EGU2020-8771
https://doi.org/10.5194/egusphere-egu2020-8771
EGU General Assembly 2020
© Author(s) 2020. This work is distributed under
the Creative Commons Attribution 4.0 License.

Groundwater quality development in response to infiltration of lake water into an aquifer

Maija Jylhä-Ollila[1], Hanne Laine-Kaulio[1], Paula Niinikoski-Fuβwinkel[2], Jussi Leveinen[3], and Harri Koivusalo[1]

[1]Department of Built Environment, Aalto University, Espoo, Finland (maija.jylha-ollila@aalto.fi)
[2]Institute of Applied Mineralogy and Economic Geology, RWTH Aachen University, Aachen, Germany
[3]Department of Civil Engineering, Aalto University, Espoo, Finland

The increasing awareness of the importance of groundwater for ecosystems limits the possibilities for groundwater usage. In Finland, for instance, several projects aiming to establish new groundwater intakes have been stuck in legal processes for more than ten years or even decades. A typical conflict in the legal process relates to potential negative impacts of the project on protected areas, such as Natura 2000 areas, or habitats of endangered species.

Managed aquifer recharge (MAR) is one of the solutions to secure the water balance in groundwater dependent ecosystems, or to produce drinking water from artificial instead of natural groundwater. In MAR, surface water is infiltrated into the ground to add water and facilitate increased groundwater extraction in an aquifer. As the surface water quality typically differs from precipitation by a higher content of organic matter, dissolved solids, bacteria and viruses, infiltration of lake water leads to a different groundwater quality compared to natural recharge formed from precipitation.

The sustainability of MAR largely depends on an aquifer's capacity to remove organic matter over the long term. We studied the impact of surface water infiltration on groundwater quality by using a natural lake-aquifer system as a surrogate for MAR. Natural infiltration of lake water to groundwater has been going on for millennia at our research site, providing information over a much longer time span compared to constructed infiltration sites or laboratory tests.

The groundwater flow velocity at the site was estimated with a MODFLOW based flow model. The share of lake water infiltrate in the aquifer was estimated from stable oxygen and hydrogen isotopes. Total organic carbon (TOC), dissolved organic carbon, oxygen, iron and manganese concentrations, conductivity and pH were monitored from lake and ground water. According to our measurements, the mean concentration of TOC in lake water was 3.0 mg/L (Jylhä-Ollila et al., 2020). Within the distance of 3 m from the lake bank (retention time 7–15 days), already 46% of TOC was removed. At greater distances along the main flowpath in the aquifer, 80–90% of TOC was removed. Signs of organic matter accumulation in the aquifer were not observed, which is positive in terms of long term sustainability of MAR. Several processes had an impact on oxygen levels in the aquifer, which led to spatial and seasonal changes in the redox conditions and in the

iron and manganese concentrations in groundwater. The results showed that an aquifer can remove organic matter from surface water over a long time span, but possible oxygen depletion and iron and manganese release should be taken into account in MAR projects aiming to secure groundwater dependent ecosystems.

Jylhä-Ollila, M., Laine-Kaulio, H., Niinikoski-Fuβwinkel, P., Leveinen, J., Koivusalo, H. 2020. Water Quality and Organic Matter Removal in Natural Bank Infiltration at a Boreal Lake in Finland. Hydrogeology Journal, in print.