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Monitoring technologies for the evaluation of a Soil-Aquifer-Treatment system in coastal aquifer environments.

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Artificial recharge of groundwater has an important role to play in water reuse. Treated sewage effluent can be infiltrated into the ground for recharge of aquifers. As the effluent water moves through the soil and the aquifer, it undergoes significant quality improvements through physical, chemical, and biological processes in the underground environment. Collectively, these processes and the water quality improvement obtained are called soil-aquifer-treatment (SAT) or geopurification. Recharge systems for SAT can be designed as infiltration-recovery systems, where all effluent water is recovered as such from the aquifer, or after blending with native groundwater. SAT typically removes essentially all suspended solids, biochemical oxygen demand (BOD), and pathogens (viruses, bacteria, protozoa, and helminthic eggs). Concentrations of synthetic organic carbon, phosphorous, and heavy metals are greatly reduced.

The pilot site of LTCP will involve the employment of infiltration basins, which will be using waters of impaired quality as a recharge source, and hence acting as a Soil-Aquifer-Treatment, SAT, system.

The LTCP site will be employed as a pilot SAT system complemented by new technological developments, which will be providing continuous monitoring of the quantitative and qualitative characteristics of infiltrating groundwater through all hydrologic zones (i.e. surface, unsaturated and saturated zone). This will be achieved through the development and installation of an integrated system of prototype sensors, installed on-site, and offering a continuous evaluation of the performance of the SAT system.

An integrated approach of the performance evaluation of any operating SAT system should aim at parallel monitoring of all hydrologic zones, proving the sustainability of all involved water quality treatment processes within unsaturated and saturated zone.

Hence a prototype system of Time Domain Reflectometry (TDR) sensors will be developed, in order to achieve continuous quantitative monitoring of the unsaturated zone through the entire soil column down to significant depths below the SAT basin. The above technique will offer continuous monitoring of infiltration rates and possible mechanical clogging effects. The qualitative monitoring of the unsaturated zone will be achieved through the installation of appropriate pore-water samplers within a multi-level basis, ensuring repeatability of sampling of infiltrating water of impaired quality. This study also involves the qualitative and quantitative assessment of the Lavrion multi-aquifer system through continuous monitoring of the performance of (i) the alluvial aquifer and its potential for additional water treatment as well as (ii) the effects of the SAT system for countermeasuring seawater intrusion in the area of Lavrion. Additionally, setup and calibration of numerical flow and transport models for evaluating and optimizing different operational modes of the SAT system within both saturated and unsaturated zones will be conducted. The monitoring system will be connected to an ad-hoc wireless network for continuous data transfer within the SAT facilities.

It is envisaged that the development and combined application of all the above technologies will provide an integrated monitoring platform for the evaluation of SAT system performance.