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Design of the monitoring system at the Sant'Alessio induced riverbank filtration plant (Lucca, Italy)

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In Managed Aquifer Recharge (MAR) schemes the monitoring system, for both water quality and quantity issues, plays a key role in assuring that a groundwater recharge plant is really managed.

Considering induced Riverbank Filtration (RBF) schemes, while the effect of the augmented filtration consists in an improvement of the quality and quantity of the water infiltrating the aquifer, there is in turn the risk for groundwater contamination, as surface water bodies are highly susceptible to contamination.

Within the framework of the MARSOL (2014) EU FPVII-ENV-2013 project, an experimental monitoring system has been designed and will be set in place at the Sant'Alessio RBF well field (Lucca, Italy) to demonstrate the sustainability and the benefits of managing induced RBF versus the unmanaged option.

The RBF scheme in Sant'Alessio (Borsi et al. 2014) allows abstraction of an overall amount of about 0,5 m^3/s groundwater providing drinking water for about 300000 people of the coastal Tuscany. Water is derived by ten vertical wells set along the Serchio River embankments inducing river water filtration into a high yield ($10^{-2}m^2/s$ transmissivity) sand and gravel aquifer.

Prior to the monitoring system design, a detailed site characterization has been completed taking advantage of previous and new investigations, the latter performed by means of MOSAIC on-site investigation platform (UFZ). A monitoring network has been set in place in the well field area using existing wells. There groundwater head and the main physico-chemical parameters (temperature, pH, dissolved oxygen, electrical conductivity and redox potential) are routinely monitored. Major geochemical compounds along with a large set of emerging pollutants are analysed (in cooperation with IWW Zentrum Wasser, Germany) both in surface-water and ground-water.

The experimental monitoring system (including sensors in surface- and ground-water) has been designed focusing on managing abstraction efficiency and safety at one of the ten productive wells. The groundwater monitoring system consists of a set of six piezometer clusters drilled around a reference well along the main groundwater flowpaths. At each cluster, three piezometers (screened in the penultimate meter) are set at different depths to allow multilevel monitoring and sampling. At six selected piezometers, depending on ongoing hydrogeochemical investigations, six sensors for continuous monitoring of groundwater head, temperature and electrical conductivity will be set in operation.

Within the Serchio River, two monitoring stations will be set in operation in order to monitor river head, water temperature and electrical conductivity upstream and downstream the experimental plot. A multi/parameter probe for the detection of selected analytes such nitrates, and selected organics to be defined will also be set in the Serchio River water.

Each sensor will constitute a node of a Wireless Sensor Network (WSN). The WSN is based on several data loggers «client» connected via radio to one server point (Gateway), transmitting to a server via GSM-GPRS. This set up, while maintaining the high quality of data transmission, will allow to reduce installation and operational costs. The main characteristic of the conceived monitoring system is that sensors have been selected so to transmit data in an open format. The sensor network prototype will allow to get a substantial sensor cost reduction compared to available commercial solutions. The ultimate goal of this complex monitoring setting will be that of defining the minimum monitoring set up to guarantee efficiency and safety of groundwater withdrawals.

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