



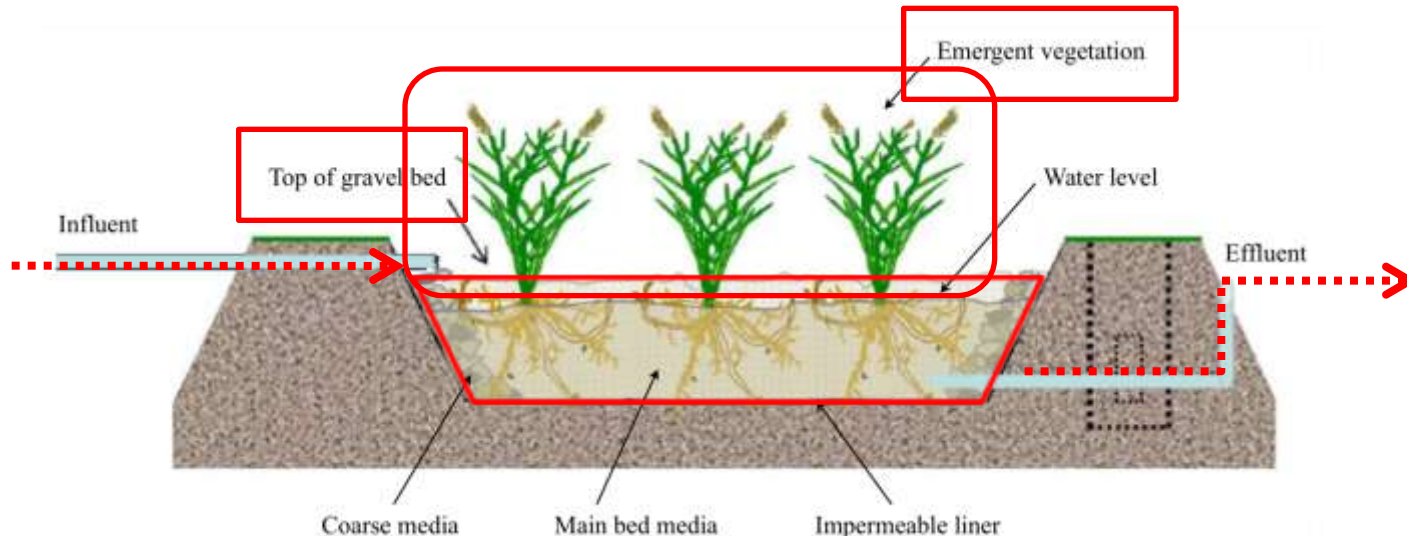
Integrated treatment of wastewater, urban runoff and sludge with constructed wetlands

C. Ávila, J. J. Salas, I. Martín, C. Aragón, J. García

Sevilla, April 26th 2011



Constructed wetlands



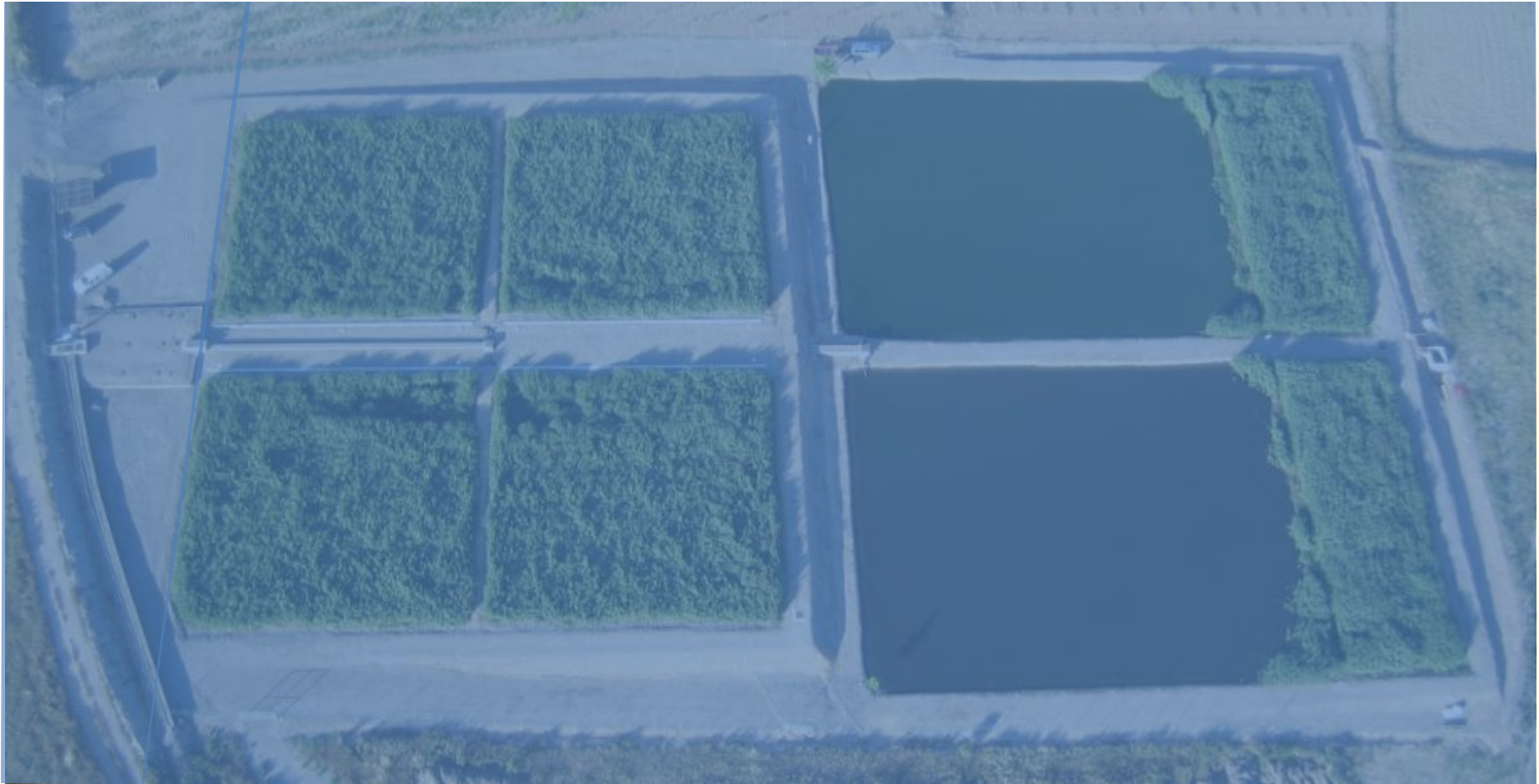
Corzo and García, 2008

- Uses:
 - Urban and industrial **wastewater treatment**
 - Mineralization and dewatering of **sludge**
- Advantages:
 - Usually **less expensive to build** than other treatment options
 - **Low operational and maintenance** expenses (energy and supplies)
 - Easily **integrated into the natural and rural landscape**



Constructed wetland system at Verdú (Lleida, Spain)

2000 PE

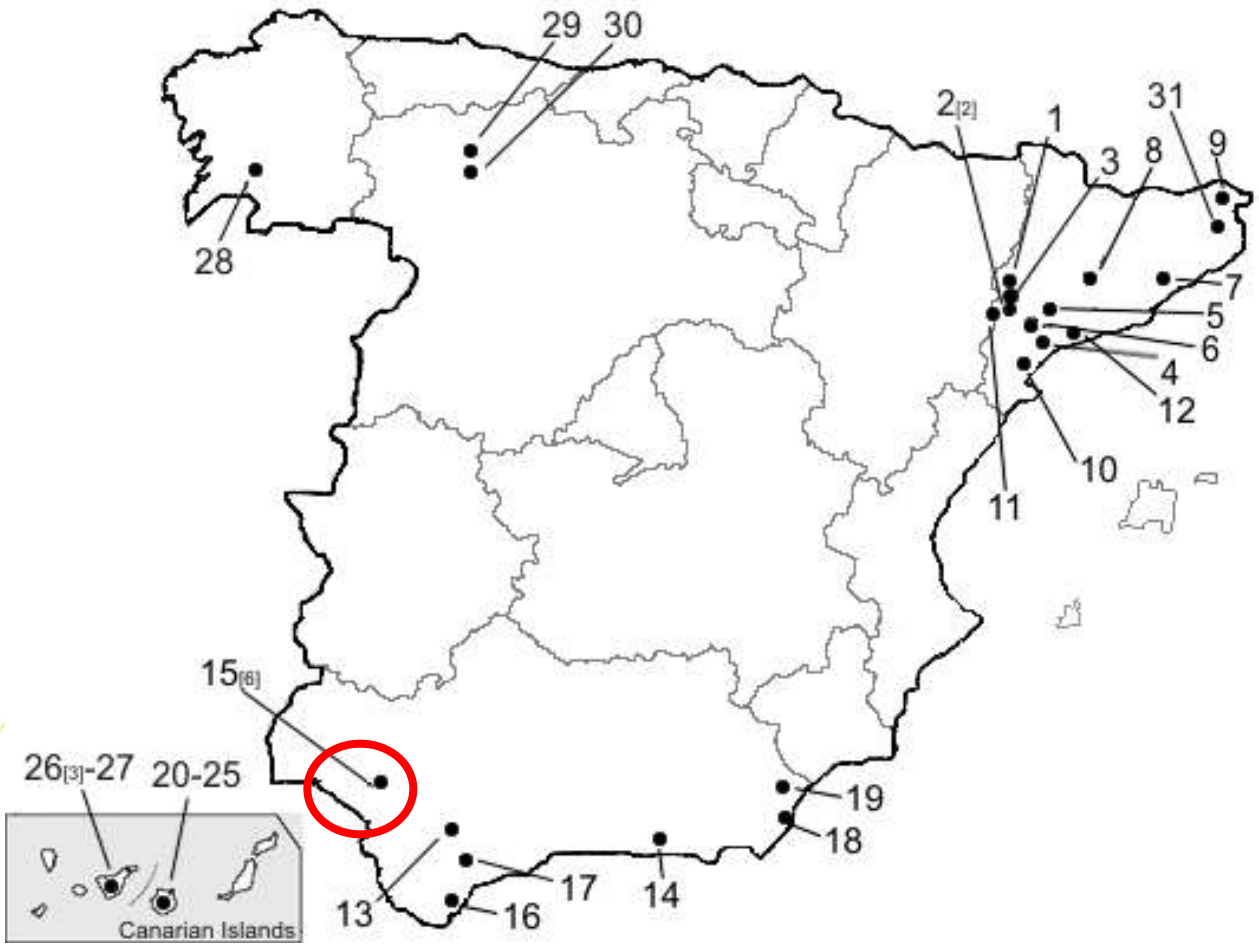


Pre-treatment
Primary treatment

Secondary
treatment

Polishing
step

Constructed wetland systems in Spain



Puigagut et al. (2007)

Experimental treatment plant of Carrión de los Céspedes (Seville)

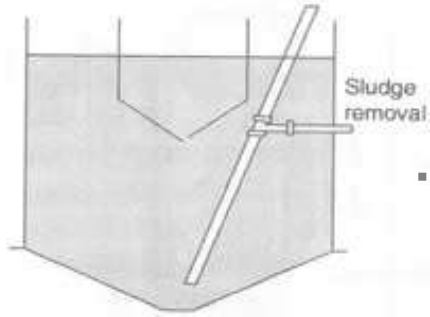
- Created in 1990 for low-cost systems
- Overall area: 41000 m²
- Management: Foundation Centre for New Water Technologies (CENTA)
- Treats the urban wastewater of the village of Carrión de los Céspedes (2300 PE) – around 330 m³/d.



- Integrated treatment of wastewater, urban runoff and sludge with constructed wetlands



Wastewater treatment line

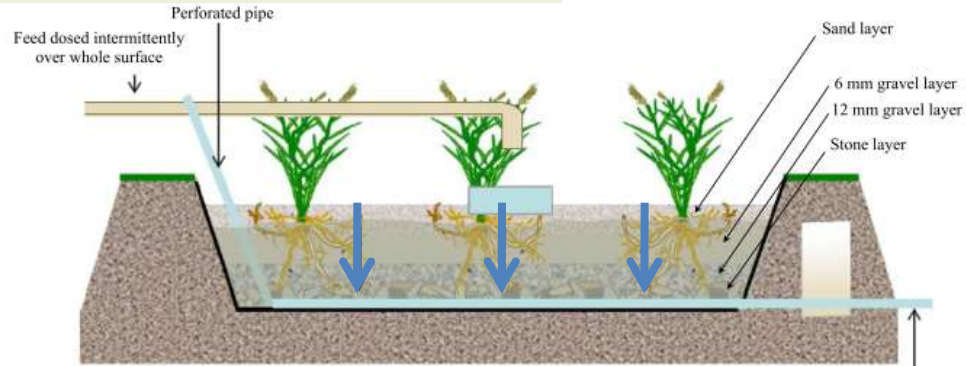


Imhoff tank

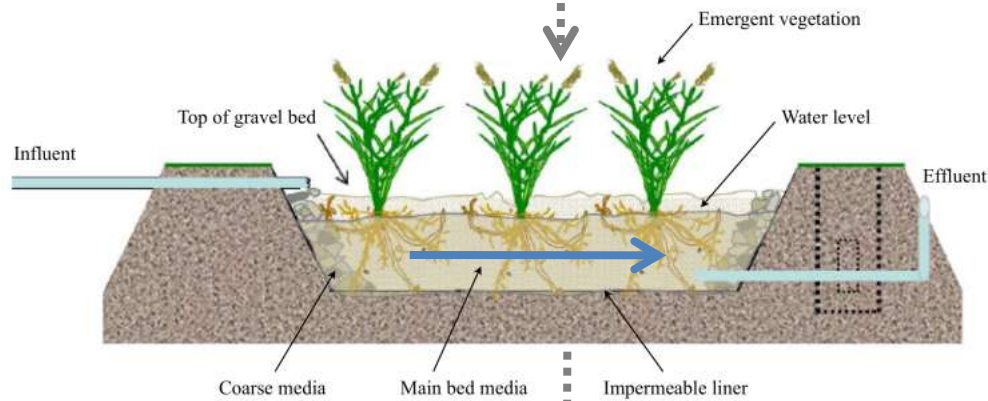
Phragmites australis

Average flow ~ 14 m³/d

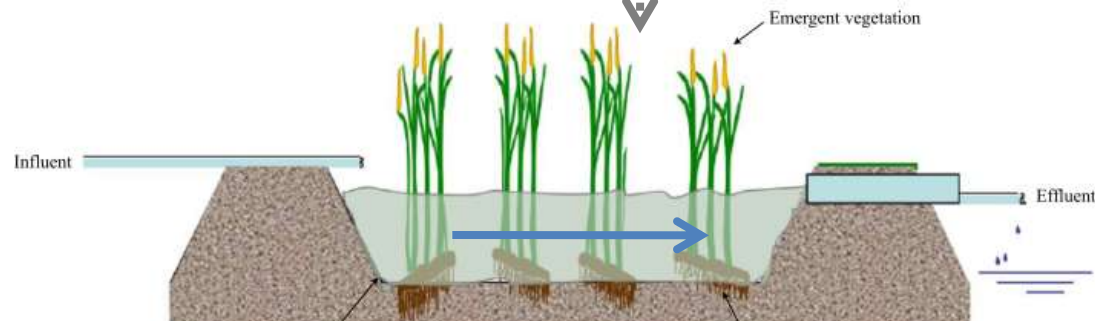
OLR ~ 9.6 g BOD₅/m².d



Vertical flow
317 m²



Horizontal subsurface flow
229 m²



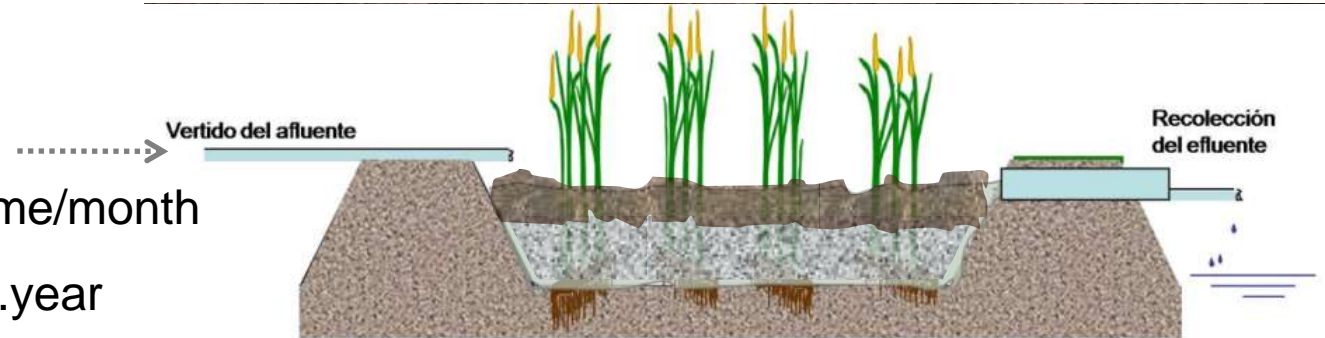
Free water surface flow
240 m²

Sludge treatment line

Area: 20 m²

Loading regime: 1 time/month

Around 42 kg TS/m².year



Water tank for water reuse

Receives water from the effluent of constructed wetlands for its reuse

Capacity: 20 m³



Vertical flow CW



Horizontal flow CW



Free water surface CW



Water tank for water reuse

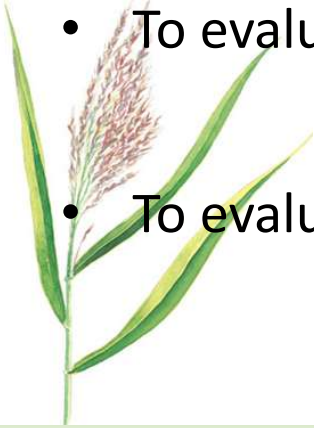


Sludge treatment wetland

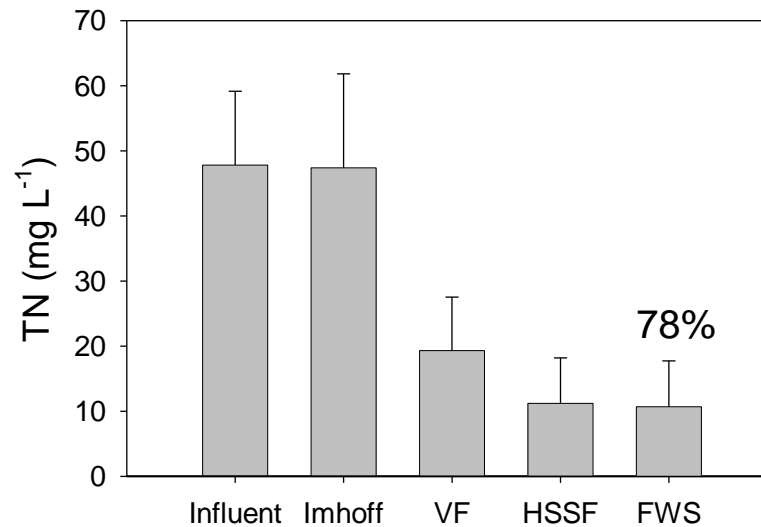
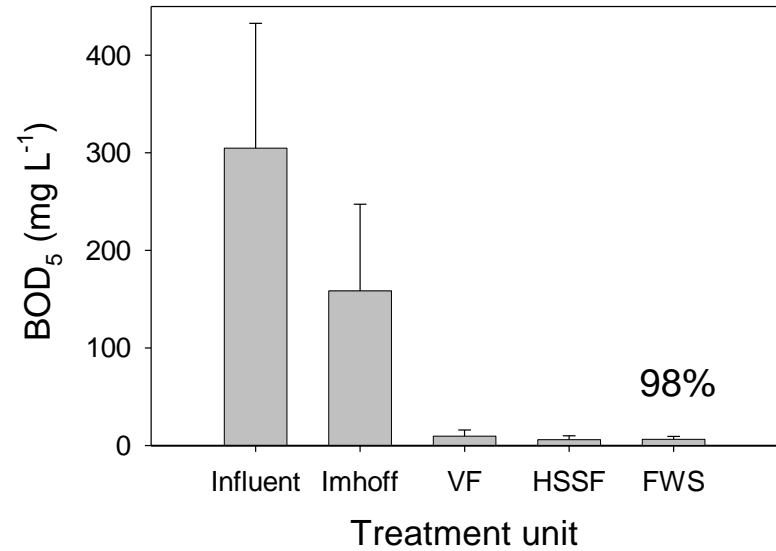
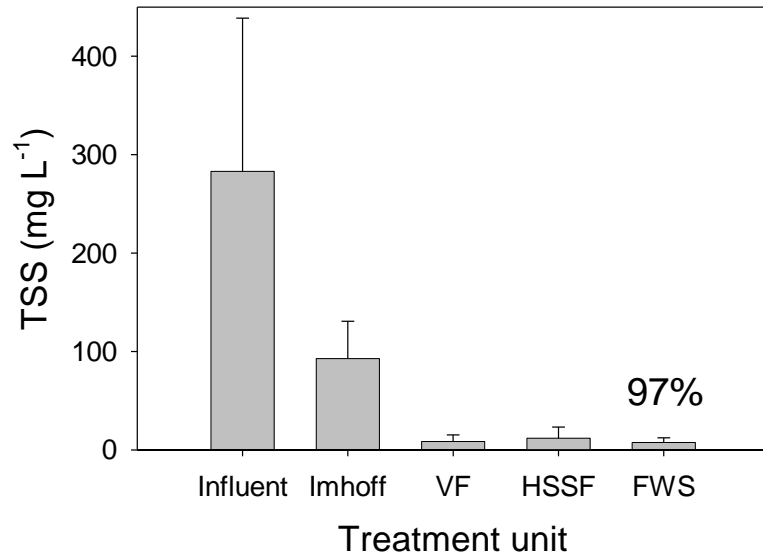


Objectives

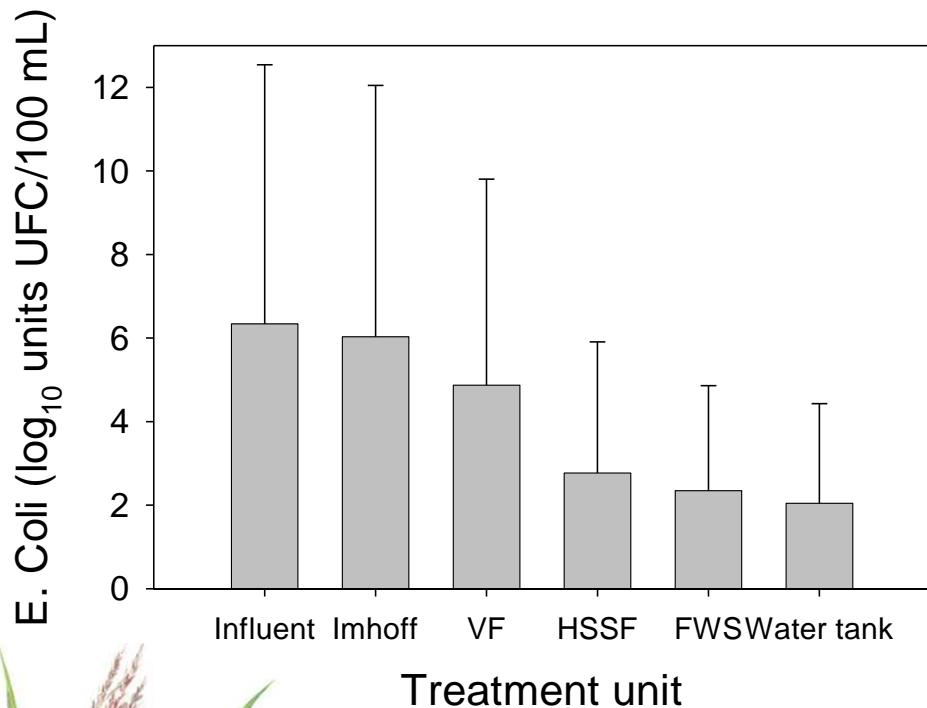
- To evaluate the performance of the wetland system for **wastewater treatment**
- To assess the **influence of heavy rainfall** on the performance of the wetlands
- To evaluate the **quality of the final effluent** for its possible reuse
- To evaluate the performance of the **sludge treatment wetland**



Wastewater quality parameters in CWs



Quality of the water tank for its reuse



- Its quality fulfills the guidelines (RD 1620/2007) for:
 - **Recharge of aquifers** by percolation through the ground
 - **Irrigation of green areas** non accessible to the public
 - **Silviculture**



Sludge treatment line

	Raw sludge	Treated sludge
Humidity (%)	95.6	74.6
Organic matter (% TS)	49.1	47.4



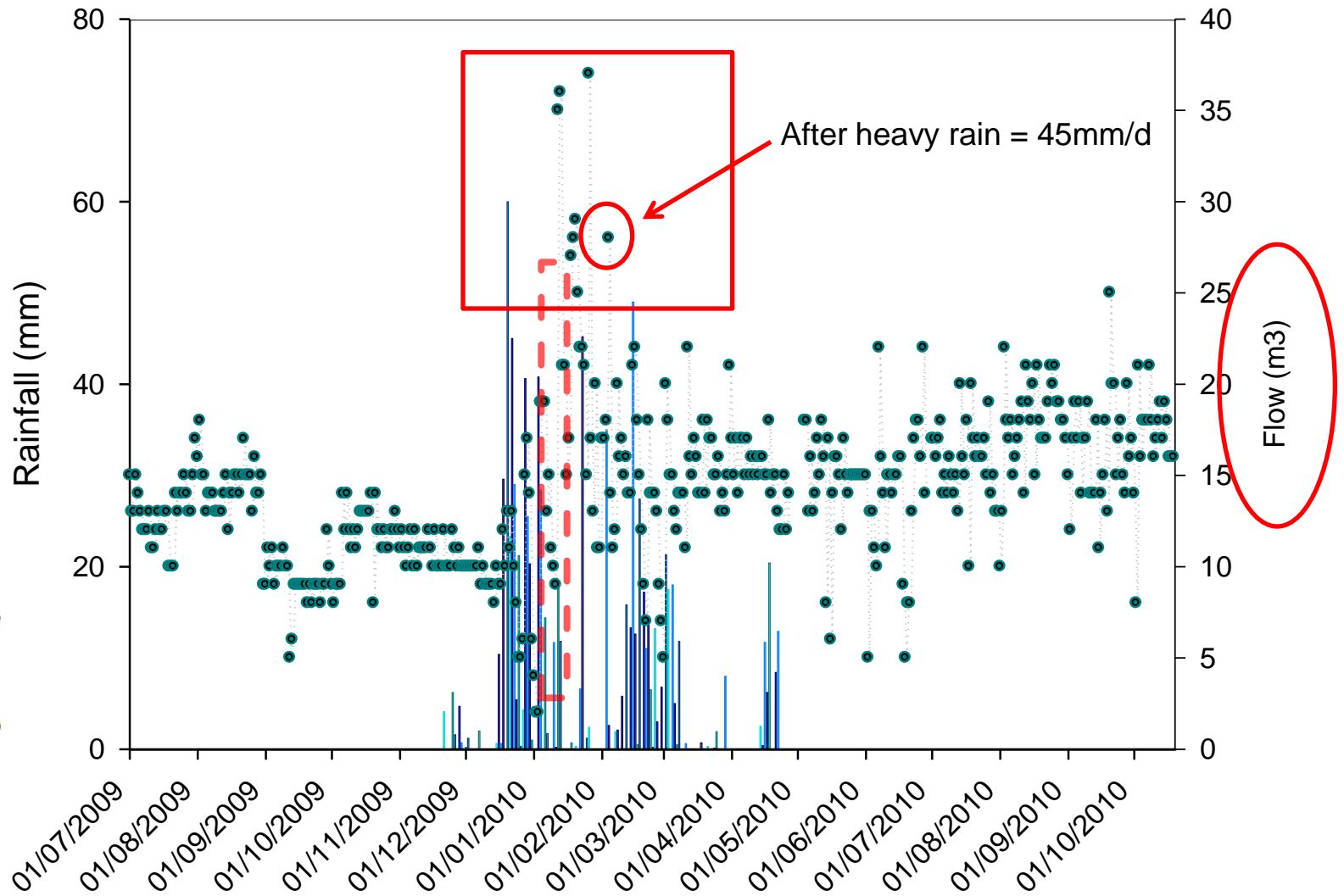
Raw sludge



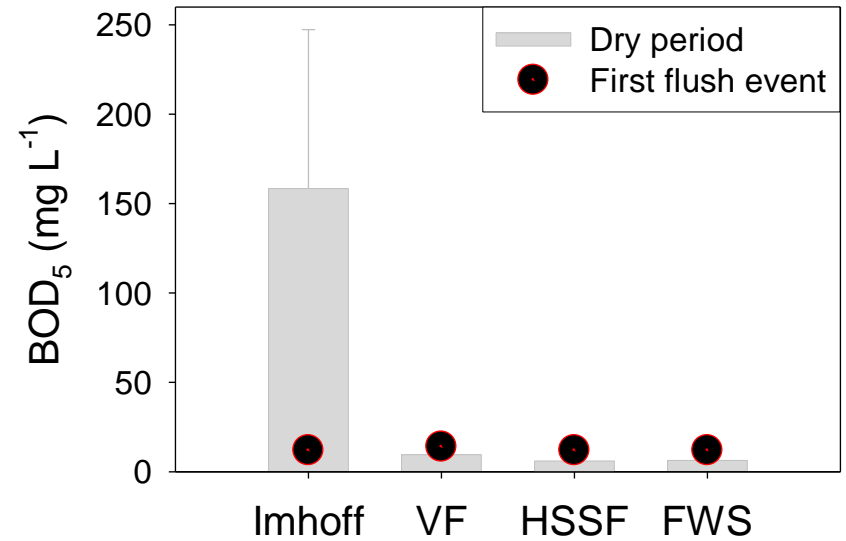
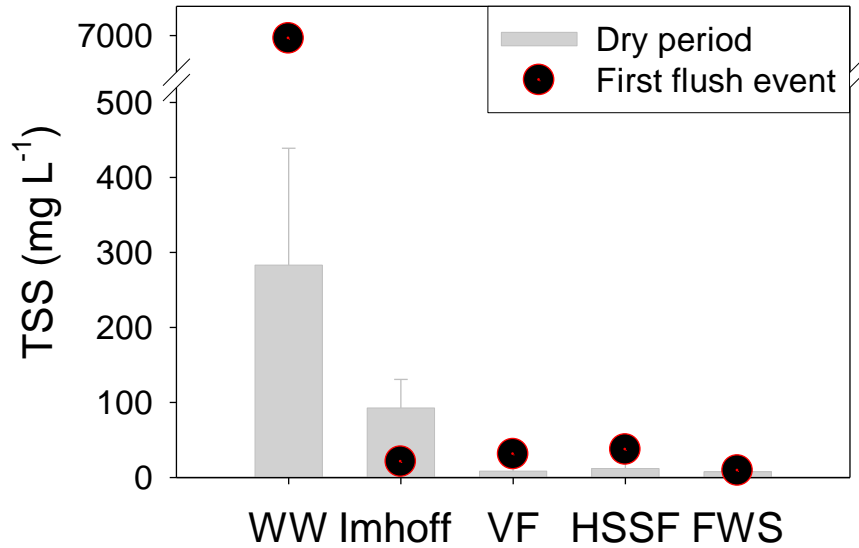
1 month later



First flush event (heavy rainfall)



First flush event (heavy rainfall)



Conclusions

- The system appears as an integrated approach capable of **accomplishing a good treatment of a combined sewer effluent and the sludge produced** in the process.
- The **quality of the final treated wastewater** fulfills the requirements for its reuse in various environmental applications, such as **irrigation of green areas non accessible to the public and silviculture**.
- The occurrence of **stormy periods does not jeopardize** the correct functioning of the system, which is able to recover to usual levels after the rain event.
- The **treatment of sludge was effective** in the sludge treatment wetland.





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