In-situ uncertainty quantification and implications for risk mitigation – a case study from WAIO Newman Hub

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Keywords: conditional simulation, uncertainty quantification, risk mitigation, accuracy, validation, accuracy plots.

ABSTRACT

Conditional simulation is widely accepted in the mining industry as the best way to quantify uncertainty in tonnage and grade. Uncertainty quantification needs to be evaluated against the potential negative consequences of uncertainty, so that effective risk mitigation strategies can be identified. However, conditional simulation models need to be carefully constructed with robust validations, otherwise risk mitigation strategies based on sub-optimal simulations, may be ineffective.

A conditional simulation case study is presented, with simulation of both categorical and continuous variables, for multiple orebodies from BHP WAIO's Newman Hub in Western Australia, using BHP's SBRE conditional simulation platform. The orebodies considered display a range of geological complexity, both in terms of the structural setting and in the presence of deleterious elements and internal waste.

SBRE conditional simulation workflows were initially constructed using exploration drilling data only, followed by validation of the simulations using blast holes. After successful validation, workflows were used to run the final simulation models for each orebody, using both exploration and blast holes, drilled prior to December 2019.

An existing deterministic estimation model, constructed using data acquired prior to December 2019, together with the simulation models constructed for this case study, were then cross validated against 'reality', based on closely spaced blast holes drilled over a 31-month reconciliation period post November 2019. Cross validation results show the value of the simulation models over the deterministic ones, in terms of the true range of potential grade values being represented in the simulation models. The use of accuracy plots to validate simulation models is discussed.

Final simulation models were used to model downstream blending options from multiple orebodies with different levels of geological complexity and uncertainty. Simulation models highlight the risk to planned crusher tonnes, with an increase in stockpile tonnes for higher production rates required to mitigate this risk.