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Estimating the decant rate at a rehabilitated opencast mine where net groundwater inflow occurs

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The expected decant rates at rehabilitated opencast pits are usually estimated by simply assuming a high recharge value (15% - 20% of the mean annual precipitation) through the spoils. This approach is based on the assumption that the inflow volumes of groundwater are balanced by the outflow volumes. However, using this standard approach for decant estimation at the mine under investigation yielded an estimate for the decant rate that was significantly smaller than the volumes of water dealt with on a daily basis at the mine. This observation suggested that either the recharge value used in the estimation of the decant rate was much too small, or the assumption of zero net groundwater inflow was wrong.

Non-zero net groundwater inflow to the pits would imply the presence of preferential pathways for groundwater flow connected to recharge areas at elevations higher than the water levels in the pits. Such preferential pathways are usually associated with geological structures such as faults or dykes. To investigate the possibility of non-zero net groundwater inflow to the pits, a magnetic survey was conducted at selected positions along the boundaries of the pits to detect the possible presence of magnetic dykes acting as, or associated with, preferential pathways. Groundwater levels in the vicinity of the pits and pit water levels were measured to evaluate the hydraulic head gradients driving groundwater flow. Information on the water levels at voids within the pits, as well as the pumping rates between the voids, was used in conjunction with measured rainfall data and estimated evaporation rates to obtain an independent estimate of the expected decant volumes. The presence of at least one prominent dolerite structure intersecting one of the pits was revealed by the magnetic survey. Groundwater levels in boreholes intersecting this structure were found to be more than 10 m higher than the ambient groundwater levels and pit water levels, confirming groundwater inflow into the pits along this structure. A water balance calculated from the measured water levels in the voids and pumping rates allowed estimation of the net groundwater inflow volume.

The results of the investigation show that incorrect estimates of the decant rates at rehabilitated opencast pits may result if the possibility of net groundwater inflows is not considered and investigated.

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