Overview of the urban hydrogeological system of Bucharest city

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Abstract

In urban areas an important man-made disturbance on the water cycle is produced (Boukhemacha et al., 2015) by: 1) the change of land use that reduces natural aquifer systems recharge from precipitation, 2) manmade sinks induced by groundwater abstraction, drains, subway tunnels, sewer systems, and others; and 3) urban infrastructure elements acting like groundwater recharge sources, as for example the water supply network losses and leaky sewer systems. Besides, human activity affects the natural hydraulic connection between groundwater and surface water.

The aquifer system component of Bucharest city region (Gogu et al., 2011), showing a high hydraulic interaction with the urban infrastructure (sewer network, subway tunnels and stations, water supply network, basements and others) is represented by the first two groundwater layers. The upper aquifer stratum of these quaternary formations called Colentina gravels is made of gravels and sands. This unconfined aquifer can be found mainly in the Bucharest city region at depths between 15 m and 20 m. However the water quality is quite low, the groundwater level can be found at 5 to 10 m depth. The aquifer thickness is between 3 to 5 m showings a variation of the particle size distribution. The hydraulic conductivity varies between 10 m/day and 70 m/day, sometimes being higher than 100 m/day. A clayey-marl layer called Intermediary deposits is underlying this layer. A second confined aquifer layer showing hydraulic heads similar to the first unconfined one is underlying these deposits. This called Mostistea sands is made of fine and medium sands with gravel intercalations and is located at depths between 25 m and 70 m. The above described component is underlined by a sequence of marl and clay layers with slim sandy intercalations.

In Bucharest, the interaction between the aquifer system and the underground infrastructure creates two major quantitative problems. The first consists in the barrier effect produced by the lined up works of Dambovita River that cuts Bucharest city in two parts, from NW to SE, increasing consequently the groundwater hydraulic heads in the surrounding areas. The second being actually a twofold concern, is shown by the strong hydraulic interaction between the sewer network and the groundwater, translated by high supplementary flow rates of used water needed to be treated. Restoration of this sewer system triggers consequently the hydraulic heads increase in several residential areas of the city.

Other local conflicts, originating from a lack of an urban groundwater management practice, regroup local settlements and subsidence, surface water level decrease, areas and caves flooding and others. As for example in the last decade a slow decrease of the water level has been observed in one of the Bucharest city lakes called “Lacul Circului”. However it has a man-made origin, the lake is naturally fed by the upper shallow aquifer of the Bucharest city. Several analysis scenarios have been studied in order to derive the real cause of
this phenomenon. The urban aquifer system behavior, showing a strong relationship with the underground infrastructure changes since 2000, has been studied. These changes included the water supply network losses reduction of the area, the sewer network interaction, the barrier-effect produced by the existing subway tunnels, and potential temporary and permanent dewatering systems. As before 2004 the lake water level showed a steady behavior, groundwater scenarios have been developed since, taking into account the infrastructure elements changes with time. Modeling results outlined a clear connection between the decrease of the lake water level and the existing permanent dewatering systems.

References
