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Implementing Water Balance Model for Stormwater Management: the case of an Infiltration-Based Green Infrastructure Under Shallow Groundwater Levels

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Infiltration-based green infrastructures (GIs) are commonly constructed to effectively storage the excessive stormwater runoff. These GIs exploit infiltration process, as the key natural phenomenon in the hydrological water balance, to detain excessive stormwater volume, especially at the outlet of the peri-urban watershed. Beside many factors playing significant roles in the performance of the infiltration-based GIs, implementing them in shallow groundwater area still represents a challenge that can restrict their widespread adoption. In fact, the groundwater level, if close to the bottom of infiltration-based GIs, can strongly influence the infiltration process. Basically, the shallow groundwater may theoretically play as a boundary conduction and subsequently reduces the infiltration rate.

The present study investigated the activation of an infiltration-based GI located at the outlet of the combined sewer system in the municipality of Sedriano (12,000 inhabitants in province of Milan, North Italy), monitoring the inflow and the water depth over a period of almost two years. Meantime, groundwater level and meteorological measurements were observed (including precipitation, air temperature, solar radiation, wind velocity, and relative humidity). Using these observations, a Water-Balance Model (WBM) was calibrated on the hydrological response of the infiltration-based GI and then, used to simulate how much time is required to empty under a specific precipitation event, and to understand the spatial distributed performances of these measures under different groundwater levels.

The implementation of an accurate WBM can be a useful tool for designing and assessing the performance of the infiltration-based GIs in shallow groundwater environments in peri-urban areas. This study is an integral part of the project Smart-Green (www.smartgreen.unimi.it) that developed online tools for supporting the water utilities to accelerate the transition towards the sponge cities utilizing GIs techniques.