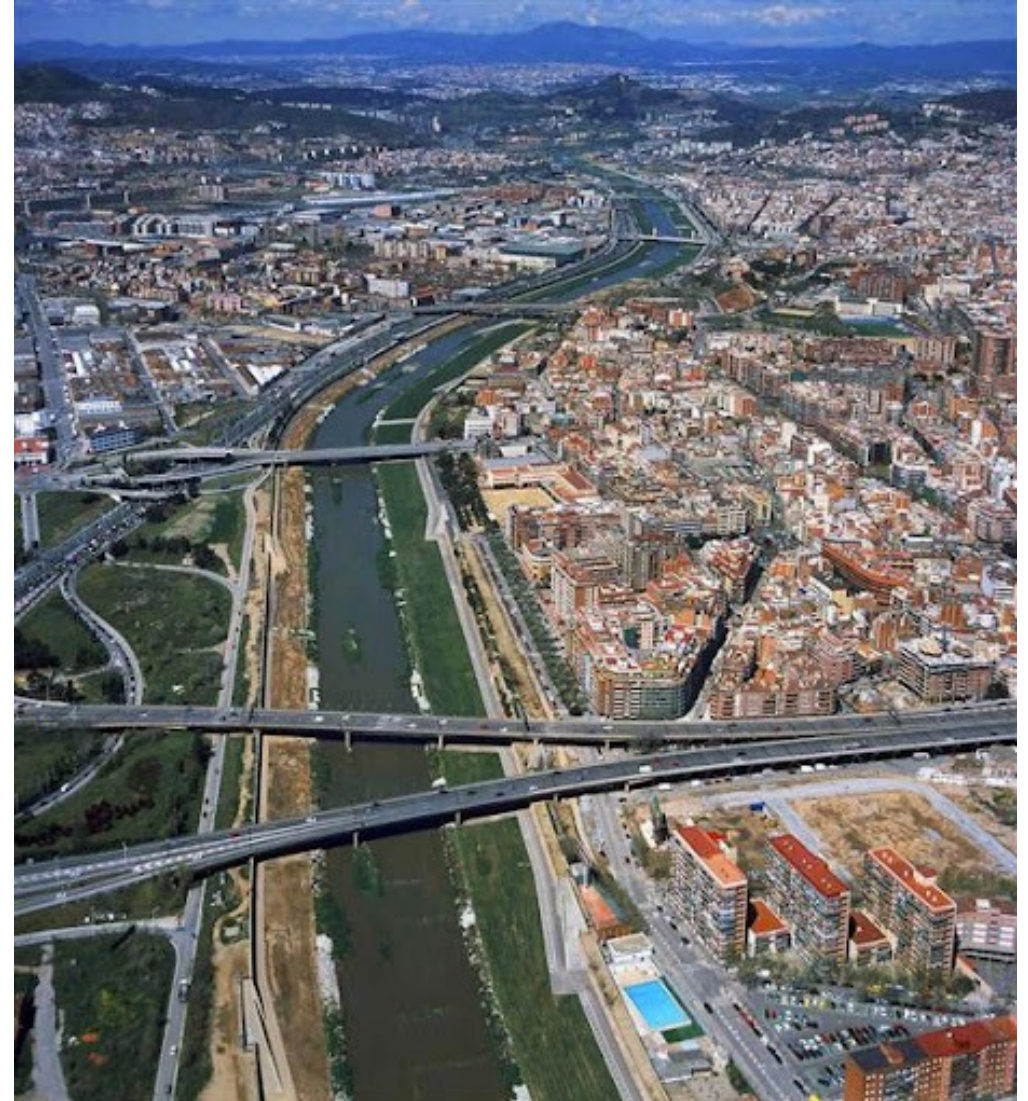
## Challenge

Prevent groundwater pollution from surface water infiltration impacted by WWTP effluents (nutrients and emerging pollutants).

## Objective

Reduce the presence of emerging pollutants by 80-90% in infiltration water (***DIRECTIVE (UE) 2024/3019***).

Barcelona Case Site



# Current solutions

IMPROVE WWTP PERFORMANCE ON THE  
ATTENUATION OF CEC



## Intensified technologies

GAC, membranes, advanced oxidation (>90%  
reduction)



## Nature based solutions

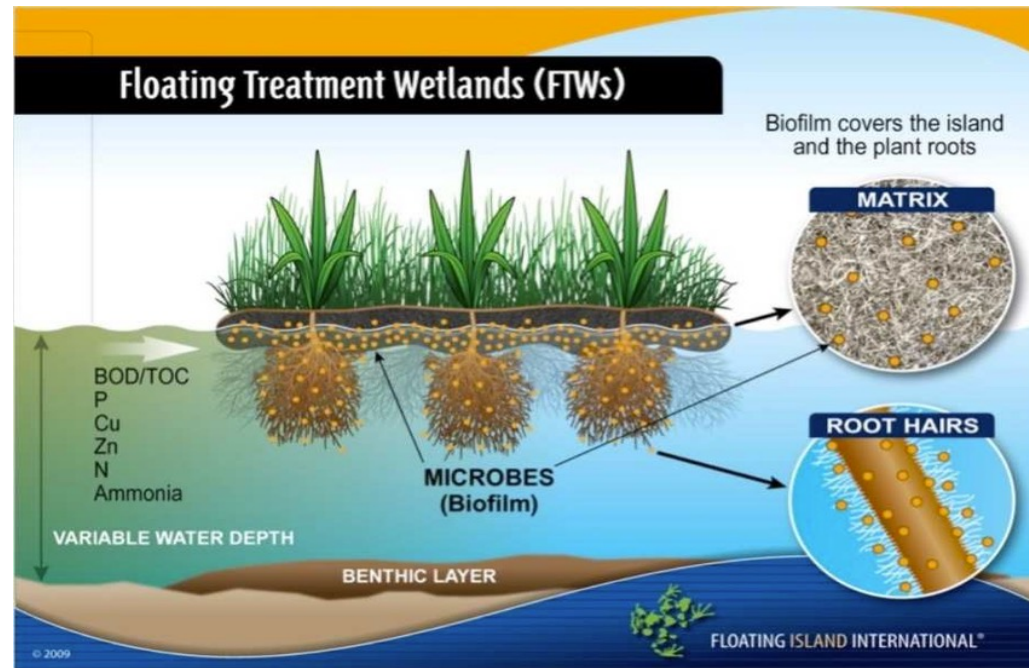
Integrated in the landscape  
Low energy costs / energy  
neutrality  
No GHG emissions  
Ecosystem benefits  
Green areas

Specific  
designs and  
high surface  
area demand

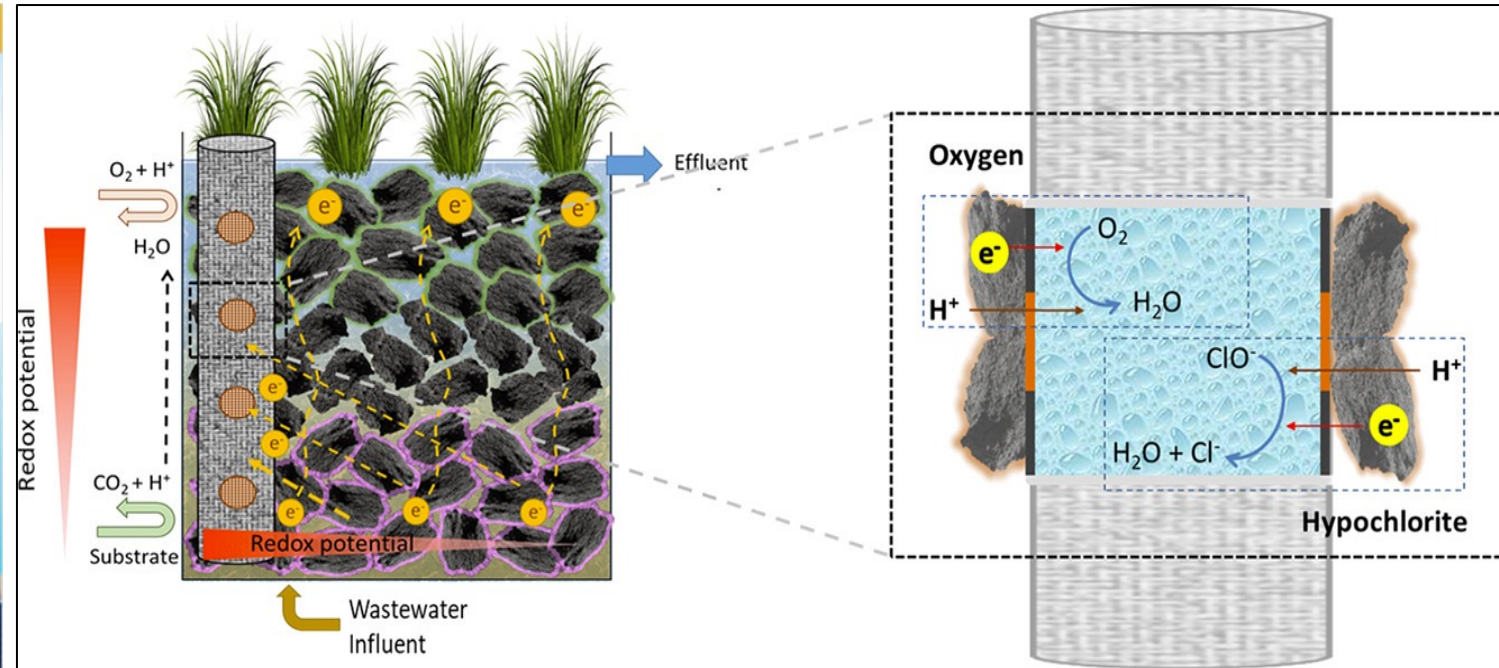


# Intensified NBS for reducing surface area demand and enhancing pollutant reduction

## Root mats CWs



## Bioelectrochemically-assisted CWs



# Construction of the pilot plant

February 2024

## Deployment of biobased solutions

- Montcada i Reixac WWTP (400,000 PE)
- Secondary treated wastewater



# Construction of the pilot plant

May 2024



P1: 25% Root mat/ 75% Biochar  
P2: 50%/50%  
P3: 75%/ 25%  
PB: 100% Biochar

# Construction of the pilot plant

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June 2024



# Construction of the pilot plant

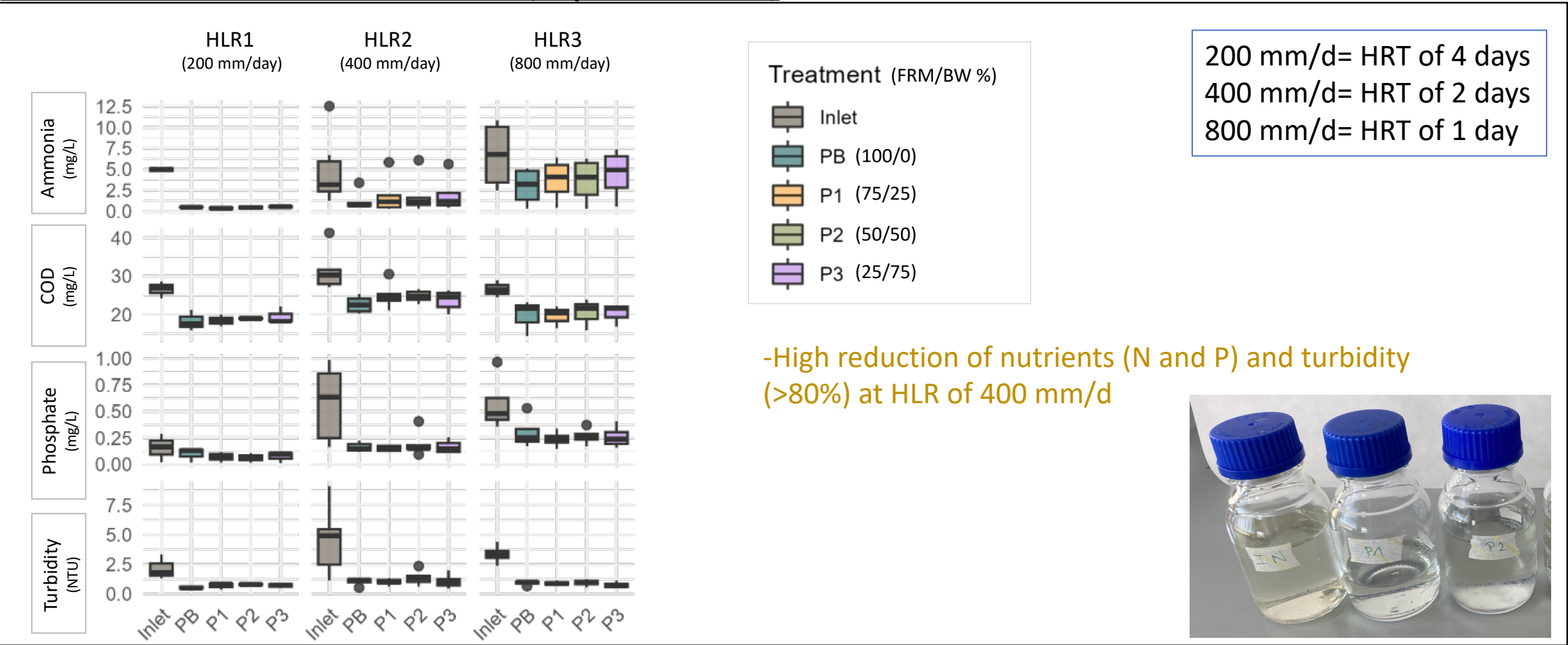
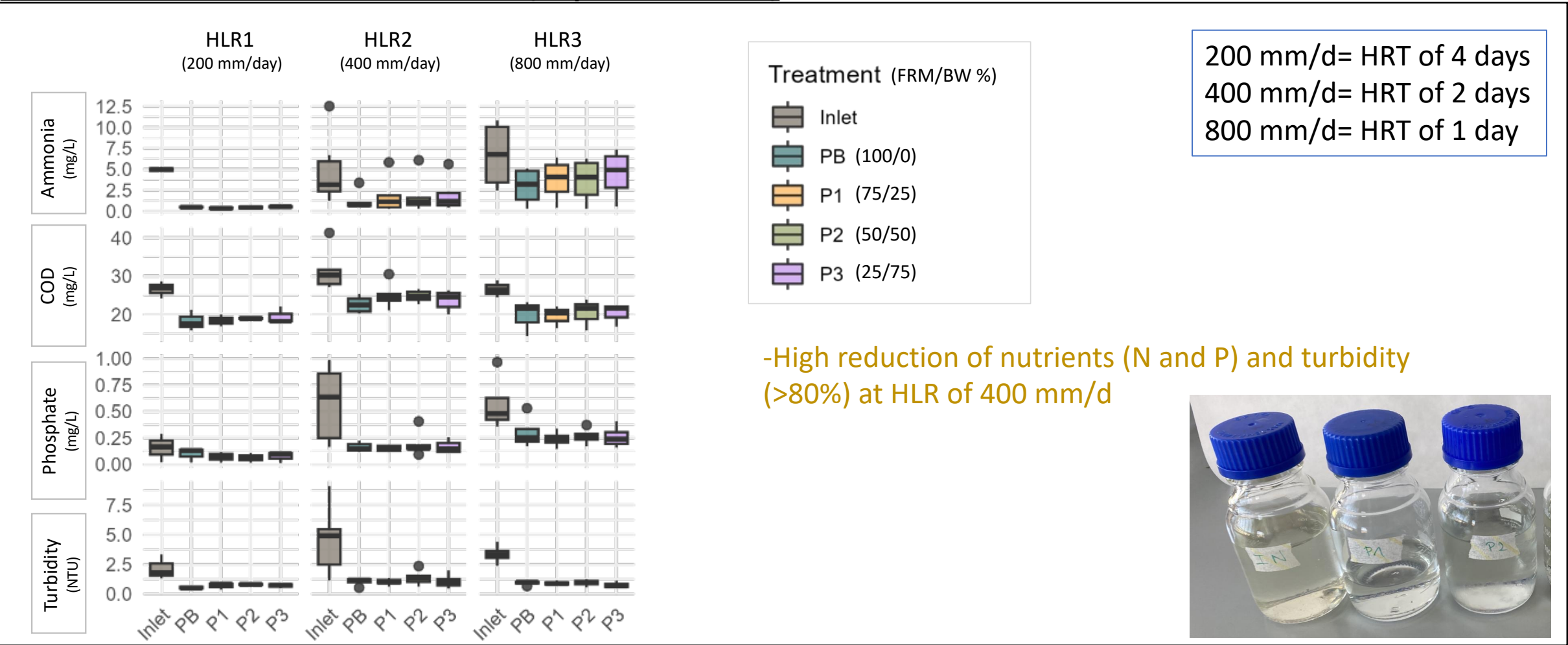
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July 2024



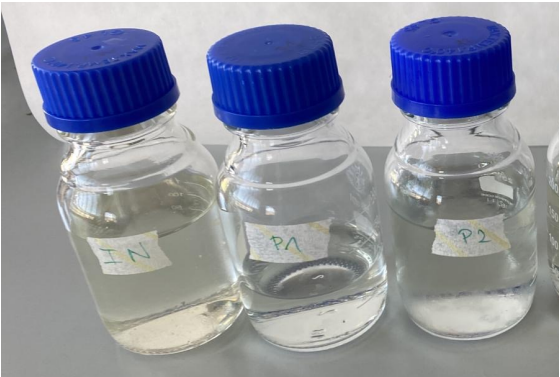
# Results

## GENERAL WATER QUALITY PARAMETERS (July-October 2024)



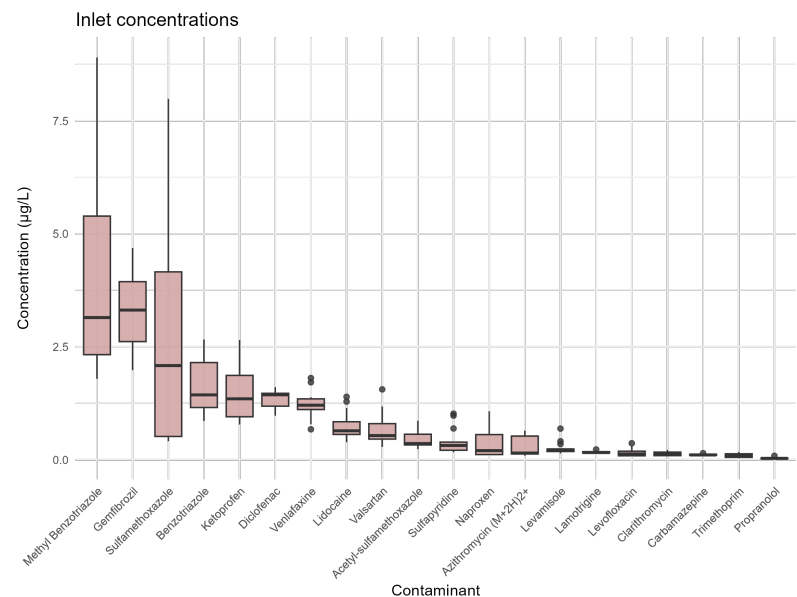
200 mm/d= HRT of 4 days  
400 mm/d= HRT of 2 days  
800 mm/d= HRT of 1 day

-High reduction of nutrients (N and P) and turbidity (>80%) at HLR of 400 mm/d

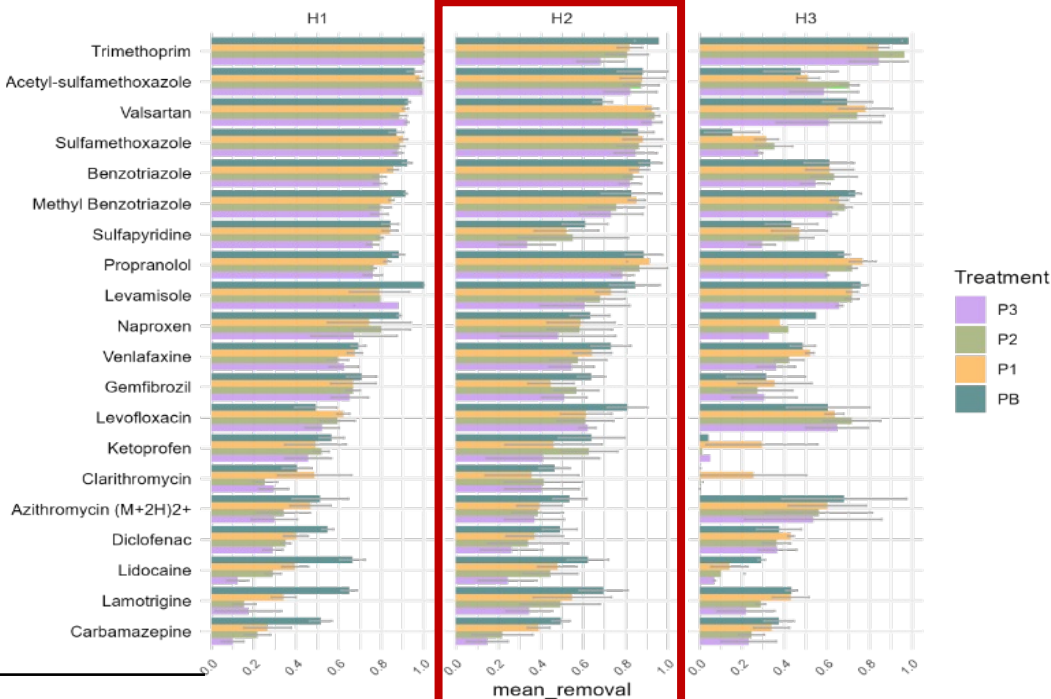


# Results

## EMERGING POLLUTANTS (July-October 2024)



### Removal efficiency(%)



	HLR 1 200 mm/day	HLR 2 400 mm/day	HLR 3 800 mm/day
PB	84% ± 20%	82% ± 19%	55% ± 26%
P1	71% ± 30%	65% ± 26%	49% ± 25%
P2	64% ± 27%	61% ± 24%	54% ± 26%
P3	62% ± 24%	59% ± 25%	57% ± 23%



DIRECTIVE (UE) 2024/3019

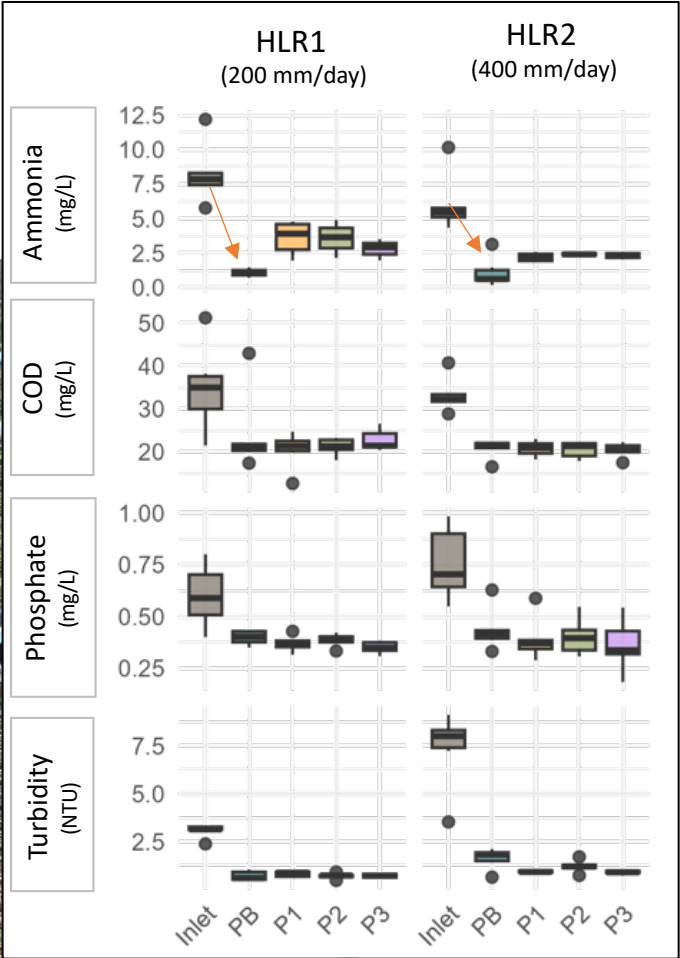
# Results

Cold conditions, outdoor temperatures -4°C

(January 2025)



## Water quality parameters



## EMERGING POLLUTANTS

	HLR 1	HLR 2
	200 mm/day	400 mm/day
PB	72 ± 21 %	58 ± 15 %
P1	55 ± 25%	51 ± 21 %
P2	56 ± 30 %	48 ± 23 %
P3	51 ± 30 %	46 ± 18 %



# Vision

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- **SPAIN:** Scale-up the NBS technology as a quaternary treatment technology in existing WWTPs to prevent groundwater pollution, helping to improve groundwater quality for use as drinking water (proximity water, KM ZERO WATER).



THANK YOU FOR YOUR ATTENTION

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<https://upwater.eu/>