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Expert elicitation for parameterisation of a Bayesian Network model designed to simulate Faecal Indicator Organism (FIO) losses from septic tank systems in rural catchments

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Bayesian Networks (BNs) are a modelling approach increasingly used in landscape management, e.g., to predict microbial water pollution risk and inform ecological risk assessment. BNs are widely acknowledged for their ability to integrate multiple data types in their structure, including expert knowledge derived through structured elicitation approaches and are therefore, advantageous when empirical evidence or large-scale datasets are scarce. Expert elicitation is a useful technique for quantifying and characterising expert knowledge regarding an uncertain quantity in situations where empirical data are missing, or additional information is required to augment available data. In this study, an expert elicitation approach utilising the Sheffield Elicitation Framework (SHELF) was employed to obtain expert judgements of an uncertain quantity included in a BN model designed to quantify faecal indicator organism (FIO) losses from septic tank systems by modifying an existing phosphorus risk BN model. The aim of the study was to quantify expert judgements on the proportions of FIOs likely to be delivered to a surface watercourse from septic tank systems based on soil hydrological properties, septic tank distance to watercourse and slope. The specific objectives were to:

- Solicit expert feedback on the structure of the BN conceptual model developed to identify key factors influencing FIO pollution from septic tank systems;
- Use the SHELF elicitation protocol to obtain individual expert judgements on FIO delivery coefficients in form of percentiles for a series of soil type, slope and distance to watercourse scenarios;
- Fit probability density curves to individual expert judgements and derive consensus from across the range of expert judgements using facilitated group discussion.

The structure of the BN model including identification and justification of model variables, approaches to expert elicitation and consensus expert judgements are presented. The study demonstrates effective use of expert opinion in BN model parameterisation and BN FIO modelling to inform on options for addressing microbial pollution originating from septic tank systems in the

Tarland catchment in North Eastern Scotland.