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Estimating Groundwater Vulnerability by Contaminant Leaching from Flood Retention Areas with an bayesian Approach

E. Bethge and U. Mohrlok

Institute for Hydromechanics, Universität Karlsruhe, Germany

(bethge@ifh.uka.de / Phone: +49 721-6087793)

During the last decade at all major rivers in Germany river bank renaturation projects have been accomplished to improve flood protection. The repeated flooding of retention areas leads to conflicts of interest between flood protection authorities and water works extracting groundwater or bank filtrate in the river plains. Water works are concerned that with the establishment of retention areas in the vicinity of their water extraction facilities the risk for groundwater contamination during flood events will be increased. The presented approach provides a method to calculate the risk of groundwater contamination and to support decisions in water management.

Processing a quantitative risk assessment for an affected water work in this case means linking the probabilities of storm water events (e.g. annualities) to the protection capacity of the top soil in the retention area. The retention and degradation capability for pollutants varies with soil characteristics. To quantify the risk for groundwater contamination numerical transport models can be used. The uncertainty associated with the parameter allocation for transport models can be minimized with an Bayesian approach: information about the parameters (soil water retention curves, sorption coefficients, depth to the groundwater table, degradation rates) from literature or expert estimations (prior data) have to be combined with data from field and laboratory surveys (posterior data) to calculate probability density functions (pdf) of model input parameters. With the help of Bayesian inference pdf's from sparely distributed soil data can be generated. The calculations for the Bayesian inference are made with analytical solutions if available otherwise by Monte Carlo Markov Chain (MCMC) integration. The parameter pdf's are linked to soil texture classes to allow regionalisation over an

area of interest. The spatial information on soil texture classes and vertical structure are derived from sources with low accurancy regarding the textural information (agricultural and forestall soil surveys from the last 70 years) and have to be combined with more detailed recent investigations. These compiled parameter pdf's are used for Monte Carlo simulations and First Order Reliability Methods to calculate the risk of legal limit exceedance in the groundwater.