Summary of PhD thesis:

A STUDY ON IMPACT OF DEWATERING OF OPENCAST MINES ON HYDROGEOLOGICAL CONDITIONS AND WATER SUPPLY IN THE CENTRAL PART OF THE KIELCE-ŁAGÓW SYNCLINORIUM

Author: Katarzyna Białecka, MSc Eng., PGI-NRI, Holy Cross Branch, Kielce
Supervisor: Arkadiusz Krawiec, Dr Eng., Professor NCU

The subject of the study is a prediction of hydrodynamic changes under conditions of planned dewatering of opencast limestone and dolomite mines in the central part of the Kielce-Łagów Synclinorium of the Holy Cross region. The Middle Devonian limestones and dolomites are a valuable industrial raw material of this area, representing a fracture-karst aquifer that is a source of water supply for the local population. At present, the extraction of rock materials is carried out mainly above the water table. However, due to the dynamic increase in demand for aggregate, the mine owners are seeking permission to extract mineral deposits also below the water table. Calculations of the range of influence of their dewatering on water conditions, presented in hydrogeological documentations of deposits, were made under the assumption that neighbouring deposits would not be dewatered. However, under the conditions of concentrated mining, where already 12 deposits belonging to 10 owners are being exploited, calculation of only individual forecasts of mine dewatering does not allow making a reliable assessment of changes in hydrogeological conditions of the area.

The main objective of the dissertation is to define conditions of groundwater circulation in the study area and predict hydrodynamic changes that may result from planned dewatering of the mined raw rock materials. The author attempted to make a complex assessment of the influence of dewatering on disposable resources of the region, exploitable resources of municipal groundwater intakes, and surface watercourses. For this purpose, the author used results of multivariate calculations made on a mathematical model of the whole hydrogeological structure, developed with the Visual Modflow software. In order to develop the model, the author analysed and used geological and hydrogeological maps at the scales of 1:50,000 and 1:200,000, regional and economic hydrogeological documentations, geological documentations of mineral deposits, and results of hydrogeological and environmental mapping of the study area.

The work also included studies of both pore space parameters in Devonian rocks, using the mercury porosimetry method, and chemical composition of groundwater. Based on the results of chemical analyses, it may be stated that the waters in the study area poorly mineralized being of HCO_3-Ca and HCO_3-Ca-Mg types. They meet the requirements for drinking water and therefore do not require treatment. Studies of mine waters show that they are also of good quality and can be used for municipal, industrial and agricultural purposes.

In the first stage of work, the present hydrodynamic conditions (as of 2019) were reconstructed on a mathematical model, and then computational simulations were made for three prognostic variants of mineral extraction below the groundwater table, taking into account the increase in water discharge rate from the intakes in the amount of issued water permits. As a result of dewatering of the currently operating mines at the first waterlogged mining levels, and at the present-day discharge rates in water intakes, a regional cone of depression will be formed, covering in its range a considerable part of the Devonian aquifer formation. Increased water discharge rates up to the amount permitted by water law permits will cause larger spreading and deepening of the cone of depression and simultaneous reduction in watering of mine workings. Groundwater intakes will be located within the cone of depression of the drained mines. This will result in both lowering of the water table in wells and potential deterioration of their exploitation parameters. In this situation, it will be necessary to restructure and rebuild the wells or to construct substitute wells.

The results of model simulations show that the rivers within the range of a regional cone of depression will change their character from draining to infiltrating. In dry periods, this may have local ecological consequences and disturb the minimum acceptable flows of the rivers, but only over their short reaches upstream of the dewatered mines. Downstream of the mines, river flow rates will increase considerably as a result of water mine drainage into them, and this may cause localized flooding.

The predicted impact of dewatering of mineral deposits on hydrodynamic conditions and abstraction capacity of drilled wells will be constantly changing depending on the progress in mineral extraction and flooding of depleted mine workings. It will be practically impossible to determine the contribution of individual mines to these changes. The influence of dewatering will be not only common but also variable in time, which additionally makes long-term forecasts of changes in water conditions difficult.

The results presented in this dissertation will allow planning further hydrogeological studies for rational water management in the central part of the Kielce-Łagów Synclinorium. They will enable making analysis of various variants of changes in hydrogeological condi-

tions during extraction of rock materials below the groundwater table, as well as indicating measures limiting negative impact of their extraction on the groundwater environment.