ABSTRACT

Risk assessment is an important part of catchment management, critical for the provision of safe drinking water. Currently, the assessment of the likelihood of microbial contamination is largely subjective. In this study, a scientifically-based benchmarking system was developed towards an improved and more objective assessment, thus a more effective catchment management.

Factors affecting the contamination likelihood were investigated through literature review, and a three-dimensional framework was developed, expressing likelihood as a function of pathogen loading, and their transport and survival in the environment. Factors selected for the framework were pathogen source from land use (loading), temperature (survival), and vegetation, soil type, and slope (transport). They were analysed and quantified with respect to pathogen reduction rate.

Inactivation rates of protozoa, virus, and bacteria increased with increasing temperature. Due to limited data, only transport factors pertaining to protozoa reduction were addressed. The presence of vegetation significantly reduced pathogen loads in surface runoff, with removal rates of $0.16 \, \log_{10}/m$ and $0.08 \, \log_{10}/m$ over vegetated and bare grounds, respectively. The rate of pathogen removal decreased with increasing soil bulk density, at a ratio of 1:0.8:0.7 for sand:silt:clay. The increase in slope served to reduce the reduction rate by 11% for every 5° slope. Therefore, for a given slope, soil type, and vegetation cover, the value for pathogen removal rate can be obtained, leading to the assessment of contamination likelihood, based on the initial pathogen loading.

A case study on Middle Helena catchment was carried out to apply the benchmarking system. Comparison between water sampling results and the predicted likelihood based on the system resulted in 25% agreement. Several factors, such as underestimations of initial pathogen loading and limitations within the derived reduction rates, may lead to this low agreement. Other factors affecting the likelihood of contamination, as well as the interactions between them should also be addressed to improve the benchmarking system.