From Catchment Hydrology to Dewatering at Mine Sites

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Extended Abstract

Large volumes of water are used in mineral processing, for dust suppression, and for normal municipal uses. However, maintaining the optimal supply and storage is tricky. Groundwater pumping may exacerbate already low groundwater tables. Sporadic and highly seasonal rainfall and snowmelt may require the mine to use complex water management rules. If dewatering rates are high, or storage options limited, then discharge to local surface water systems is usually necessary.

The catchment is the spatial context in which a mine is located. All mines impact the groundwater and surface water in their catchment. These impacts are highly spatial and complex, and may be cumulative across multiple mines and mine sites. Yet, traditional water balance modelling simplifies the feedbacks and interactions between groundwater, surface water and catchment hydrology. Failure to get this right can lead to poor operational decisions and increased costs.

For a copper mine in Africa, we have developed novel methodologies to integrate complex groundwater models for dewatering, with regional physics based catchment models. The two models are linked via the dynamic, spatially distributed groundwater recharge, as well as through the dynamic lateral groundwater boundary flow. The overwhelming advantage of this approach is the ability to look at detailed dewatering scenarios, while taking into account the feedbacks and exchanges in the regional hydrology.

The physics based catchment model surrounding the mine is being used to simulate catchment related water issues, such as the siting of tailings disposal facilities, planning for stream diversions, and screening for flood impacts.

In general, such hydrology models can be used to answer both operational and social questions, such as:

- How will surface water disposal of dewatering water impact river flow and downstream users?
- Are water management plans and operational rules robust enough to accommodate both very wet and very dry years?
- What are the implications of irrigation, drainage, and storm water management on social, mining and environmental users?
- Is the mine closure plan sustainable with respect to long term hydrology – especially in the context of climate change?

Whereas, the detailed groundwater model takes into account the complex geology around the mine (imported from MineSight), as well as the mine development over time to address operational issues, such as:

- What are the optimal locations and depths for dewatering wells?
- What are the expected changes in dewatering rates as mining progresses?
- Can the mine plan be optimized to minimized dewatering costs and maximize effectiveness?

Key words: Mine water management, groundwater-surface water interaction, groundwater modelling, catchment hydrology, physics-based modelling