

TROPHIC WEBS FROM DISCHARGES: NATURE ENHANCEMENT THROUGH THE WATERHARMONICA CONCEPT

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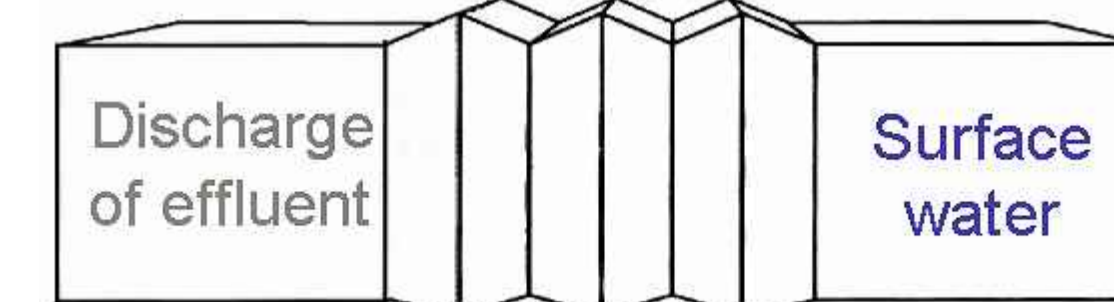
The Waterharmonica concept: initial approach

- Treated wastewater: clean, but "dead" effluent, still with impacts on the receiving water bodies
- Need to return "live" effluents to the environment (European WFD) renaturalization of waters to be discharged for standard compliance (specially acute where dilution flows are low)
- Constructed wetland systems are effective transition zones between WWTPs and environment
- Designed and operated with a trophic web approach
- Waterharmonica website: www.waterharmonica.nl



"Dead" effluent (What we are discharging)

- Sludge particles
- High concentration of loose bacteria
- High concentration of inorganic nutrients
- Low concentration of dissolved oxygen
- Odours

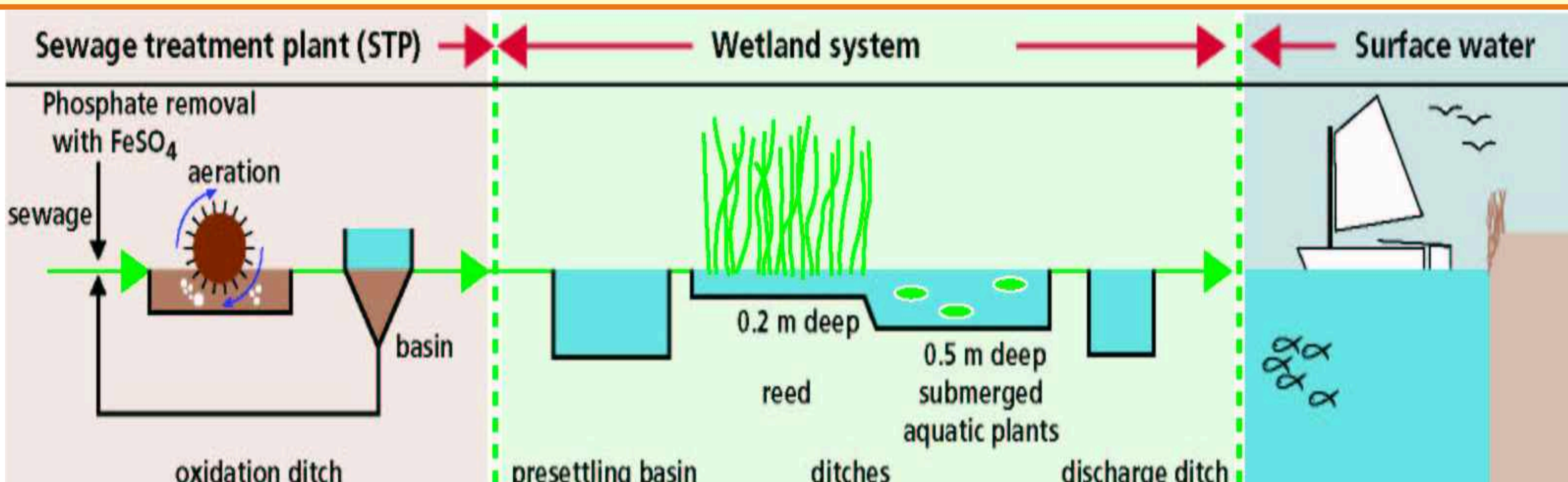


the missing link from tap to source

"Live" effluent (What the environment needs)

- Algae, crustaceans, insect larvae, etc.
- Naturally disinfected water
- Low concentration of inorganic nutrients
- Oxygen dynamics as in natural water bodies
- Absence of odors

Engineering



Nature

Design approach: "Hard" treatments to be used for wastewater treatment (higher efficiency, smaller footprint), and "soft" treatment systems to be used for effluent polishing, where efficiency of the "hard" ones decreases and/or requires expensive investments (i.e., use of membranes)



Upgraded treated waste water for environmental protection

• Nature enhancement through the development of trophic webs

Eversteekoog constructed wetland (Island of Texel, The Netherlands): Full scale constructed wetland for effluent polishing, since 1994



- **Ameland (Fryslân, The Netherlands):** use of naturally upgraded effluent to lure fish across high dikes to the water system of this Wadden sea island: plans will be presented in October 2007. The effluent is now discharged into the Wadden sea, causing loss of usable water.

- **Ridaura river basin (Costa Brava, Spain):** Water transfers from Ter river basin for municipal and domestic supply has allowed the recovery of the natural flows in the Ridaura river in average rainfall years. Wastewater reclamation and reuse for agricultural and golf course irrigation (0.6 hm³/year not withdrawn from a coastal aquifer of 5 hm³/year of renewable resource production) has also decreased both groundwater and fertilizer demand (avg. 16 tons N/year and 2 tons P/year recycled), and helped restore natural flows, reduce discharges and improve macro-invertebrate abundance in this temporary Mediterranean stream

- **Aqualân Grou (Fryslân, The Netherlands):** On 8 June 2007 a new constructed wetland, based on the Eversteekoog experiences, has been officially opened. The wetland has been designed to convert well treated waste water into a natural values. It is the first application of Daphnia ponds for biological filtration, aimed on disinfection of waste water. The last pond of the system is in open contact with the canal to provide a spawning area for fish



- **The Sa Riera Park and the Tossa de Mar Creek (Costa Brava, Spain):** In 1997, a project was undertaken in order to turn marginal land located between the WWTP and the local creek (Tossa de Mar creek) into a park by using reclaimed water to help establish the newly planted vegetation. The Sa Riera Park was also completed with a wetland, which provides water to the creek by soil percolation, preventing its total desiccation in summer downstream of the Sa Riera Park. It has been observed that the slight flow gained is crucial for the survival of eels and also for the quicker recovery of macro-invertebrate indexes when natural flows run again



Ridaura river basin, 00's: -after flow restoration measures-: left, river bed upstream WWTP (march 03); right, downstream WWTP (august 05).

- **Empuriabrava constructed wetland (Costa Brava, Spain):** Effluent polishing for environmental reuse at the Aiguamolls de l'Empordà Nature Reserve since 1998. Flora and fauna increasingly similar to the adjacent natural wetlands. Sustenance of dense and diverse populations of birds in spring due to food abundance. Improvement of the microbiological quality of the nearest beach at the mouth of the Muga river



Tossa de Mar: Images of the Parc de Sa Riera (sustained with reclaimed water) and streamflow augmentation with reclaimed water through soil percolation in Tossa Creek (June 2007).

Ongoing and future research and monitoring efforts

- Biological filtration of treated waste water as an alternative for technical filtration (see Kampf et al, elsewhere in this poster session)
- Assessment of improvement of ecological quality, removal of microbial indicators, fate of suspended particles, pathogens and micro-pollutants in the constructed wetland systems of Empuriabrava and Grou and assessment of the improvement in receiving water bodies according to EU's WFD

