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Vadose zone modelling as a tool to develop a generic framework for the re-use of soil or mineral waste onto soil

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Slightly contaminated soil that is excavated during building or land management projects can be re-used at other locations either as soil or as building material. Likewise, mineral waste products re-usable as building material can be applied onto soil, e.g. in roadworks or building foundation layers. In order to ensure that this is done in a safe manner without compromising soil or groundwater quality, quality standards need to be set.

In this study, a framework is developed of generic quality standards for the re-use of excavated soil as well as mineral waste products re-usable as building materials. Topics that are addressed before the start of model calculations are:
- what are safe concentrations in soil and groundwater that ensure protection of human and ecosystem health;
- what are typical application scenarios;
- what is the range of soil parameters to be used in the model calculations;
- what type of leaching tests are used to describe leaching of contaminants from the excavated soil or mineral waste and how can these test results be translated to a source term for model calculations.
These boundary conditions are defined within the limits set by EU regulations such as the Water Framework Directive and the Landfill Directive and presented and discussed with stakeholders.

Next, risk-based quality standards are calculated that are protective for both soil and groundwater. Since well-defined applications scenarios were set for the derivation of quality standards, model calculations are carried out using a 1D analytical water flow and transport model. Calculations are done for different metals and for a range of soil parameters that are either critical for soil (high sorption) or for groundwater (low sorption). Quality standards for re-use are determined iteratively as the concentration at which the maximum tolerable concentration in soil or in groundwater is reached. Different sets of quality standards are presented and the sensitivity of the results to the choice of soil parameters, application scenario and source term is discussed.

This study presents an application of unsaturated zone modelling for deriving environmental standards and illustrates the pitfalls and difficulties in transferring model results to practice, such as the compilation of relevant (soil) parameters as model input and the quantification and communication of uncertainty of model results.