



Pilot site of a MAR injection trench in Northern Italy: preliminary lessons learned from field monitoring and modelling

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The Cuneo Plain, located in Northwestern Italy, hosts a vast unconfined alluvial aquifer mainly exploited for agrozootechnical activities. Besides conventional pumping wells, groundwater is conveyed to the irrigation network through lowland springs, locally known as *fontanili*. These drainage trenches were excavated since the Middle Ages to reclaim marshy lands by intercepting the shallow aquifer and lowering its water table. In recent years, some lowland springs have run dry during severe summer droughts, fostering the experimentation of Managed Aquifer Recharge (MAR) to recover their former discharges.

As a result, a pilot injection trench consisting of a 100 m long perforated pipe enables the infiltration of the surplus surface water that is circulated in the canals off the irrigation season. After a few months of testing, the first results regarding injected volumes and aquifer response are available. Preliminary findings highlight both the benefits and downsides associated to the high hydraulic conductivity of the studied aquifer. In particular, the time-lag in water table rise and the rapid dissipation of injection effects are key parameters for planning sustainable and effective injection strategies. Moreover, the spatial distribution of monitoring wells and their proximity to the MAR infrastructure proved, in this case, crucial to detect the water table rise and its spatial extent.

A monitoring network is currently being developed to enable real time visualization of data from monitoring wells, water levels in the lowland springs and infiltrated volumes. This is particularly useful to verify proper operation of the injection trench and implement alert systems able to identify and communicate malfunctions (e.g. clogging of the inlet), allowing prompt intervention.

Finally, a groundwater flow model has been developed for multiple purposes: to better interpret the interaction between the lowland spring and the aquifer; to validate the effects of the artificial recharge; to plan injection times based on the spring response time lag; and, ultimately, to explore possible developments in the MAR injection method. The model simulates the main hydrogeological features of the study area: the lowland spring, the surrounding streams, and the artificial recharge. The model was calibrated based on a piezometric map produced in October 2025 and having high spatial resolution thanks to the engagement of citizens from surrounding municipalities, who granted access to their private wells, providing dense observation points and

demonstrating the effectiveness of citizen science initiatives.