



## **A simple deep monitoring well dilution technique.**

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Well dilution techniques are well known and studied as one of the basic techniques to quantify groundwater fluxes. A typical well dilution test consists of the injection of a tracer, a mixing mechanism (e.g. water circulation with a pump) to achieve a homogeneous concentration distribution within the well, and monitoring of the evolution of tracer concentration with time. An apparent specific discharge can be obtained from such a test, and when details on the well construction are known, it can be converted into a specific discharge representative of the undisturbed aquifer.

For deep wells however, the injection of tracer becomes less practical and the use of pumps for circulating and mixing the water becomes problematic. This is due to the limited pressure that common pumps can endure at the outlet, as well as the large volume of water that makes it difficult to achieve a homogeneous concentration, and the impracticalities of getting a lot of equipment to large depths in very small monitoring wells.

Injection and monitoring of tracer at a specific depth omits several of the problems with deep wells. We present a very simple device that can be used to perform a dilution test at a specific depth in deep wells. The injection device consists of a PVC tube with a detachable rubber seal at its bottom. To minimize disturbance of the water column in the well, we integrated an EC sensor in this injection device, which enables us to use demineralized water or dissolved salts as a tracer. Once at the target depth, the PVC tube is retracted and the EC sensor and tracer become subject to groundwater flow.

The device was tested on a shallow well, on which different types of dilution tests were performed. The results of the other tests agree well with the injection tube results. Finally, the device was used to perform a dilution test in a deep well in order to demonstrate the feasibility of the approach.