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Impact Assessment of an urban Pollution on the Aquifer of Ljubljana, Slovenia

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The town of Ljubljana with a population of about 270 000, is completely reliant on local groundwater abstraction for municipal water supply. The city presents a rare example of a reliable and high quality water supply being sustained locally with no artificial pre-treatment of water. However, despite relatively deep (in regard to the European aquifers) groundwater table (approx. 20m) the local phreatic, partly conglomerate, Pleistocene and Holocene gravel aquifer (Ljubljansko polje) is vulnerable to pollution. The urban area extends over approx. 80% of the aquifer, presenting many potential sources of contamination.

The assessment of the urban water resources is being conducted in Ljubljana as one of the four case-study cities within the EC 5^{th} FP project AISUWRS (Assessing and Improving Sustainability of Urban Water Resources and Systems). The 3-year research project developed innovative new modelling techniques for urban water resource management in cities that depend on underlying or nearby aquifers for their water supply. Four individual models were developed by CSIRO Urban Water, Australia: UVQ-Urban Volume and Quality, to estimate water and contaminant fluxes within an urban area; NEIMO-Network Exfiltration and Infiltration Model, for predicting leakage and contaminant flux from sewer pipes; SLeaki-Sewer Leak Index, to assess wastewater leakage through unsaturated zone to groundwater and POSI-Public Open Space Index, to estimate open space infiltration through unsaturated zone to groundwater. The models are linked together with a decision support system (DSS). In particular, research focused on the understanding and modelling of urban water and contaminant transfer and fate. A combination of field research and the development of a modelling

suite considering the urban water cycle contributed to the management of urban water resources and the prediction of potential future scenarios.

In Ljubljana, beside base line scenario, which has provided an overview of water fluxes in chosen urban area, three scenarios were tested to assess their impact on the urban water system: sewer rehabilitation scenario with sewers constructed in 1965 or before rehabilitated, replacement of septic tanks by sewers connected to the sewage system scenario and decentralized rainwater infiltration scenario with infiltration basins installed, to reduce the volume in the sewer system. By applying UVQ and NEIMO, infiltration scenario gave the worst results and contributed more load to the unsaturated zone than base line scenario. In comparison with the base line scenario, the most favourable scenario that has reduced the loads to unsaturated zone was replacement of septic tanks by sewers connected to the sewerage system. The sewer rehabilitation scenario results showed negligible effect on the unsaturated zone. But when applying POSI and SLeakI, because of the thick unsaturated zone in the study area, negligible amounts of contaminants from the research urban area reached the groundwater table and there is also no significant difference in contaminant loads to groundwater from different scenarios.

The research has shown that the main problem of Ljubljana city water supply policy is not the urban impact, but yet well-investigated agricultural activities in the areas around Ljubljana. From this point of view it seems that a sustainable urban development with improved sewer control and standards will produce improvements to groundwater in the future, what was not expected at the beginning of the study.