Geophysical Research Abstracts
Vol. 16, EGU2014-16261, 2014
EGU General Assembly 2014

13. Groundwater in urban seashore sediments affected by tunnel constructions

Nils-Otto Kitterød
Norwegian University of Life Sciences, Aas, Norway (nils-otto.kitterod@nmbu.no)

The purpose of this study was to examine the impact of a planned tunnel construction on the local groundwater level in the archeological deposits at the Old Wharf (Bryggen) of Bergen. The groundwater level is a function of infiltration rates, transmissivity, and boundary conditions. These variables were deduced from available data and supplemented by leakage measurements into the existing Railway tunnel located upstream of the Bryggen area. Previous studies have documented that the pore water in the deposits at Bryggen has different origin (viz fresh precipitation; leakage from drainage systems; infiltration of seawater; infiltration via the bedrock). The catchment of Bryggen is characterized by variable topography (from sea level to about 500 m a.m.s.l.) and steep gradients. Major parts of the catchment have very sparse sediment cover and can be considered as exposed bedrock. The major sediment volumes are deposited close to the sea front. In the upper part of the catchment, the groundwater level in the bedrock is close to the surface. Some observations indicate that boreholes located in lower part of the catchment have artesian pressure, which implies that there is a groundwater flux from the bedrock and into the sediments. Based on this conceptual model, a numerical model was constructed where the seawater was the boundary condition at one side and the groundwater divide on the other side. Transmissivities in the bedrock were deduced from pumping analysis, and steady state infiltration rates was calibrated to give simulated groundwater levels that were consistent to observations. Given these model simplifications, it was possible to calculate a groundwater level in the sediments at Bryggen were all water into the sediments came from the bedrock only. The simulated groundwater level captured roughly the observed groundwater levels. After simulation of the natural groundwater level (i.e. without any artificial extraction of water in the catchment), the impact of the water leakage into the existing tunnels was calculated. Given the relatively rough estimates on water leakage into existing tunnels (4 liter/day/meter of tunnel), the calculated decline of the groundwater table was less than 1% of the natural groundwater head (<1 cm). If leakage rates were increased to one and two orders of magnitude, the steady state groundwater decline would be from 5% to more than 35% of the reference groundwater head (4 - 15 cm). The reason for this relatively robust groundwater conditions in the sediments are the boundary conditions: Without any local water sinks in the deposits, the steady-state groundwater table at Bryggen will always be higher than the seawater level. A crucial point for these results was the leakage rates into the existing tunnels, which is highly recommended to monitor before execution of any new tunnel constructions.