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Effect of River Restoration on Ground Water Recharge: Investigation of Groundwater-Surface Water Interactions with Distributed Temperature Sensing (DTS)

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Following the EU Water Framework Directive 2000/60/EC (1) Switzerland passed the Water Protection Act 814.20 (2), obligating the cantons to restoring their surface water bodies to a near-natural state within the next 100 years. In case of rivers and streams this comprises the provision of extensive areas to allow for meandering, sufficient discharge to prevent drying-out of the river, as might be caused by hydropower production, and adequate water quality, e.g. by limiting waste water discharge. Hereby, the main aim lies in improving the ecological status of the surface water bodies, as well as flood protection and mitigation (2). However, apart from the enhancement of the water quality, river restoration has the potential to increase groundwater recharge due to improved connectivity between the surface water bodies and the underlying aquifers.

A new method for the estimation of groundwater recharge in rivers is currently developed at Eawag in Switzerland, and will be employed to investigate if river restoration enhances groundwater recharge. This method comprises the use of distributed temperature sensing (DTS), as well as heatable glass-fibre optics cables. DTS is a fibre-optical method for temperature determination over long distances with high accuracy and precision (3), largely depending on the instrument settings and calibration, as well as the fibre-optics cables employed in the measurements (4). Temperature data will be used to distinguish between ground- and surface water, due to their different temperature signatures (5). By heating the glass-fibre optics cable the additional information on the cooling behaviour of the cable may be used to (i) distinguish between up- and downwelling water and to (ii) estimate the volume of water exchanged locally in the river bed. In order to separate the signal of horizontal flow from vertical flow over the cable, it will be buried 30-40 cm deep in the river bed; a control cable will be installed in 10-20 cm depth right above the aforementioned cable.

In order to simplify this application in remote areas, the DTS will be transformed into an autonomous DTS system (ADTSS), allowing for automated data transfer and remote control. As an additional feature, the system may be employed grid-independent. Upon completion, the Autonomous DTS System will be installed in various locations throughout Switzerland, with the aim to investigate if river restoration, apart from improving the ecological status and mitigating floods, enhances groundwater recharge.

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