



AquaNES

Flexible use of modified retention
soil filters to treat wastewater
treatment plant effluent and
combined sewer overflow

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Challenges in our river catchment

Pressures on small river systems through:

- High wastewater load during dry weather
- High hydraulic load and additional pollutant load during storm events



Sewage treatment plant discharge in the Wallbach creek

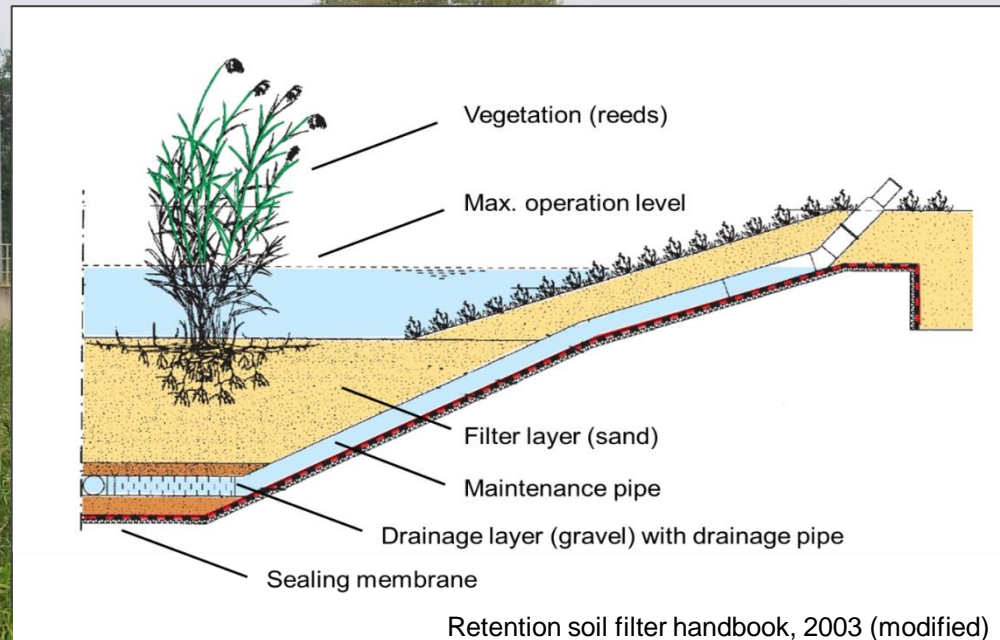
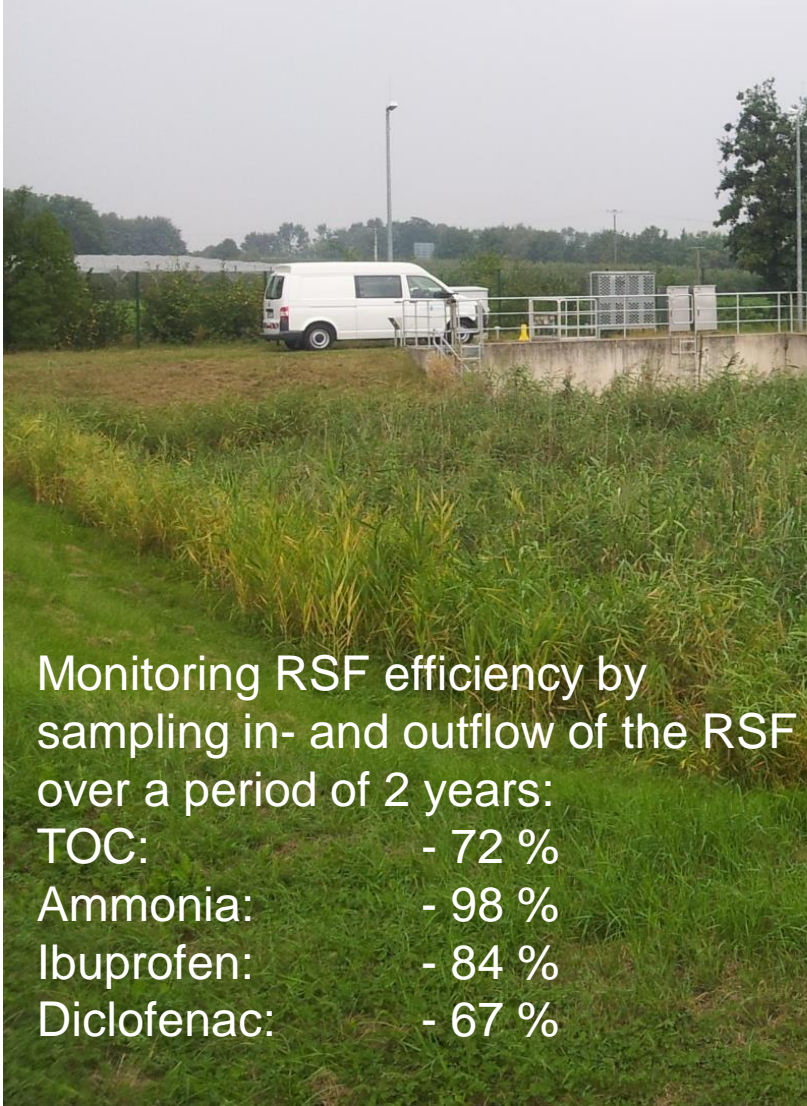


Combined sewer overflow outlet at the Wallbach creek



Retention soil filter for treating combined sewer

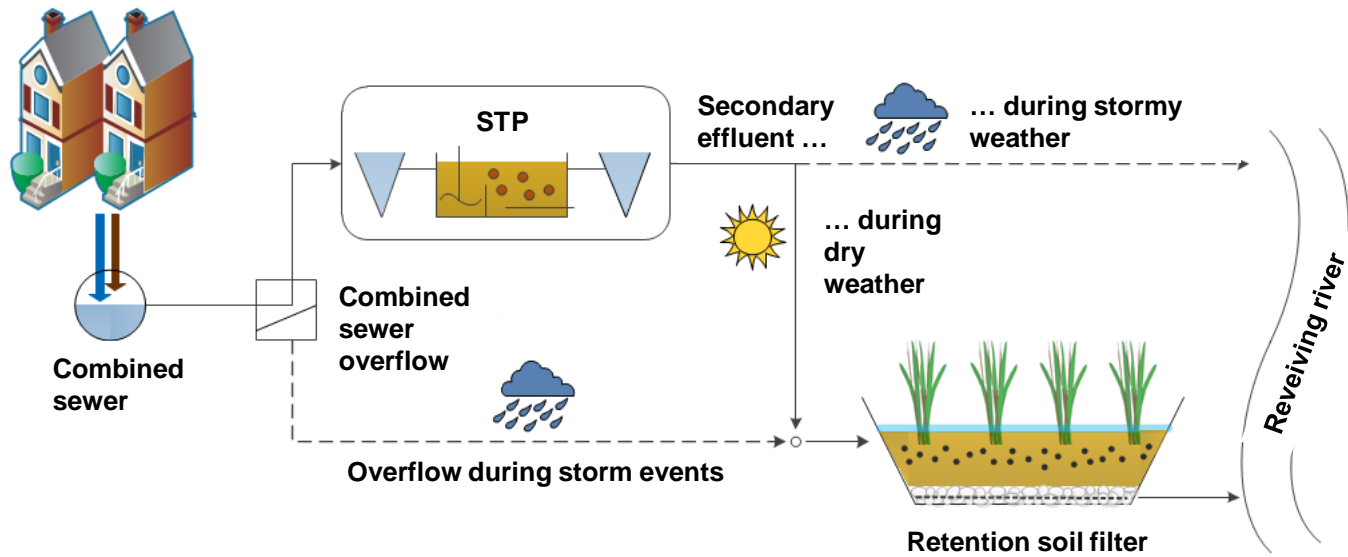
- Retention soil filter (RSF), German specification of vertical flow constructed wetlands



Monitoring RSF efficiency by sampling in- and outflow of the RSF over a period of 2 years:

TOC:	- 72 %
Ammonia:	- 98 %
Ibuprofen:	- 84 %
Diclofenac:	- 67 %

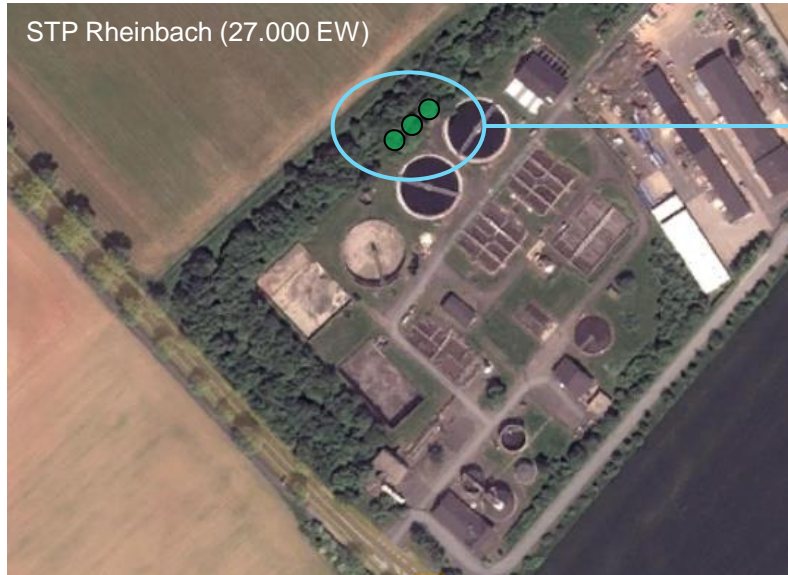
Current and potential usage of RSF





Research on RSF

Pilot scale RSF at the Rheinbach sewage treatment plant



STP Rheinbach (27.000 EW)

Photo: Google Maps

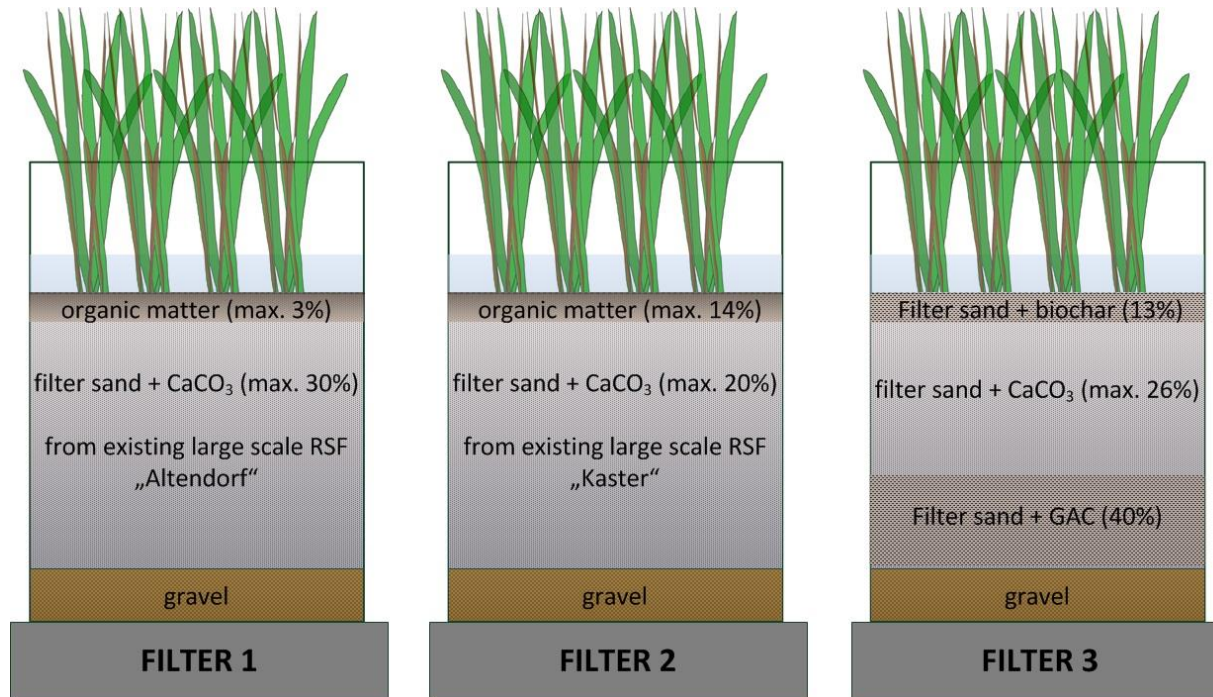


- Pilot plant to test treatment efficiency of RSF
- Operation start in 2014 bzw. 2015
- Two conventional RSF & one RSF with granular activated carbon (GAC)
- Aerobic conditions: Alternating cycles of feeding and non-feeding
- Feeding volume: 0.03 L/s/m^2 (RSF Handbook)
- Taking samples in four depths at each filter



Research on RSF

Pilot scale RSF at the Rheinbach sewage treatment plant

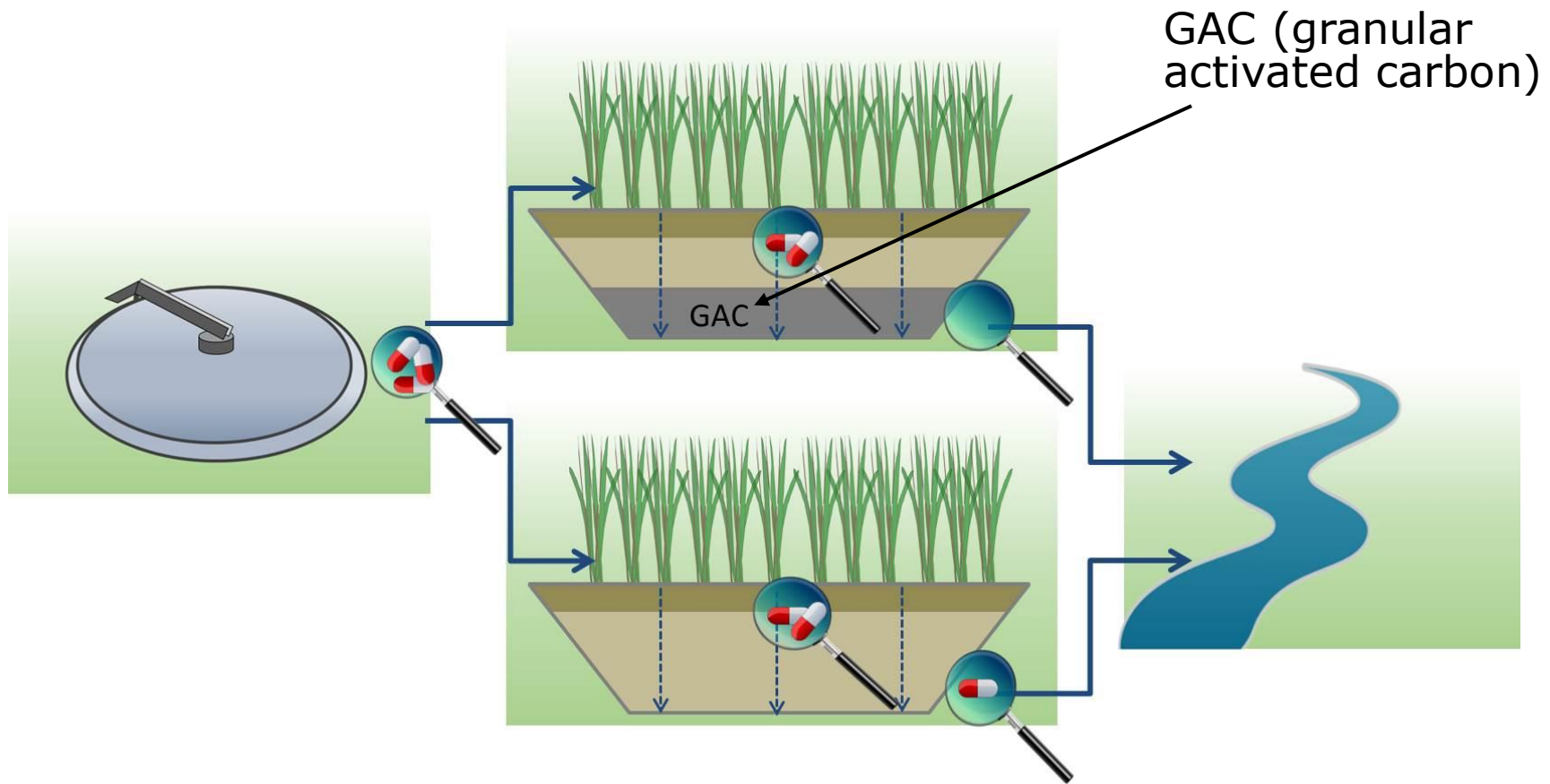


What was investigated?

- Treatment of sewage treatment plant effluent and combined sewer overflow
- Removal of DOC, TOC, nutrients, pathogens, organic micropollutants
- Optimisation of operational conditions
- Identification of removal processes

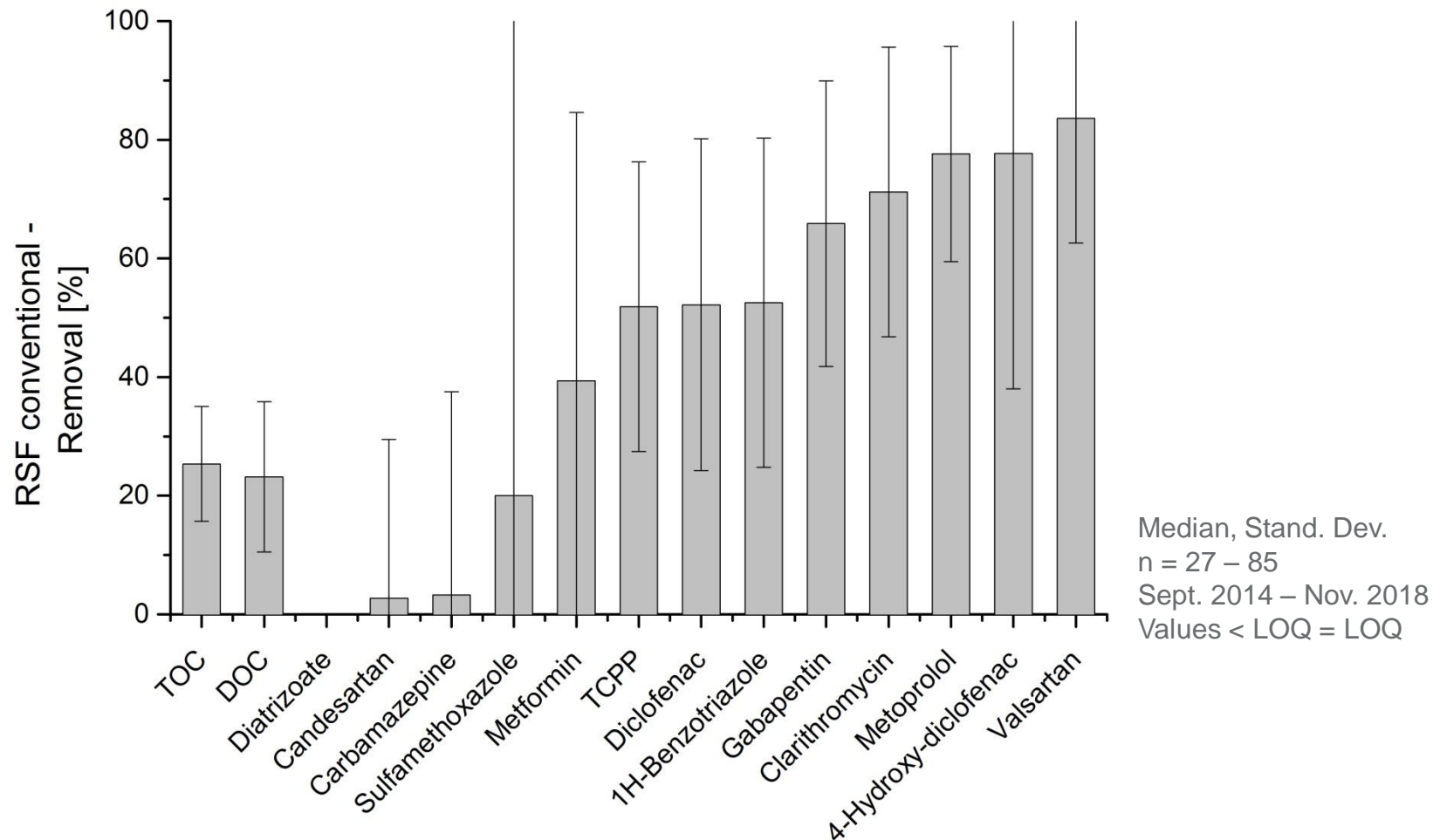


RSF for treating sewage treatment plant (STP) effluent





Conventional RSF for treating STP effluent

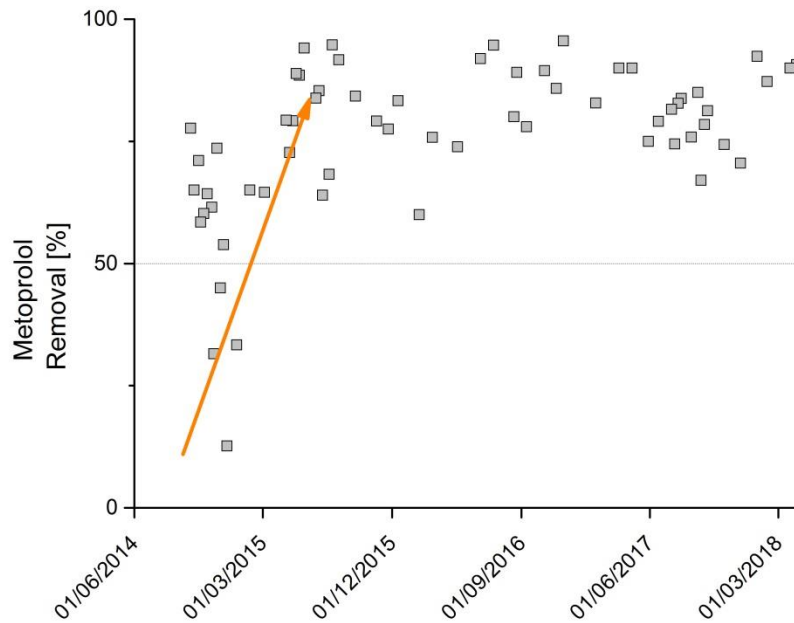


- Removal of organic micropollutants shows high variability (0 – 80 %)



Conventional RSF for treating STP effluent

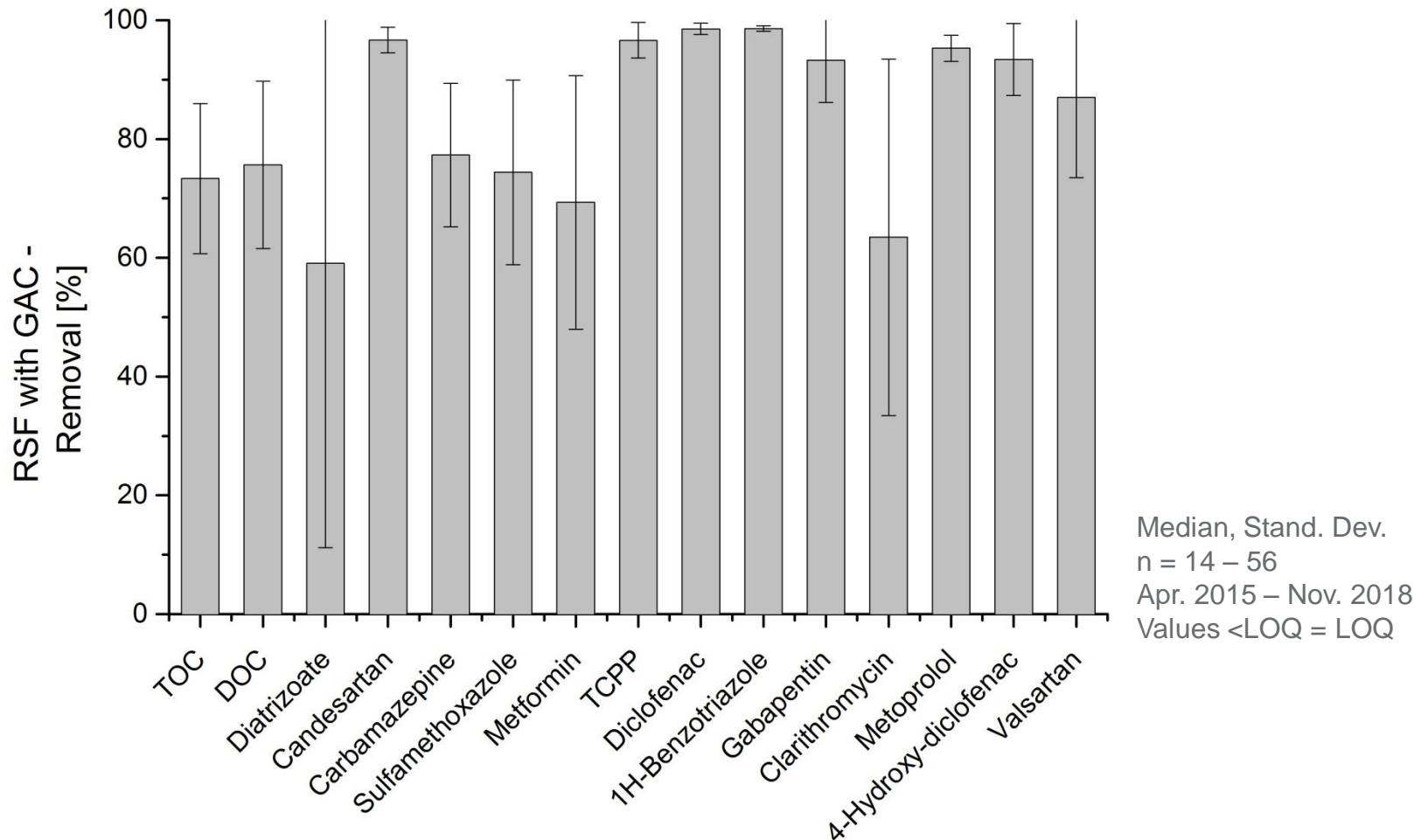
Removal over 3.5 operational years



- Metoprolol removal needs a start up phase of approx. $\frac{1}{2}$ years until it reaches its optimum



RSF with GAC for treating STP effluent



- Positive effects of GAC on removal. Only few micropollutants were found in RSF effluent above LOQ. No total breakthrough for micropollutants was determined.

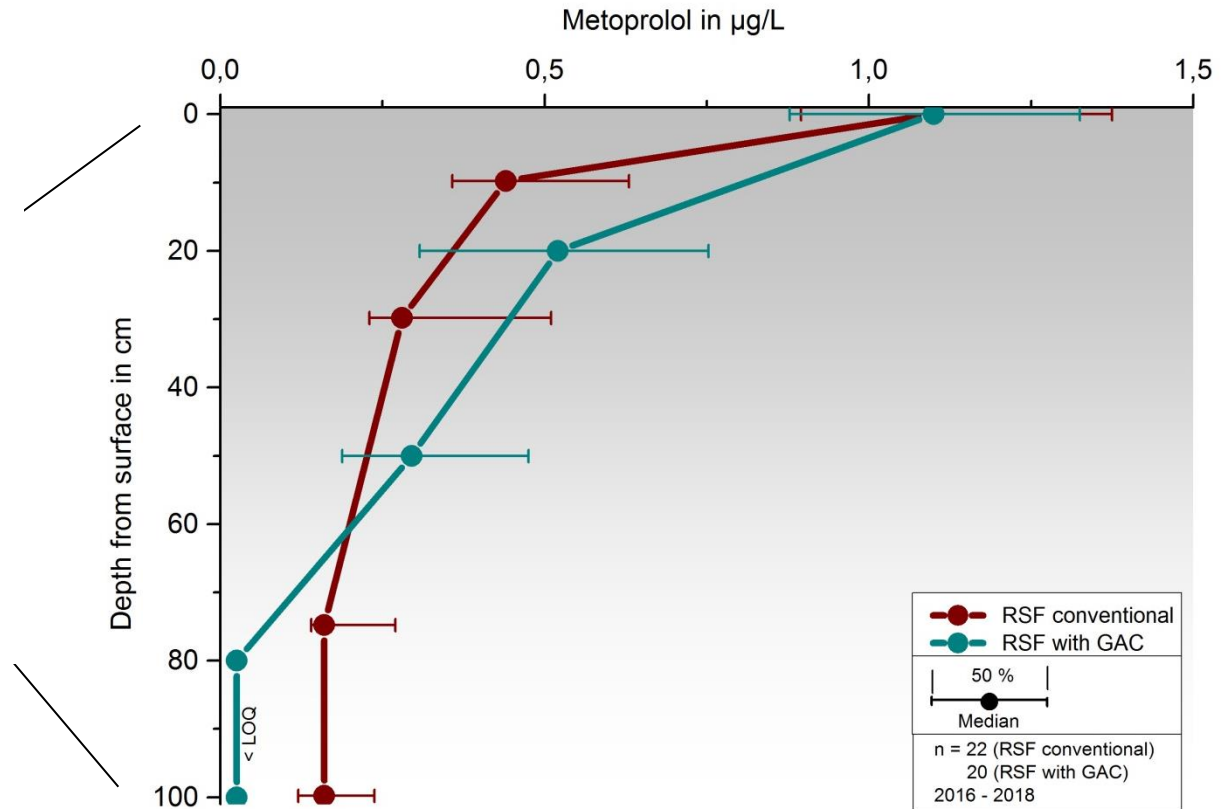


RSF for treating STP effluent

Identifying layers with best removal capacities

→ Positive effects of:

- The organic rich upper layer of the conventional RSF
- Biochar as an additive
- GAC as an additive

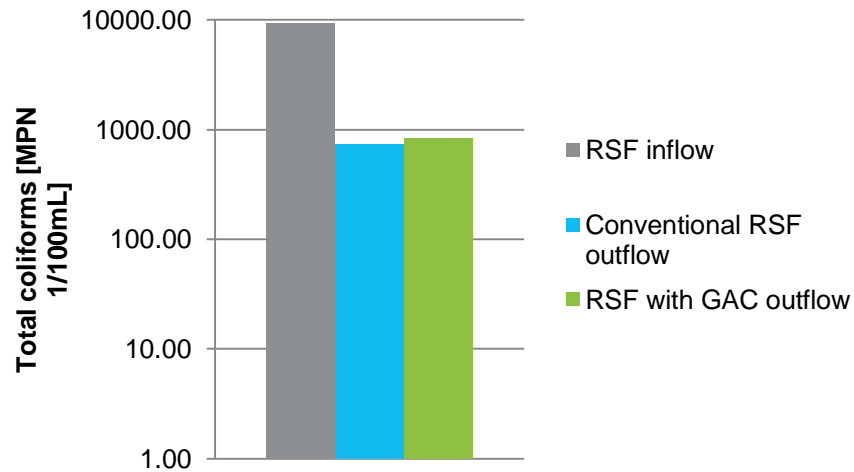


- The self grown organic layer is most important for micropollutant removal
- In new RSF with no organic layer biochar helps to prevent fast loading of GAC

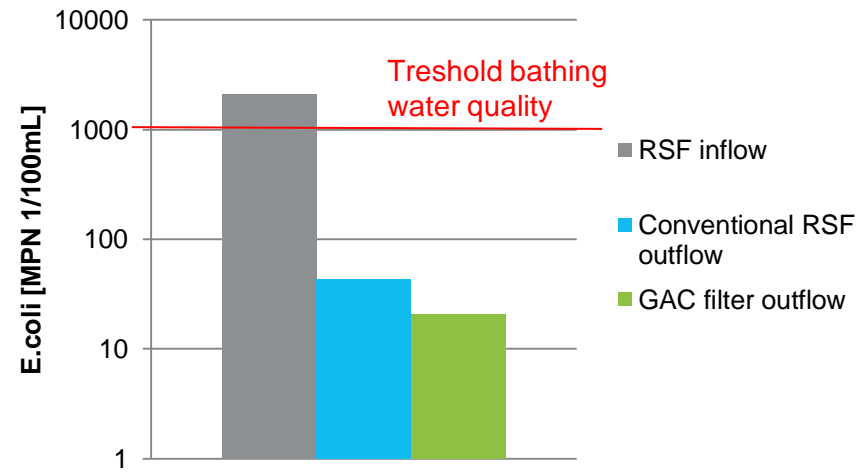


RSF for treating STP effluent

Removal of bacteria



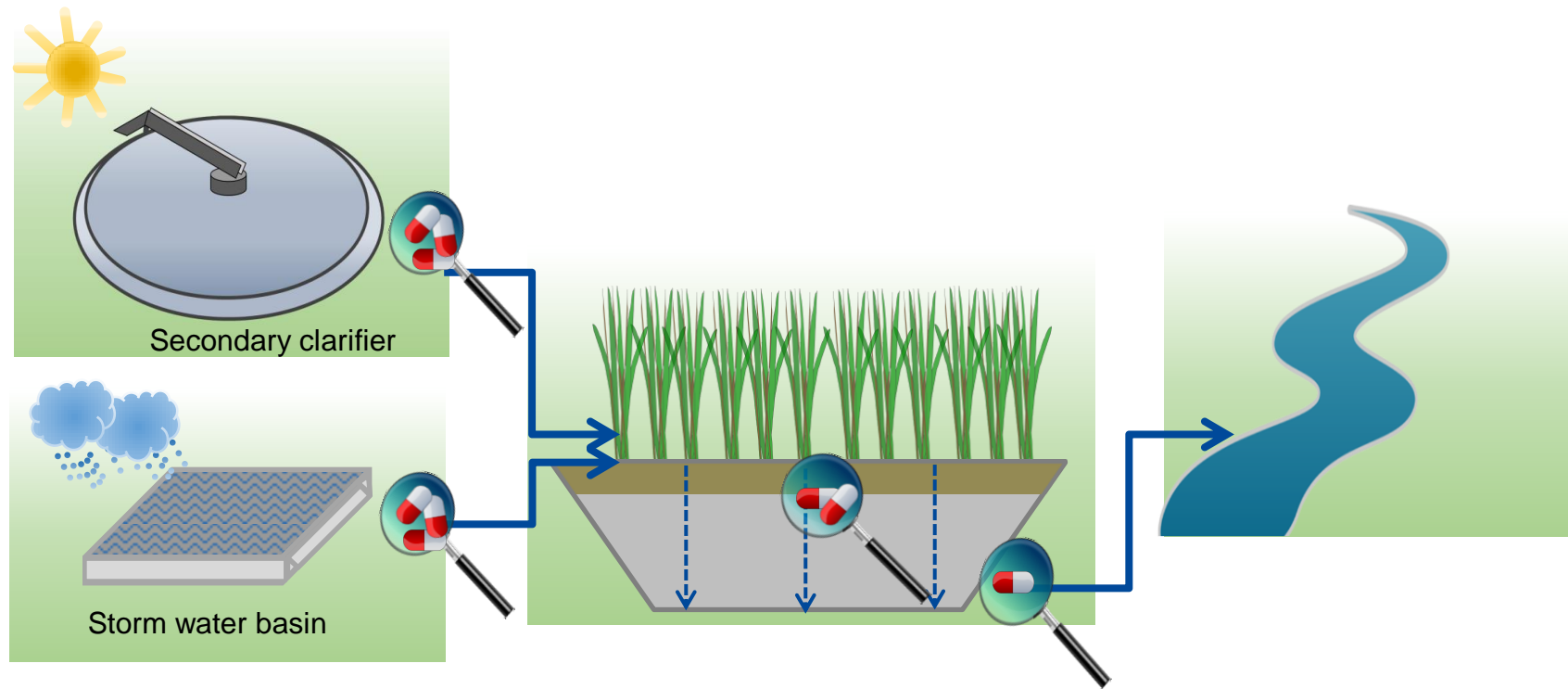
- Total coliforms: ~1 log unit removal



- E. coli: ~ 2 log unit removal



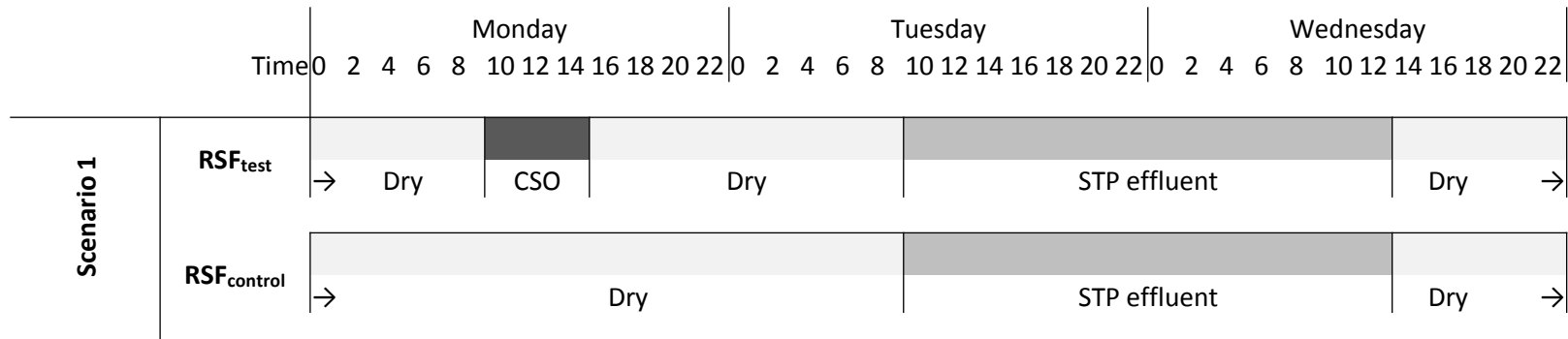
RSF for flexible use





RSF for flexible use

Simulation of combined sewer overflow (CSO) events in the dry phases of STP effluent feeding

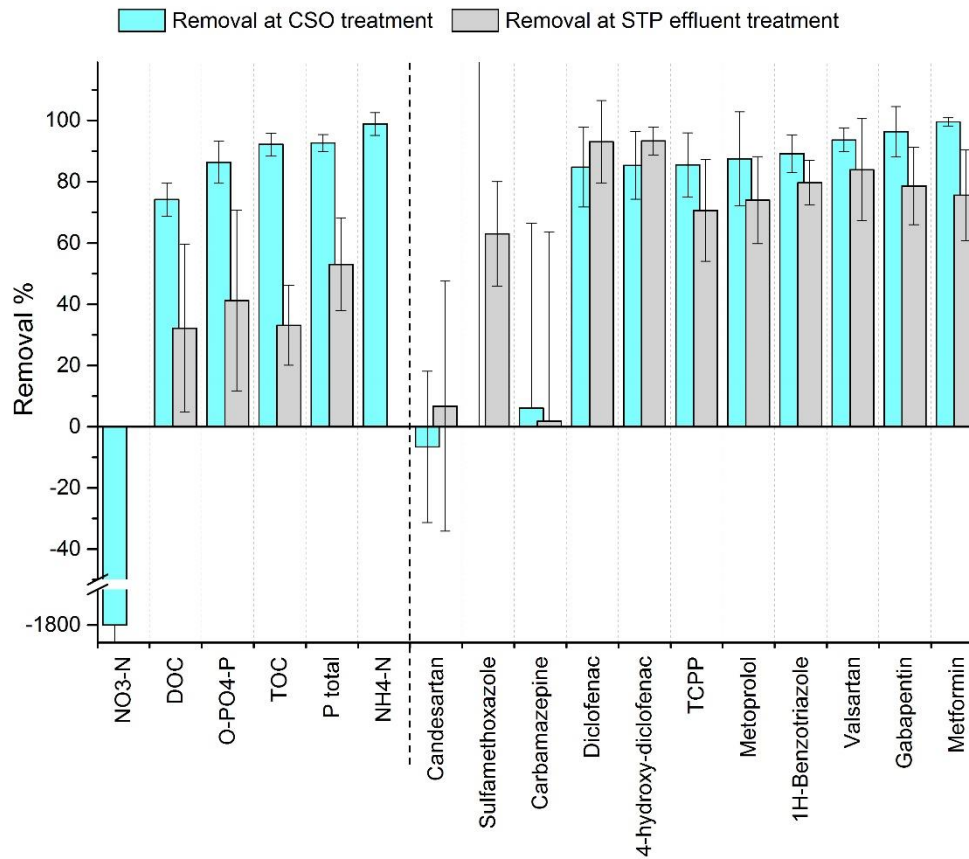


- Is removal at CSO and STP effluent treatment comparable?
- Do CSO events have impact on STP effluent treatment?
- How important are dry phases inbetween CSO and STP effluent feeding?



RSF for flexible use

Removal of wastewater parameters and micropollutants during CSO and STP effluent treatment



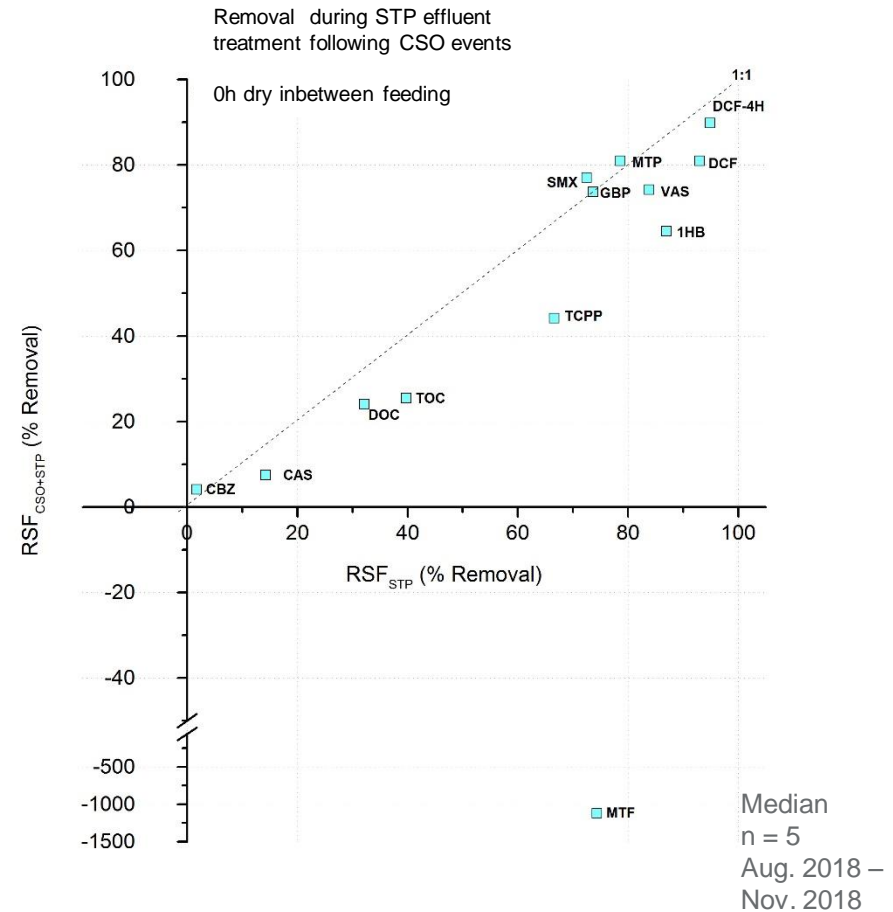
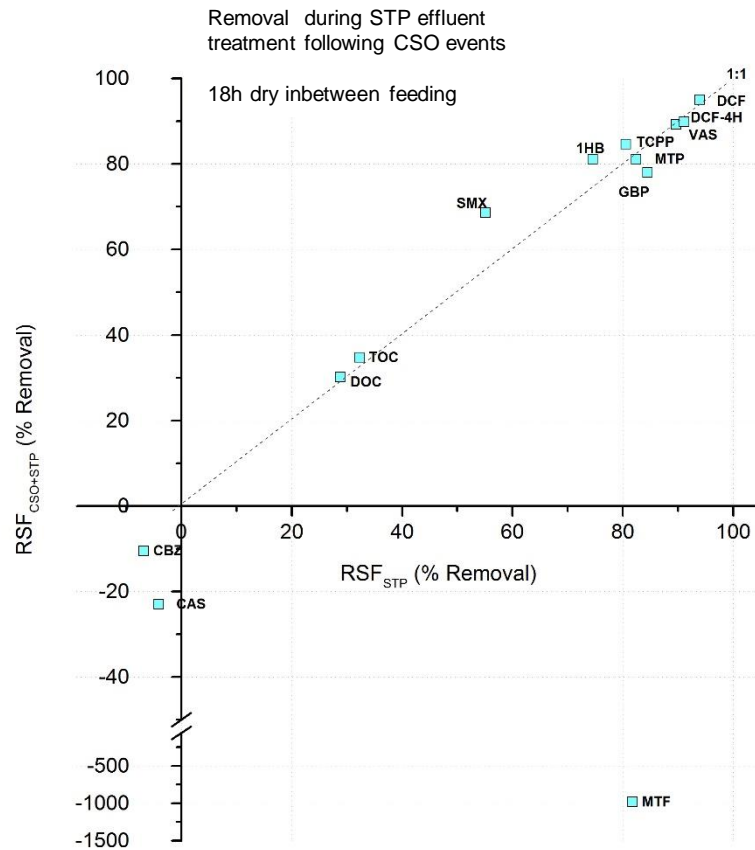
Median
n = 9
May 2018 – Nov. 2018

- Nitrification of ammonia
- Higher removal of wastewater parameters at CSO treatment due to higher inflow concentrations
- Removal of micropollutants is comparable in CSO and STP effluent treatment



RSF for flexible use

Do CSO events have impact on STP effluent treatment?



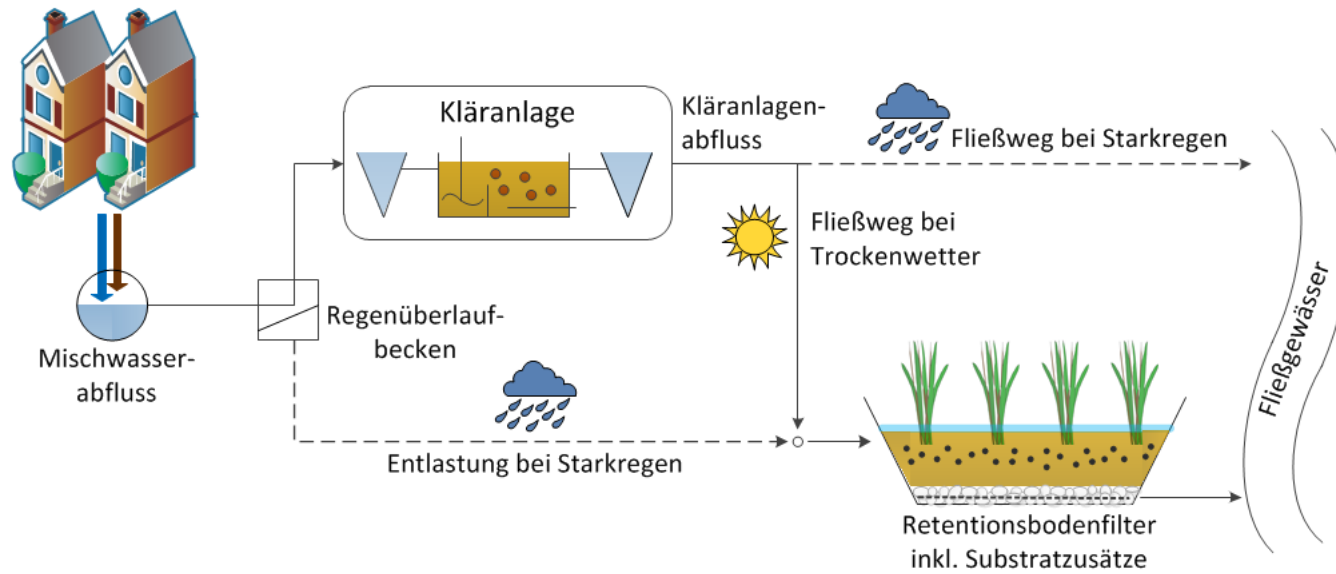
- CSO events have no impact on STP effluent treatment when there is a dry phase inbetween feeding
- No long term influence on RSF treatment capacities could be determined (data not shown here)



RSF^{plus} for the flexible use of combined sewer and secondary effluent treatment

Pilot project at Rheinbach STP (EW 27.000)

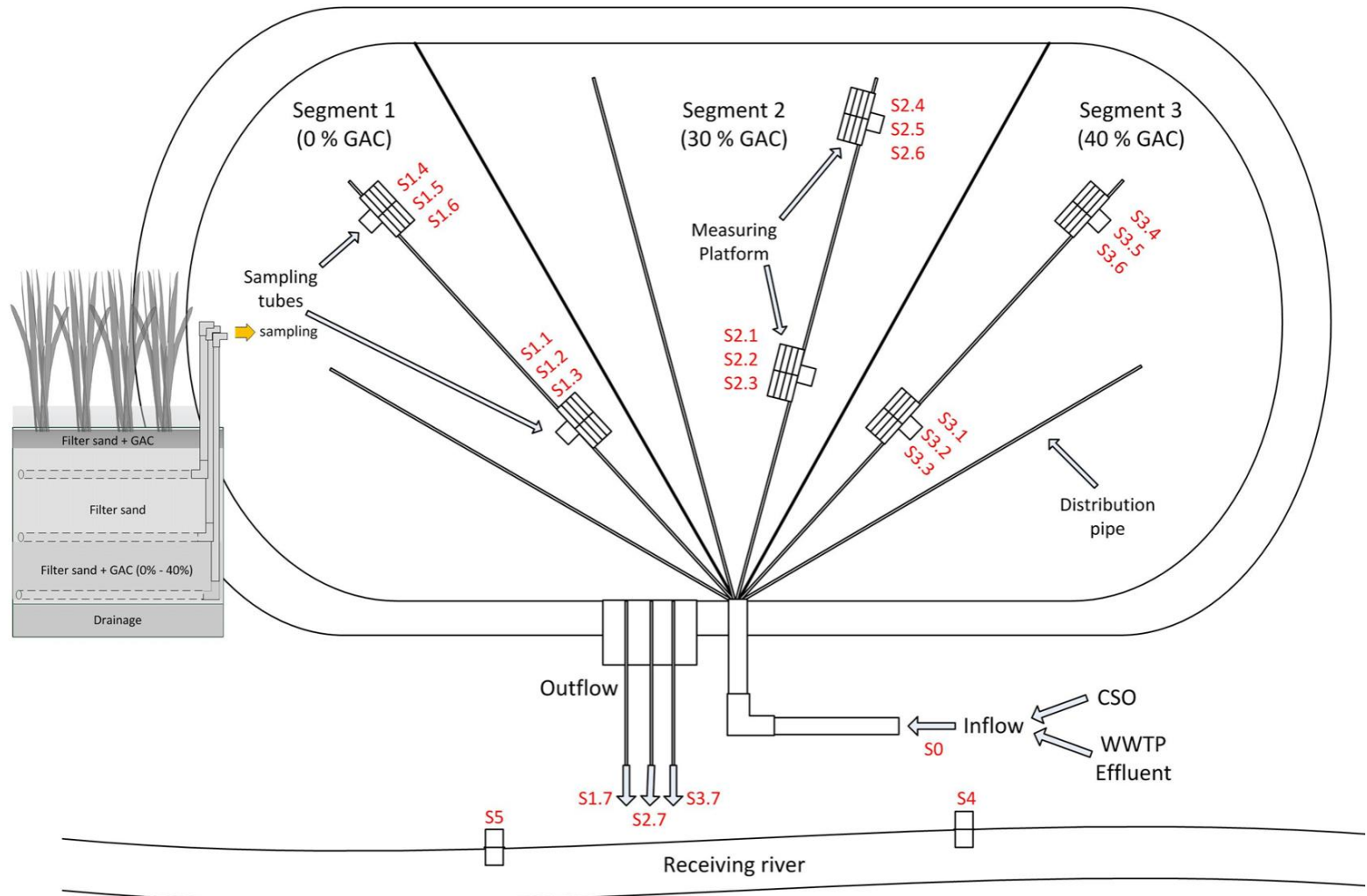
- Intensive investigations and good results on treatment efficiency ✓
- Realising the large scale RSF^{plus} concept





RSF^{plus} for the flexible use of combined sewer and secondary effluent treatment

Construction and monitoring concept

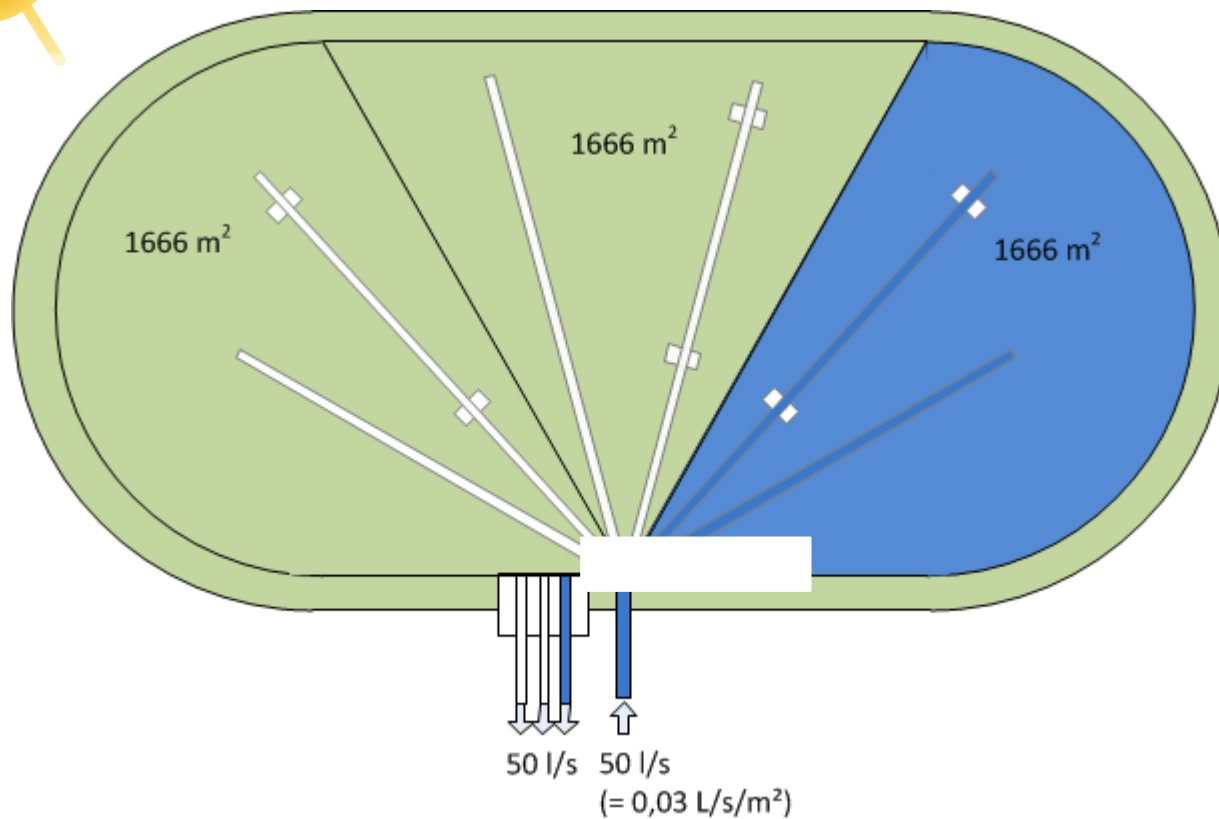
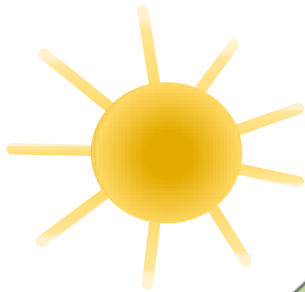


S_n = Sampling location



RSF^{plus} for the flexible use of combined sewer and secondary effluent treatment

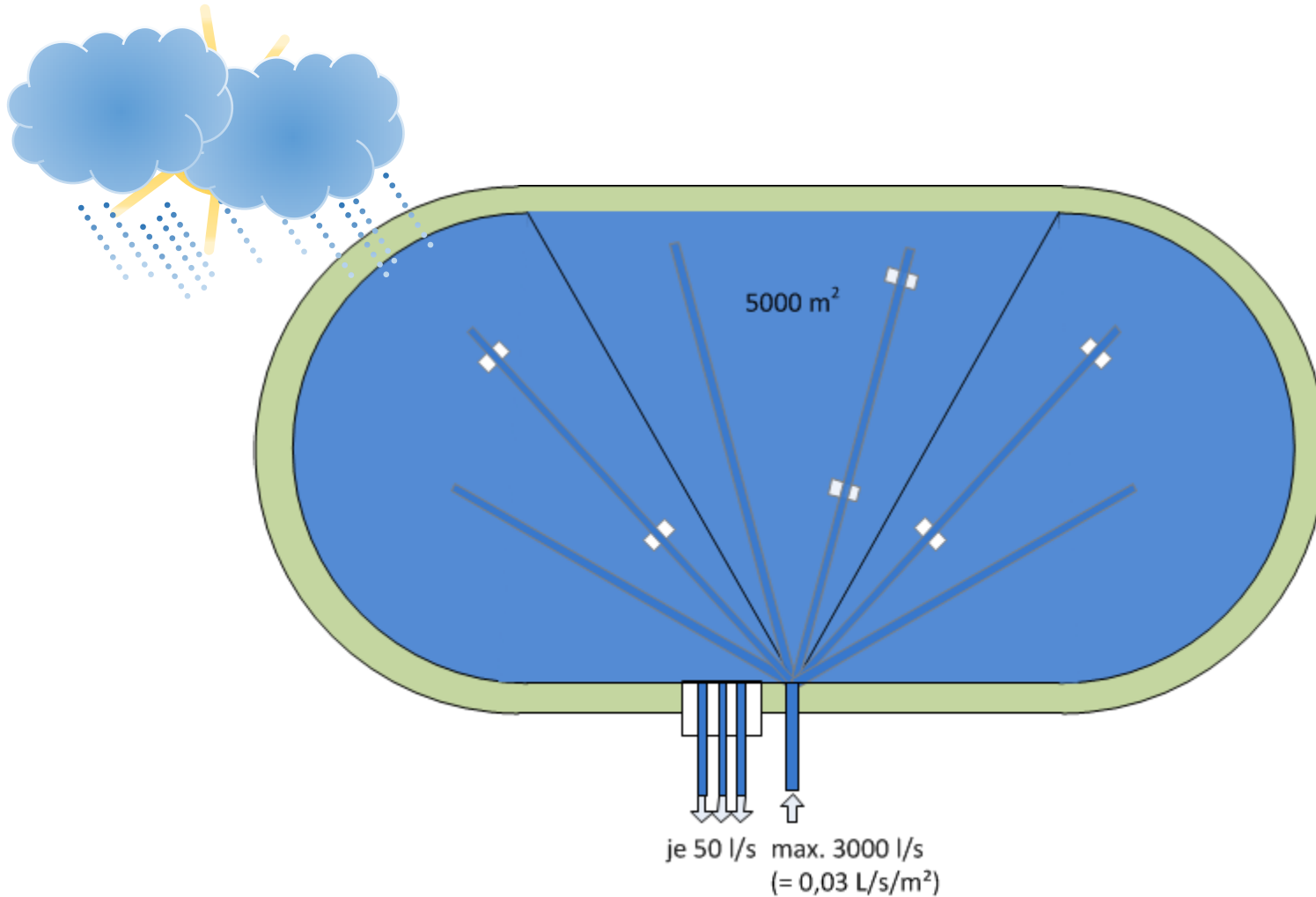
Operation





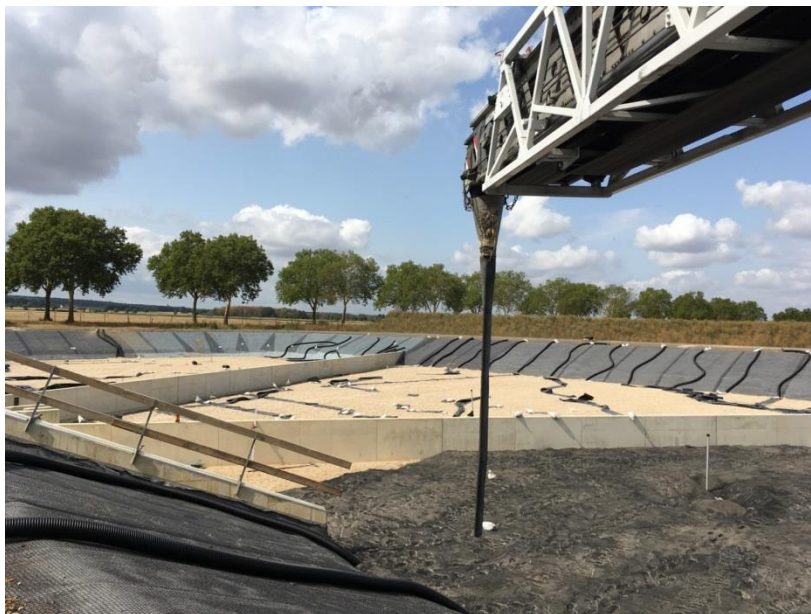
RSF^{plus} for the flexible use of combined sewer and secondary effluent treatment

Operation





RSF^{plus} – Impressions of the construction site



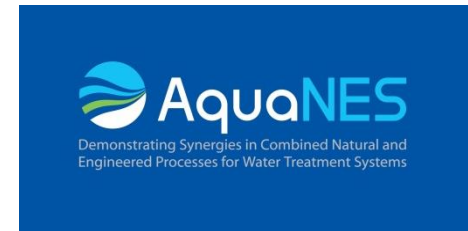


Questions?



The AquaNES project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 689450

www.aquanes.eu





Demonstrating Synergies in Combined Natural and Engineered Processes for Water Treatment Systems



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