Upsacaling an ecohydrological solution: case of Lyon demosite

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ECOHYDROLOGY FOR WATER SECURITY

5th International Symposium of Healthy Rivers and Sustainable Water Resources Management

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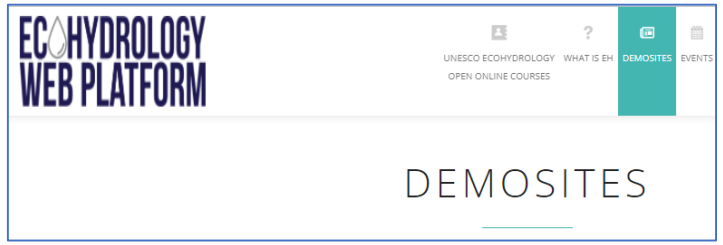
….with many colleagues from different disciplines over years



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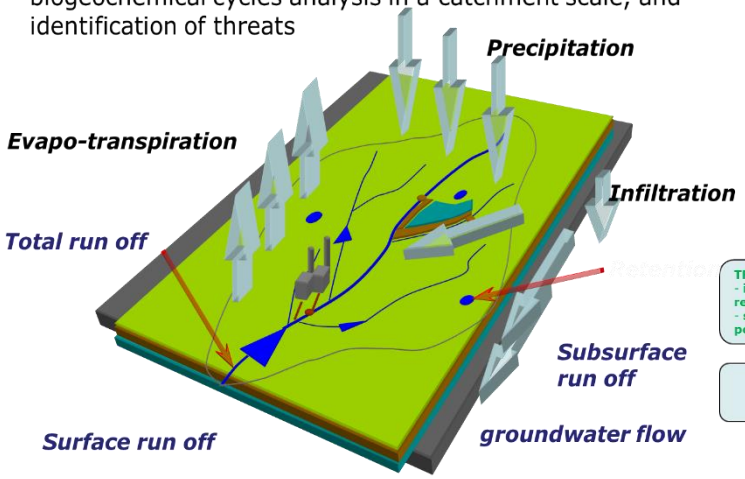
EcoHydrological 3 principles

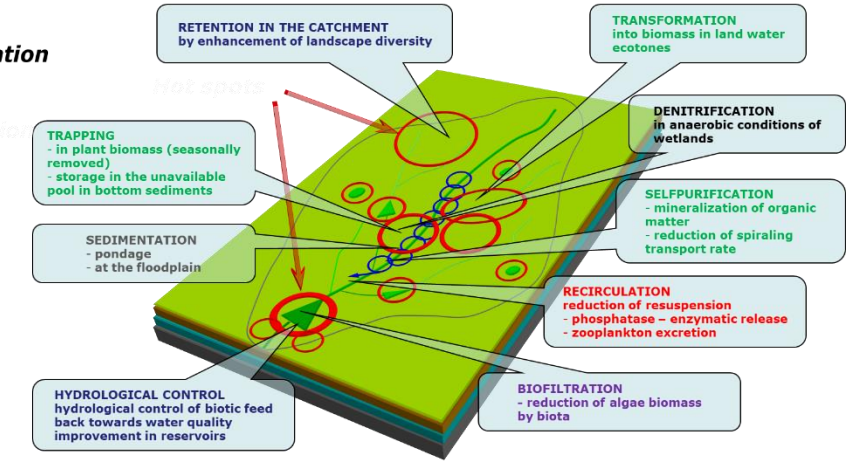
I – FIRST PRINCIPLE (Zalewski 2010)
Hydrological principle

Quantification of hydrological processes (cycle) as a template for biogeochemical cycles analysis in a catchment scale, and identification of threats

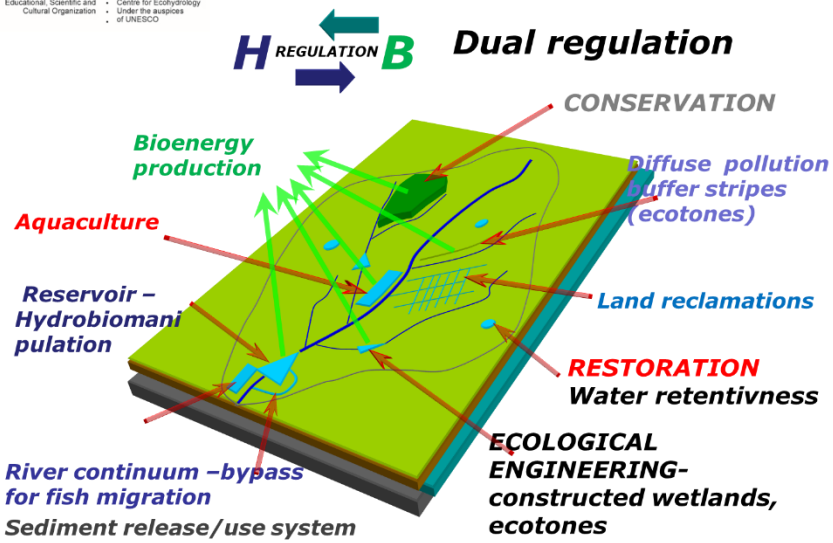


II – SECOND PRINCIPLE
Ecological principle

Identification of biological processes and of potential areas for enhancement of ecosystem carrying capacity

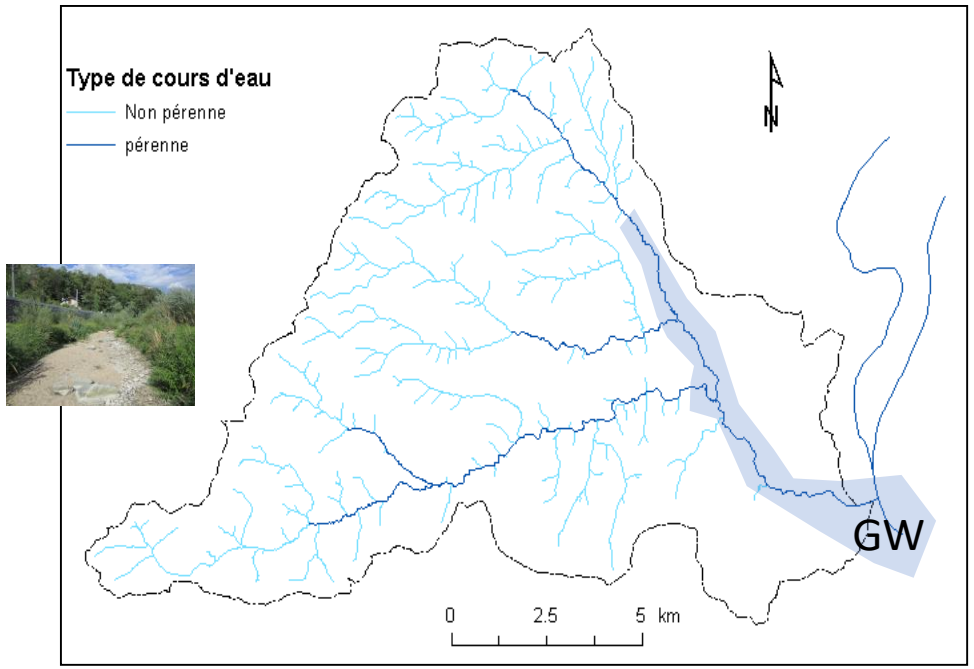


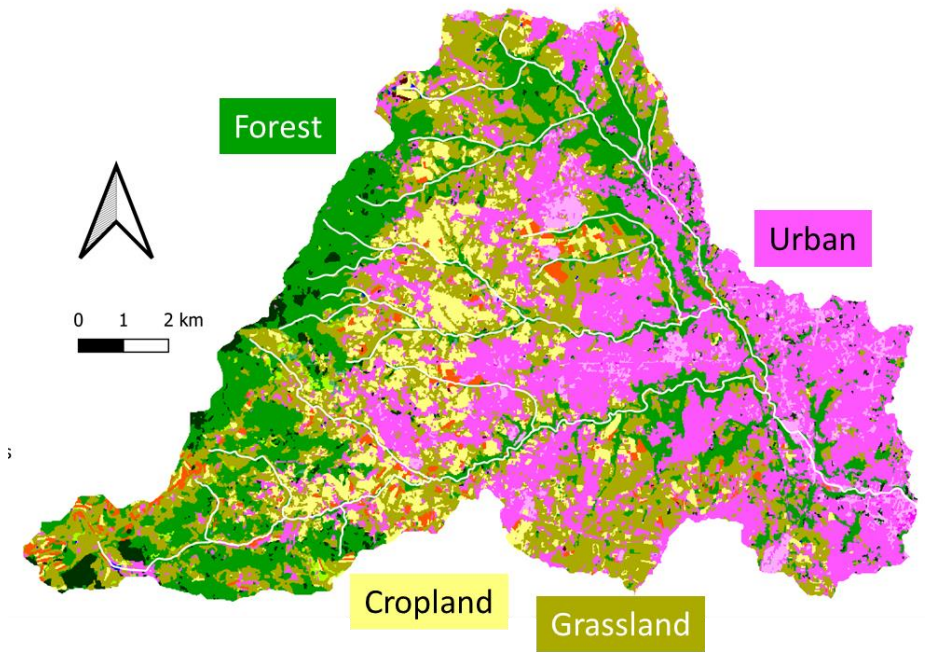
III – THIRD PRINCIPLE
Ecological engineering principle



WBSR+CE+PL: Water, Biodiversity, Services for society, Resilience to climate change and anthropogenic impacts, the implementation of which has to be broadly supported by Culture and Education, Policy & Law.

First principle : Hydrological / biochemical template





Main features : 150 km2; Av. Rainfall : 824 mm/y; av. air T : 11.4 °C
Mother rock : granite, schist → sand
Low flows from June to September

Hydrological Key points :

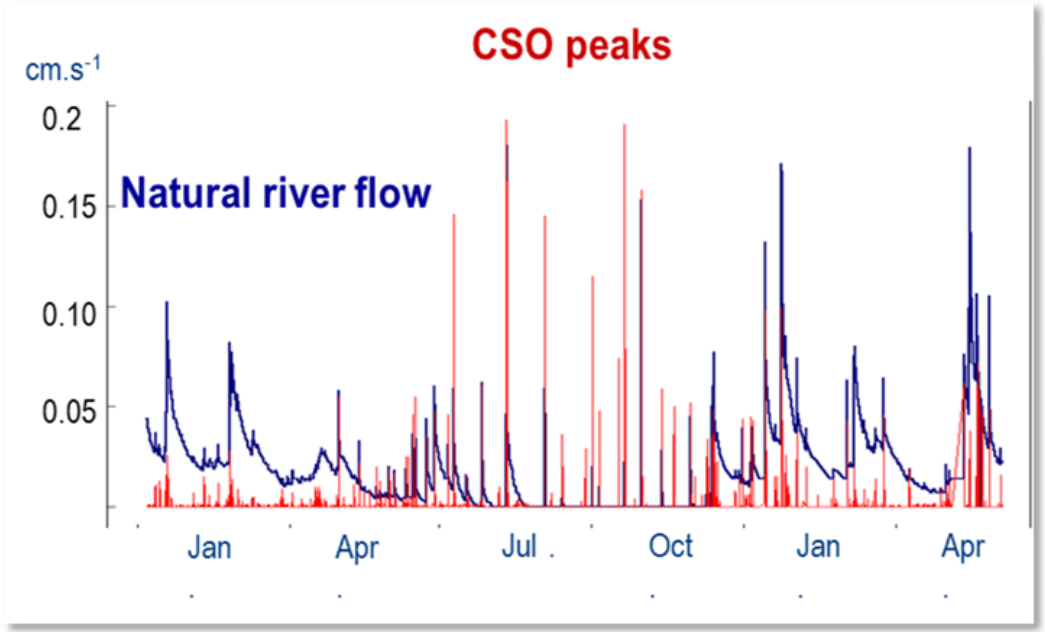
- Seasonal drying of 60% of the river network
- Permanent GW connection only in the downstream part

Biochemical footprint:

- UP-downstream land use gradient from natural to agricultural to urban…

First principle : …….threats identifdication

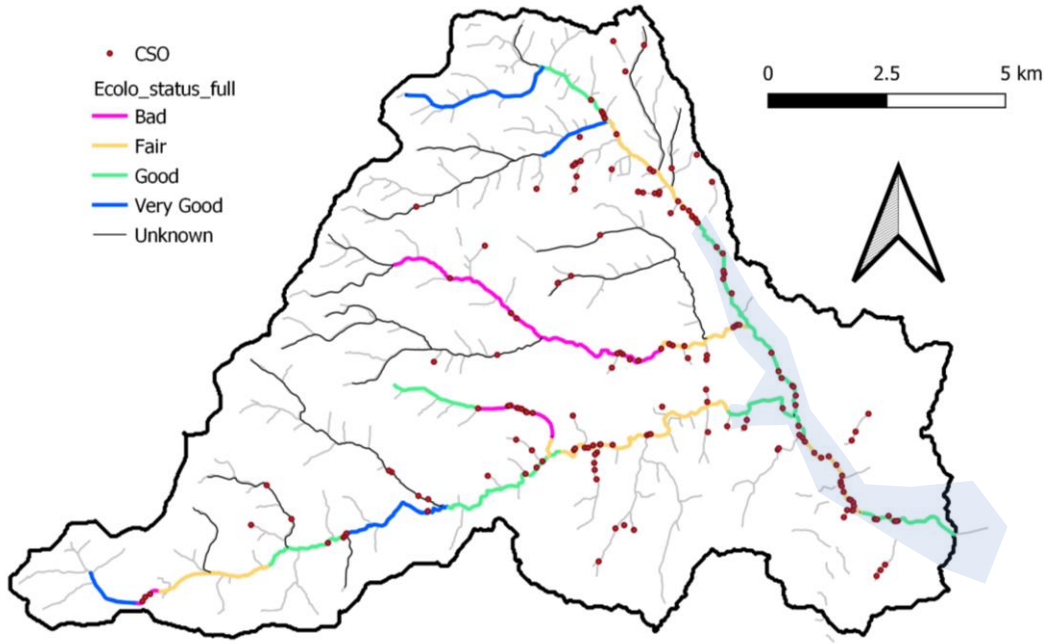
Impact of urban runoff:
About 180 combined sewer outlets and direct connections of urban runoff to the river system. This has implications for geomorphology and water quality at the surface and in the sediment.

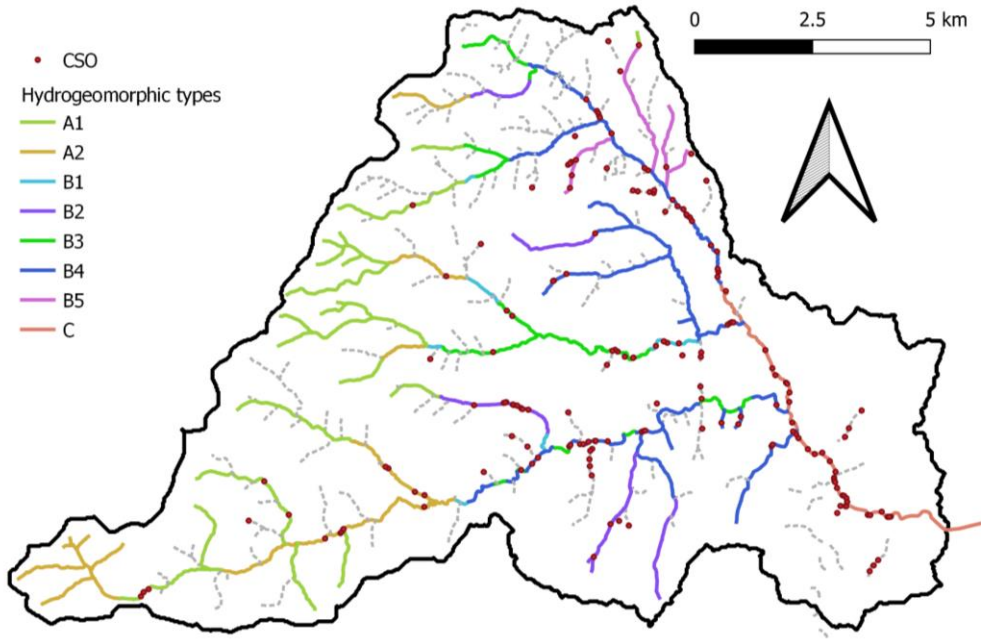


Periurban expansion →rapid land use change →More impervious areas → Saturation of existing sewer networks

Threats identification:
- Urban flood peaks during the low flow period (summer storms). No dilution.
- They bring various pollutant loads including biodegradable organic pollution.
- Low flows and urban flooding are expected to increase with CC.

Second principle : biological processes…and their drivers

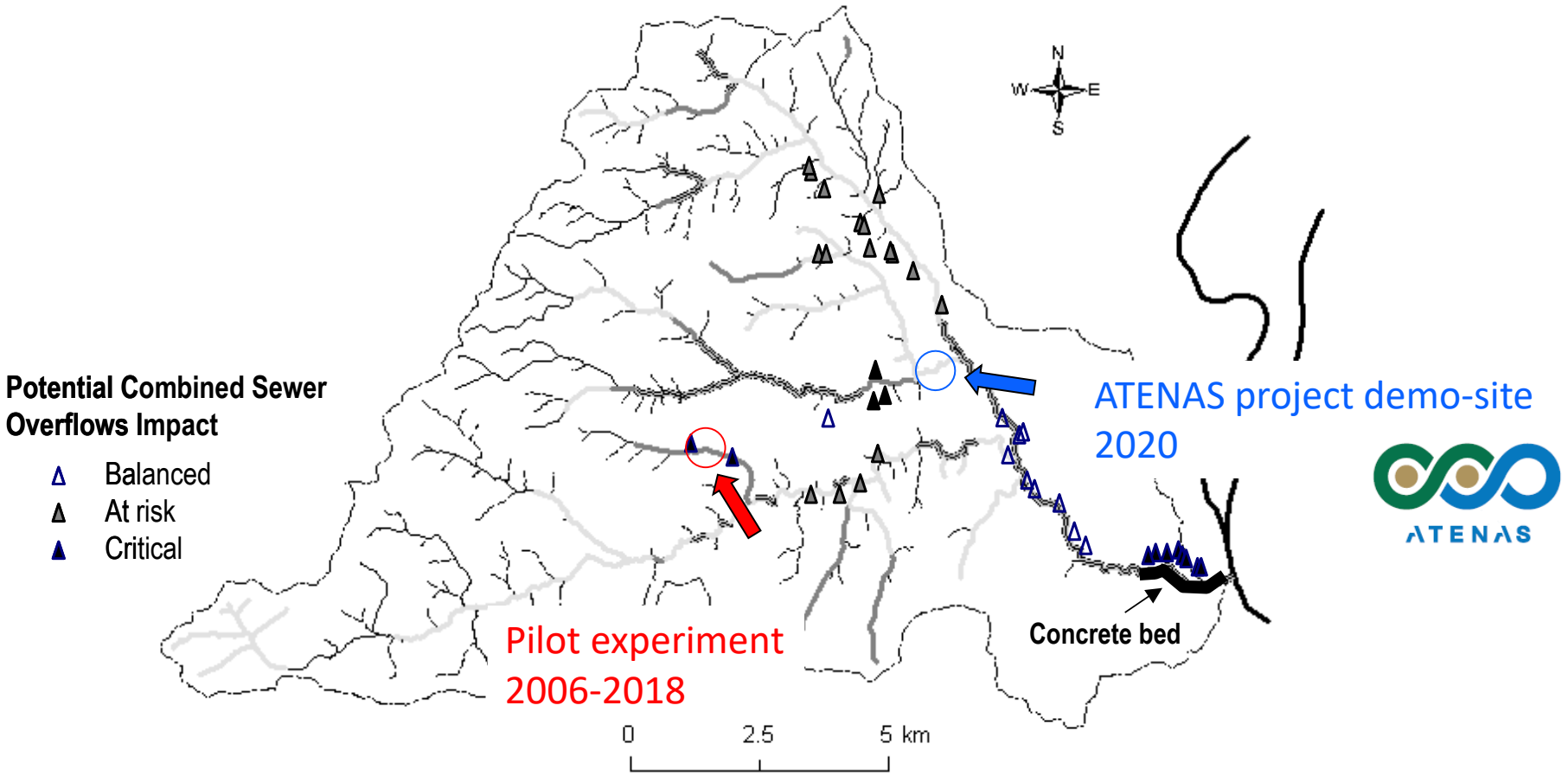




Ecological indicator : A combination of standardised indices for biology and water quality.
Key points:
Evidence of self-purification capacity from upstream to downstream.

Hydrogeomorphology of river sections & GW are potential drivers :
Poor ecological status persists in geomorphological types B2 to B5 except where groundwater is present.

Second principle : …. where to enhance ecosystem carrying capacity ?

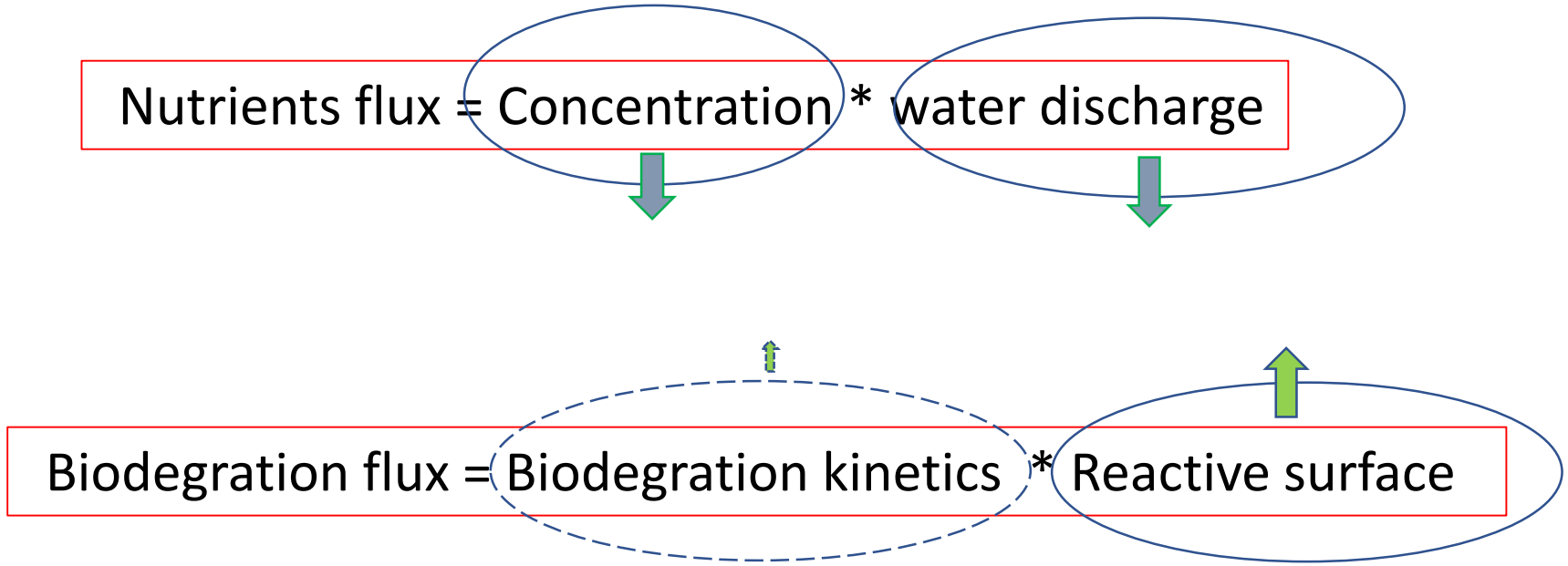


Third principle : dual regulation to naturally process threats…

Nutrients flux = Concentration * water discharge

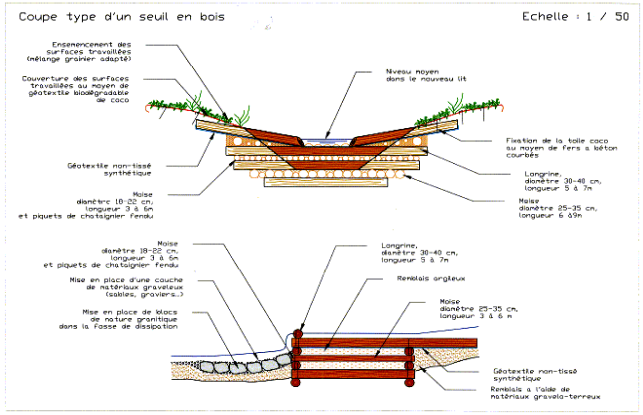
Biodegration flux = Biodegration kinetics * Reactive surface

Third principle : dual regulation to naturally process threats…



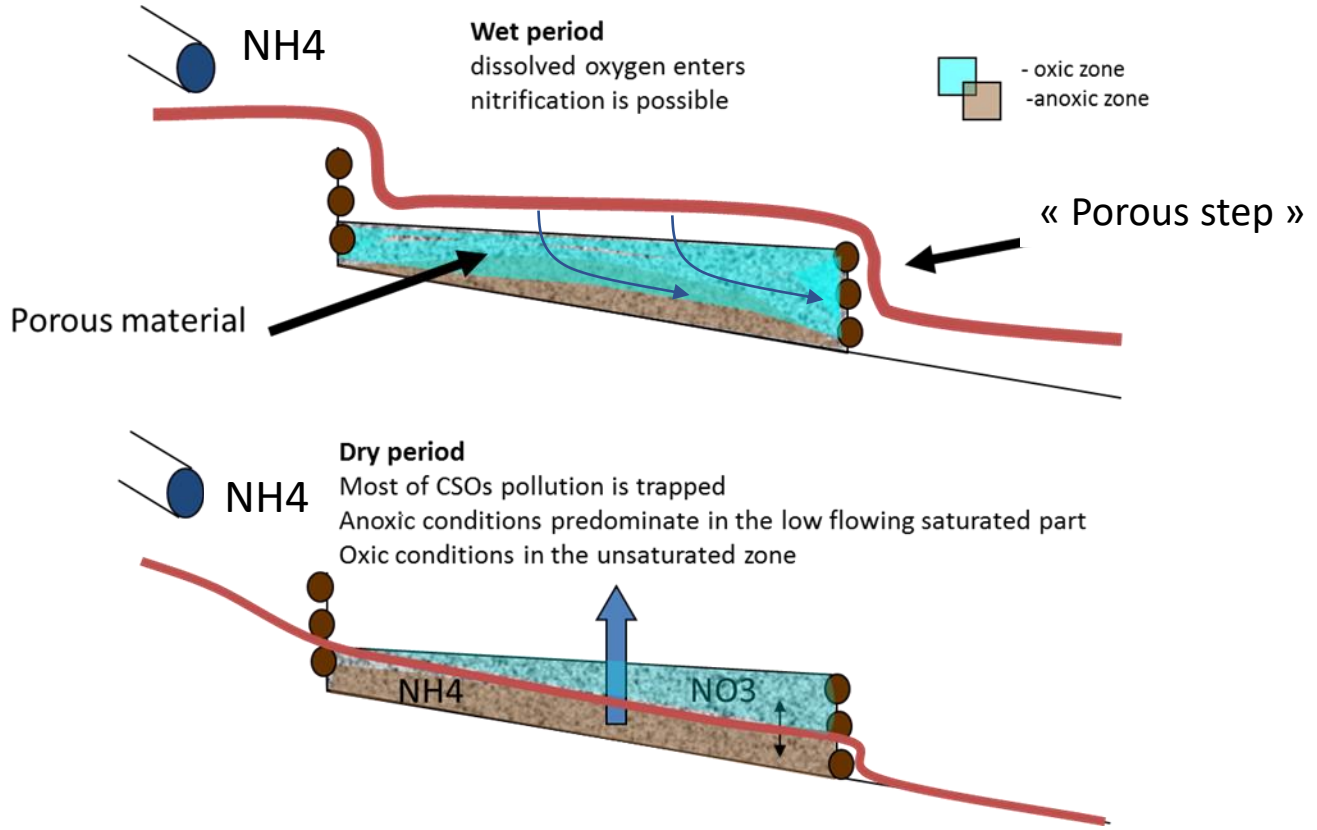
Third principle : dual regulation to naturally process threats…

The pilot Experiment …to reach the proof of concept



“ Porous step ”

Longitudinal view

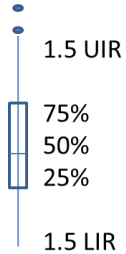


The pilot Experiment …make the proof of concept

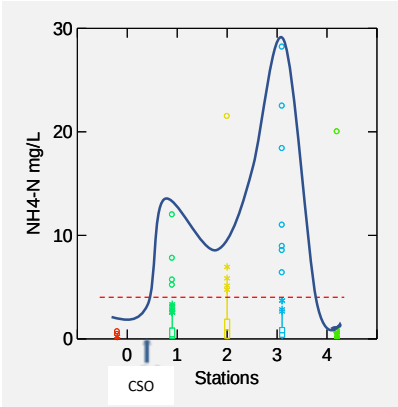


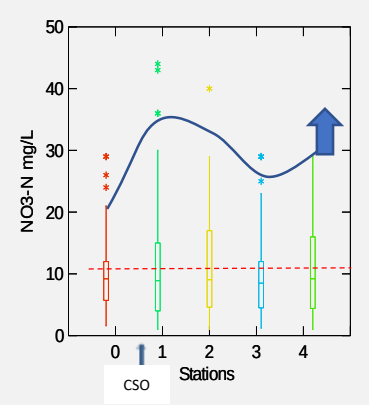


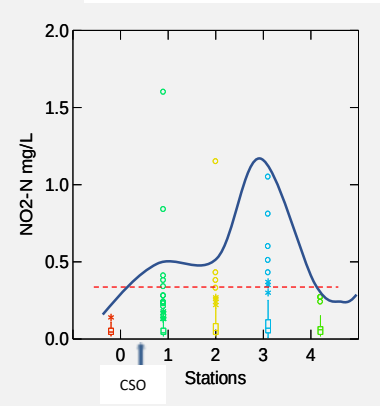
0 CSO 1 2 & 3 4

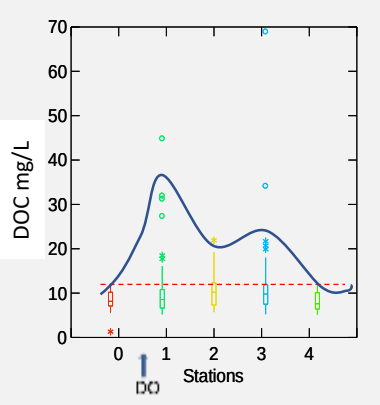


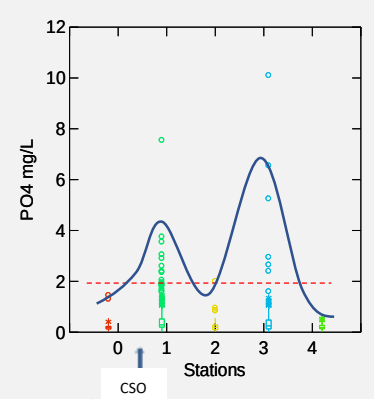
Permitted concentration for surface water



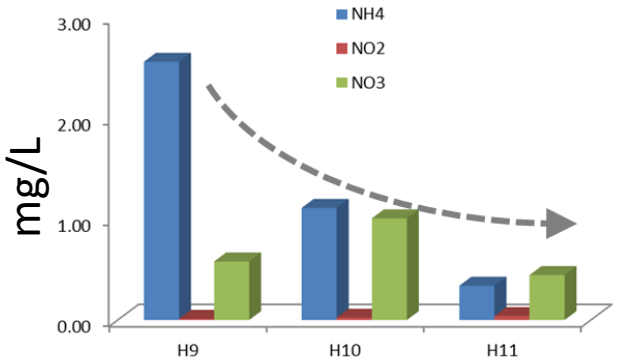






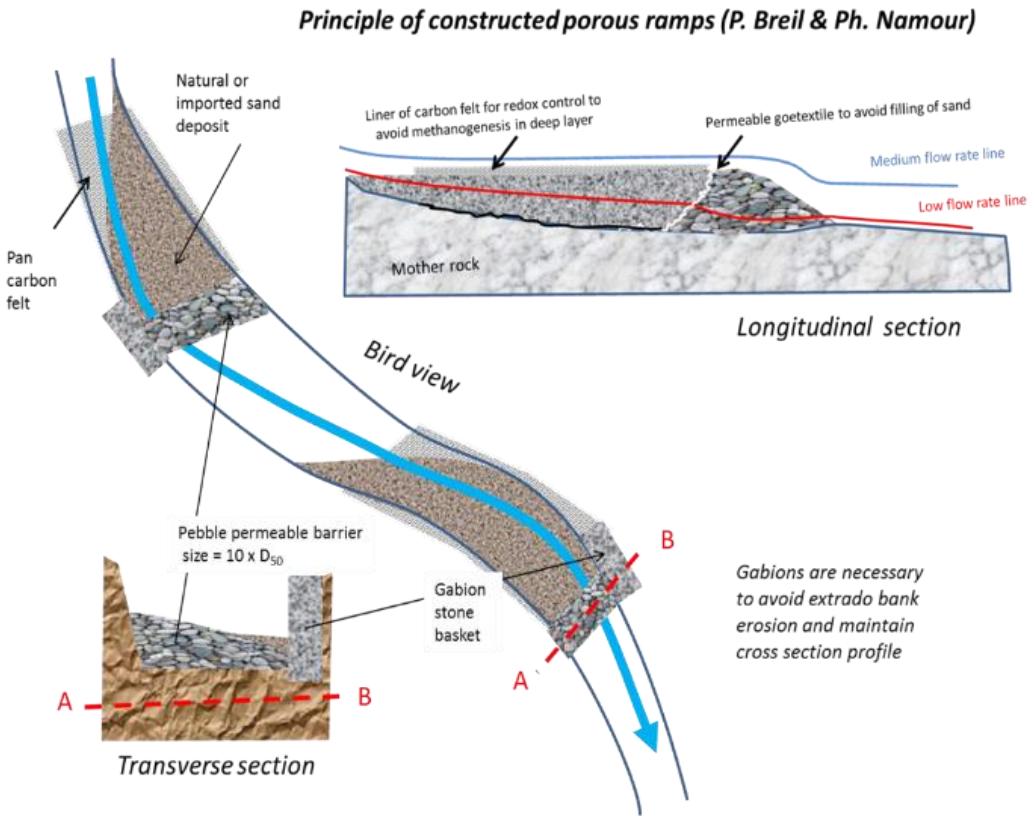


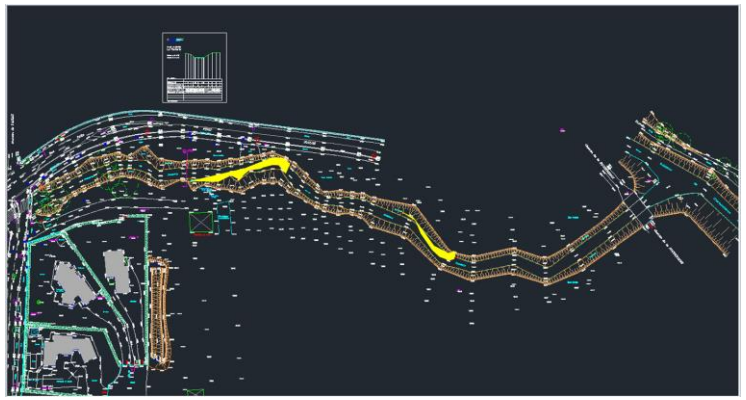
- NO3 fertilizers
- CSOs pollution is trapped
  - Organic N, Organic C, P



Is the pollution processed?

Scaling up the EH solution...towards an operational application





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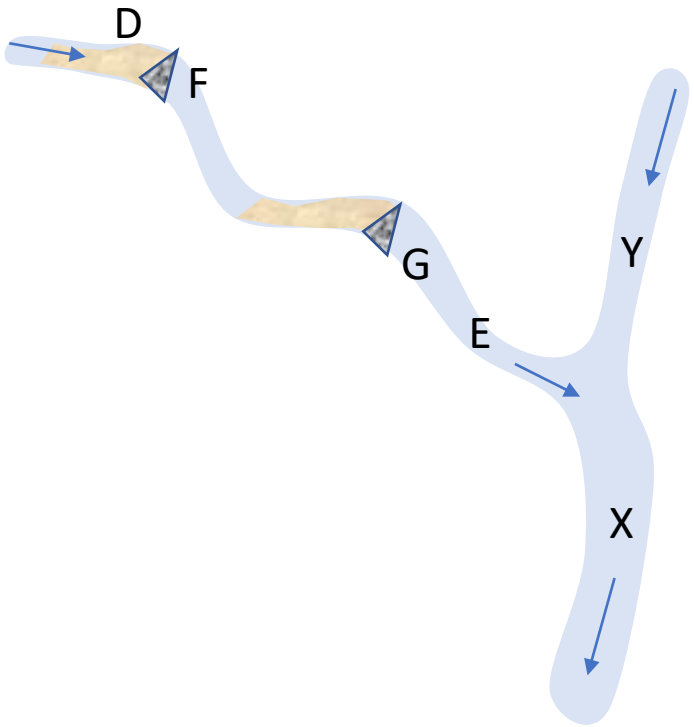
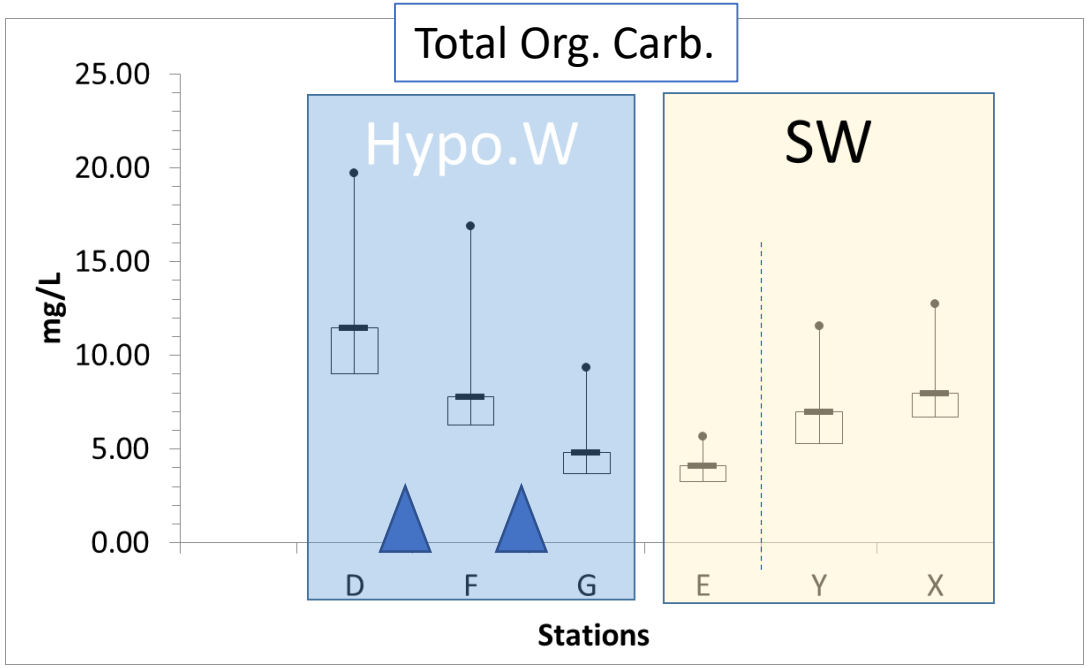
Larger stream -> New design : Porous sloping ramps to block sand but allow continuous flow at the bottom for fish mobility.

Upscaling of the EH solution...first results





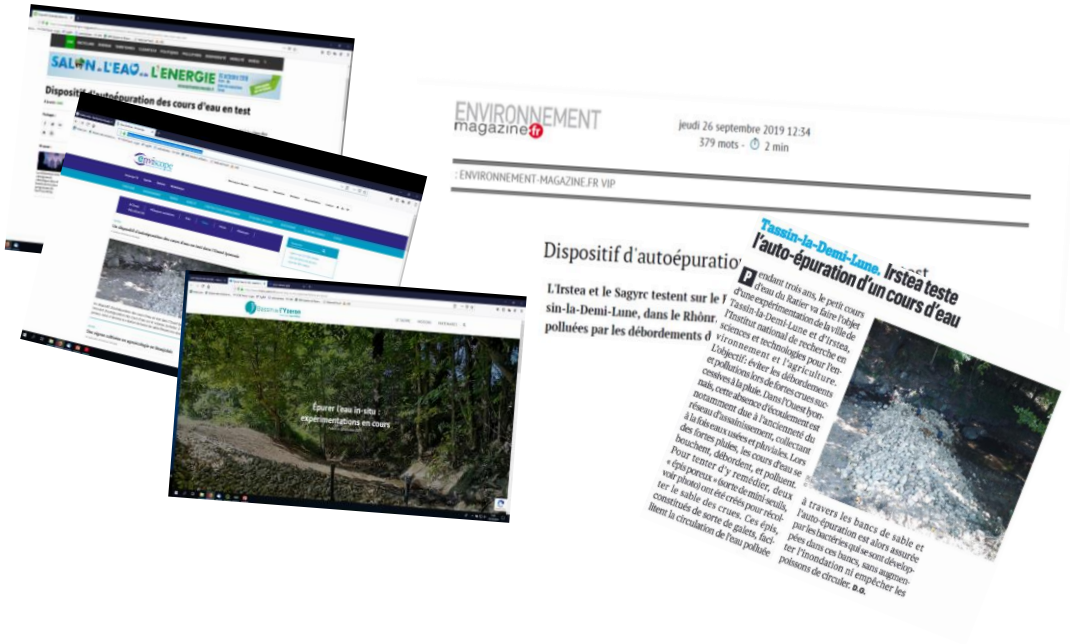
sample size : 30 weekly samples for each station

- TOC is stored in sandy beds, biodegraded or bioassimilated
- The surface water downstream of the porous ramps contains less TOC than the major river...this is an improvement.

Co-construction, Communication & Education …Transfer…Law

Key actors :

River Syndicate
Sanitation syndicate
Fishing association
Water police
Riparian owners



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