Evaluation of Mine Dewatering and Related Impacts at a Deep Underground Iron Mine in Northern Sweden

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ABSTRACT

Plans are underway to expand the Kiruna underground iron mine, in northern Sweden, to deeper mine levels. The objective of this investigation was to provide hydrologic information useful in obtaining the permits required for mine expansion and continued operation. The Kiirunavaara ore body dips about 60 degrees to the east towards the town of Kiruna. Continued mining of the ore body has resulted in a gradually increasing zone of ground deformation. The expanding deformation zone not only results in a transformation of the town and infrastructure, but also creates continually-evolving groundwater hydraulics.

The project consisted of both site characterisation and numerical modelling. Two process models were developed. A surface water model of watersheds surrounding the mine, including the Luossajoki River-Lake Yli Lombolo-Lake Ala Lombolo flow system, focused on understanding the potential impacts of the mine on the surface water flow system. A regional groundwater model focused on forecasting mine dewatering rates and predicting potential impacts on groundwater levels near the mine, especially near Lake Ala Lombolo and Kiruna where private wells exist. The groundwater and surface water models were coupled through watershed recharge.

Modelling of the surface water-groundwater system was complicated by the predicted expansion of the deformation zone with continued deepening of the mine. Aquifer material properties were varied linearly through time in the groundwater model to accommodate the expanding deformation zone. The expanding surface expression of the deformation zone acted to enhance recharge with time. Model uncertainties were highest for predicting precipitation and the deformation zone extent. Using estimated upper and lower bounds for these model parameters, a range of mine inflows was calculated for the twenty-year prediction period.