

Background

Since the decision, in June 2006, of the Belgian government to locate the surface disposal facility for low and intermediate level waste -short lived (LILW-SL) in the municipality of Dessel, different detailed technical studies are being carried out to prepare different license applications with a view to enter the construction phase by 2011-2012. During the current project phase (2007-2010) an *assessment basis* will be established comprising detailed design, phenomenological description of the evolution of the installation and its environment, and safety assessment scoping calculations. Once a sound and defensible assessment basis has been formed, the formal *compliance radiological long-term safety assessments* will be conducted.

Objectives

One of the challenges within building the assessment basis is to investigate and document the dynamics of groundwater flow for the region Mol-Dessel. The transient behaviour of the shallow and deeper groundwater flow is analysed on the basis of time series of groundwater level observations belonging to the SCK•CEN regional and local piezometric network. In order to understand and reproduce this dynamic behaviour of groundwater, a local-scale transient groundwater model has been set up.

Principal results

Due to the complexity of the model input and the scope of this study, the transient model has a relatively limited extent of 18.6 km². Vertically, the transient model is divided into four numerical layers, representing the Mol Sands, Kasterlee Sands and Diest Sands aquifers and the Kasterlee-Diest transition layer (KDTL) aquitard (see Figure 1). Two types of boundary conditions are applied for the upper and lower aquifer. In the upper aquifer, the boundaries are formed by rivers that surround the modelling domain. In the lower aquifer, a time-varying head boundary condition is applied (see Figure 1).

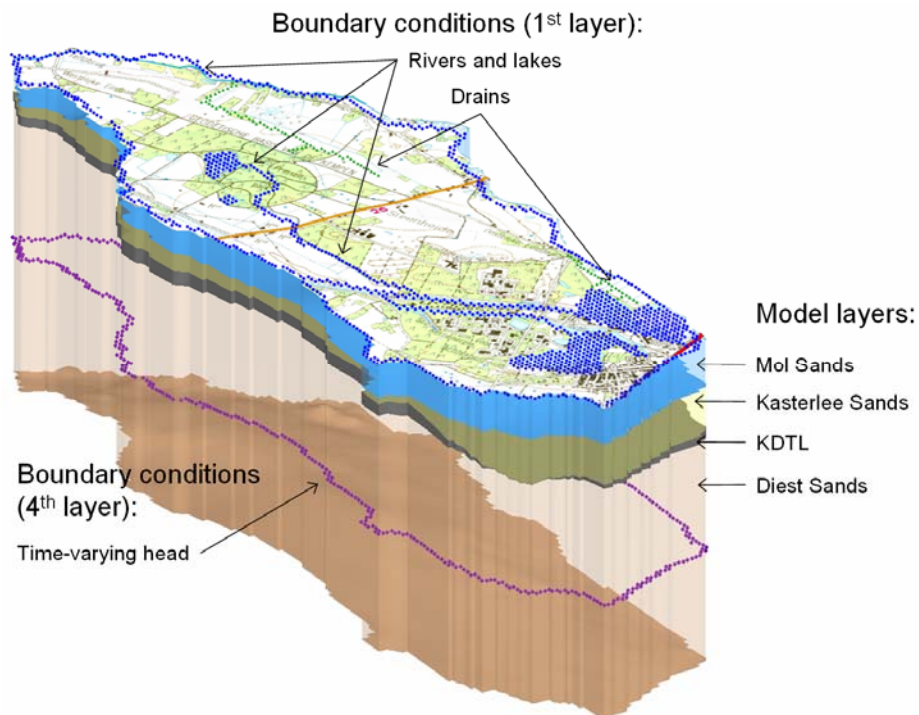


Figure 1: Three-dimensional sketch of the transient model with applied boundary conditions

The transient infiltration input data were calculated using unsaturated zone modelling taking into account precipitation and potential evapotranspiration, along with other data measured at various climatological stations of the Royal Meteorological Institute. Calibration parameters for the transient groundwater model included the hydraulic properties of the hydrostratigraphic units, such as the hydraulic conductivities, specific storage and specific yield and the conductances of the local rivers and brooks.

Two modelling periods were considered, the calibration period from 2001 to 2005 and the validation period from 1990 to 2000. This sequence of time series was chosen to put more weight during calibration on the largest dataset of shallow groundwater level observations. During this calibration period, optimal parameter values were derived using manual and automated calibration techniques. These optimal parameters were then used to simulate the groundwater levels during the validation period. The simulated levels were compared to the observed ones at a number of piezometers from the SCK•CEN local and regional piezometric networks.

Satisfactory agreement between the simulated and observed groundwater levels was achieved at the majority of observation points (see Figure 2). Most parameters derived during the transient model calibration are in agreement with the parameters used in a larger-scale steady-state model for the site. Besides validating the parameters, the transient model represents also a useful tool for further analyses of the local groundwater flow and transport.

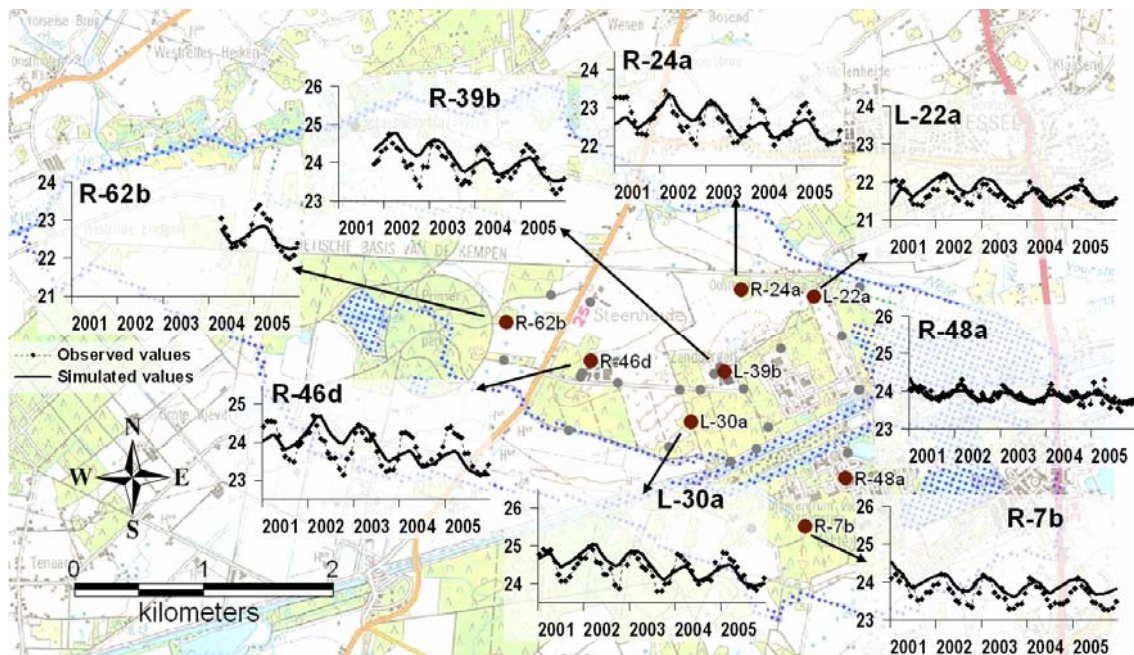


Figure 2: Observed versus simulated values at selected observation points after calibration

Future developments

The transient model is an important modelling tool within the assessment basis but should be further improved and updated as new information and data become available. Possible future developments are to test model's robustness when a higher degree of heterogeneity in boundary conditions and hydrogeological parameters is accounted for.

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Main reference

Gedeon, M. and Mallants D., 2007. "Local-scale transient groundwater flow calculations in support of the Belgian surface disposal facility performance assessment. Project Phase Disposal Category A Waste", External report, SCK•CEN-ER-46.