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The effect of river regulation on the hydrological conditions of the aapa mire in a mining development site in Northern Finland

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Central Lapland Greenstone Belt is highly prospective for gold and Ni-Cu-PGE deposits. The study area in Sodankylä, in northern Finland, has been glaciated during last ice ages forming complex sedimentary succession with low conductivity till and highly variable sorted sediments, which hydraulic conductivity can be orders of magnitudes higher. The complex Quaternary sediments usually cover weathered/fractured bedrock, which is preserved due to weak glacial erosion and can host bedrock aquifers, as well. Rivers, lakes, streams and mires are common features in northern boreal and subarctic regions and their hydraulic interactions are usually poorly understood.

Planning of mining operations in such environments needs a detailed understanding of water balance and groundwater discharge and recharge patterns, which are linked to subsurface sediments. In baseline studies, present hydrogeology, hydrology and ecology of the development site has usually been studied intensively. However, main rivers in northern Finland have been regulated since the 1970s and surrounding environments are not in their natural stage. The understanding, how much the environments could have been changed due to the regulation, is needed.

The study area locates in the western part of Natura 2000 protected Viiankiaapa mire, which lies about 300 meters above high-graded Ni-Cu-PGE deposit. The regulated River Kitinen is running close to the western edge of the Viiankiaapa mire. The construction of the hydroelectric power plants and the regulation of the River Kitinen has changed the hydrology of the study area from the 1970s onwards. The Matarakoski power plant built in 1995 affected the study area most directly by ending the regular spring floods and rising the river stage.

The changes in the groundwater flow and recharge/discharge patterns were studied with 3D groundwater flow modelling with MODFLOW-NWT and flood modelling with HEC-RAS. Pre-regulation situation was compared to the present stage with two different groundwater flow models in order to understand how regulation of river has affected the groundwater

recharge/discharge patterns and flow patterns of the mire. Flood modelling was used to simulate the pre-regulation flood distribution.

The regulation of the River Kitinen has affected the western part of Viiankiaapa mire by raising the water table and smoothing the hydraulic gradient towards the river leading to partial wetting of the mire. Annual water table variations decreased due to ending of the flooding and the regulation created a more stable hydrological environment in mire area. The stabilization of the hydrological environment, as well as the rising of the water table, might have affected the distribution of habitats of endangered moss species *Hamatocaulis vernicosus*. The mire might have become more favourable for *Hamatocaulis vernicosus*, which is resistant to flooding and high water table. This study emphasizes the importance of understanding the interactions of surface water and groundwater and the present and pre-regulated stage of the river in order to assess the difference between the present and natural stage of the mire.