

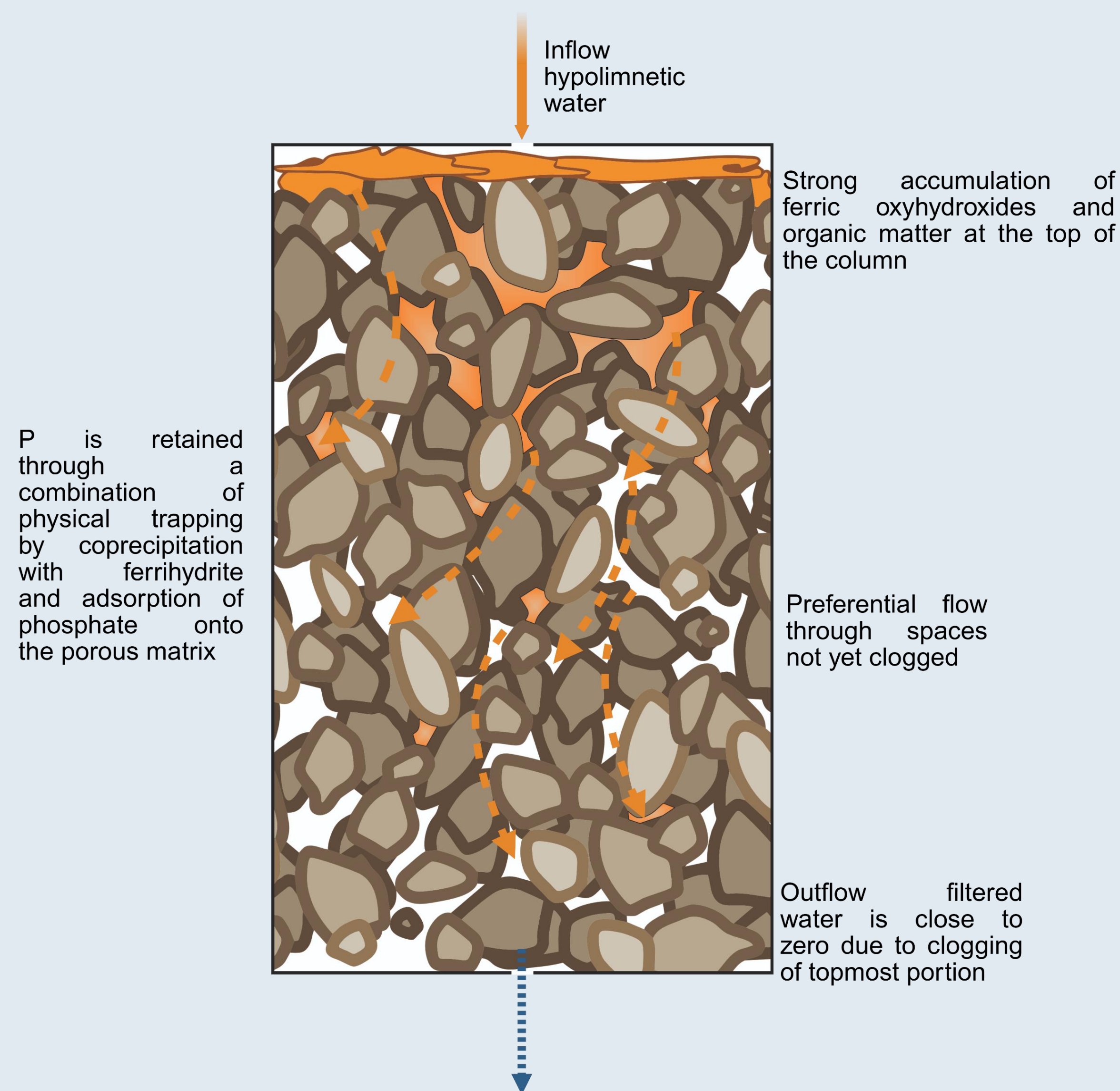
Towards a Predictive Framework for Filter Clogging in Hypolimnetic Withdrawal and Treatment Systems (HWTS)

Filter clogging due to accumulation of solids is one of the biggest impairment in filtration systems, which leads to delays in any water treatment project.

This work investigates this issue in the context of lake restoration.

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Introduction and Goals

Eutrophication continues to deteriorate water quality of freshwater ecosystems. This project contributes to restoration of lakes through developing the technology of hypolimnetic withdrawal. Due to consistent internal loading during thermal stratification, there are cyclical episodes of algae growth despite external loading reduction. In the HWTS, nutrient-rich water is pumped out of the lake and its P concentrations are reduced by aeration and filtration. The filters however clog quite quickly due to accumulation of precipitate at the top, which impairs the operation.

The specific goals of this work are:

- To build a hydrogeochemical model to simulate the processes that take place in the filtration units.
- To apply the model to specific scenarios of loading of hypolimnetic water.
- To create a predictive framework with regards to porosity and permeability reduction.

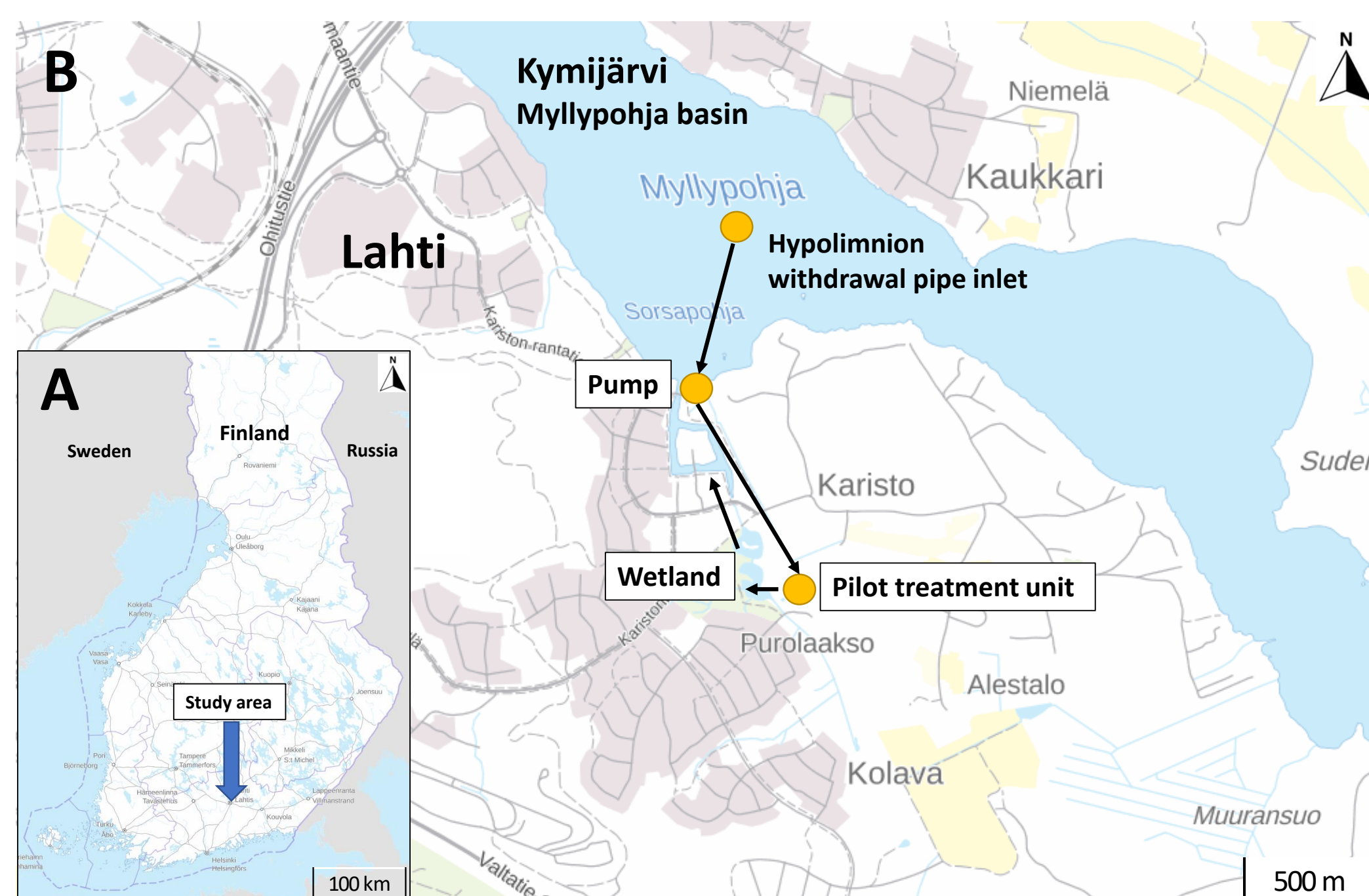
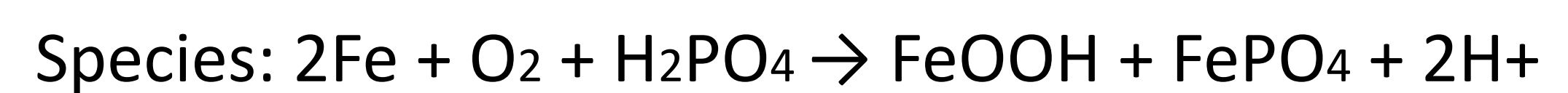


Figure 1: Location of the pilot HWTS at Kymijärvi, southern Finland. (B). HWTS treatment cycle.

Methodology

Transport of Diluted Species in Porous Media (tds):



Different porosities and grain sizes

Darcy's Law:

Downward flow

Initially 2D modelling approach

Should any other physics be included, such as Chemical Reaction Engineering?

Expected results

Model is still under construction, any suggestions highly welcome!

Overall goals are:

- To be able to predict when and what under circumstances the filter get clogged
- To propose an optimal inflow setup that will maximize the filter's lifetime with satisfactory phosphorus removal rates



Figure 2: Column experiment realized in the summer of 2023 to test efficiency of Kymisand, Rådasand and Polonite in P and Fe retention.

REFERENCES

Ruttenberg, K.C., 1992. Development of a sequential extraction method for different forms of phosphorus in marine sediments. *Limnology and Oceanography* ASLO. <https://doi.org/10.4319/lo.1992.37.7.1460>

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