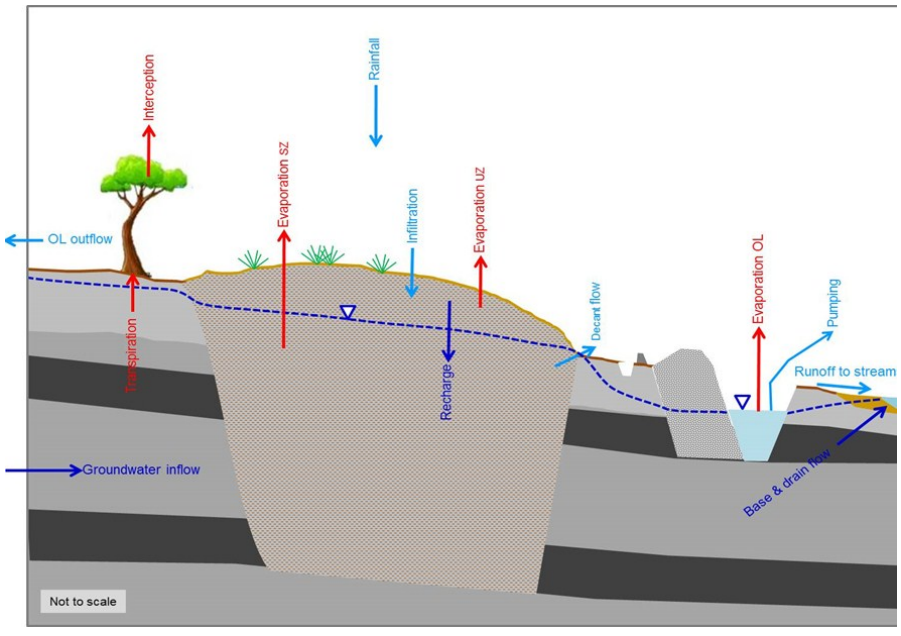
DHI SOLUTION

MINE WATER MANAGEMENT

Integrated physics-based hydrology

Water is vital to the efficient operation of a mine — water surplus and scarcity during the life of the mine can severely limit mineral production. Securing a water supply is critical for obtaining new mine permits and can have major implications for neighboring communities. The physical and ecological sustainability of post-closure mine rehabilitation schemes depends completely on the hydrology of the site and it's interaction with local catchments.

Despite its apparent importance, water is generally viewed merely as a peripheral part of the mining process. The scope of water management is often narrowly limited to the confines of the mine site and does not incorporate the wider catchment interaction. At DHI, we evaluate mine water management in a catchment context. Using physics-based modeling, we evaluate the interactions between runoff, evapotranspiration and infiltration. Our approach ensures that mine water management strategies are holistic and provide a level of reliability that is not achieved using alternative traditional approaches.



Conceptualisation of the fully integrated water balance at an open cut coal mine

SUMMARY

CLIENT

- Mine operators
- Mining consultants
- Regulators & permitting authorities

CHALLENGE

- Unsustainable water resources management
- Ineffective evaluation of the environmental effects of mining activities
- Need to prepare adequately for climate change
- Need to comply with environmental regulations and obtain requisite approvals

SOLUTION

A fully integrated mine water balance model using MIKE SHE to evaluate the feedbacks of the components of the hydrologic cycle and the interactions between them

VALUE

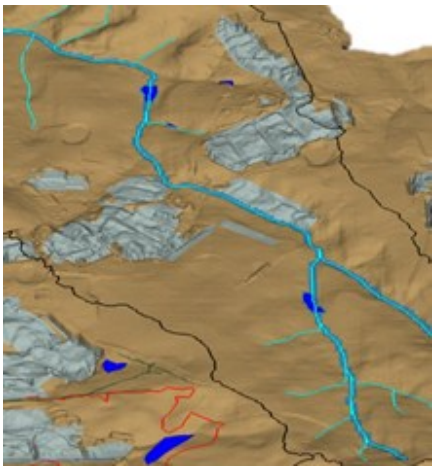
- Minimized operation risk
- Reduced environmental impacts
- Better legislation
- Improved safety (inside and outside the mining area)
- Reduced downtime and consequent decreased costs from downtime and remediation
- Minimized risks from potential accidents
- Improved public acceptance
- Swift project approval

FULLY INTEGRATED MINE WATER BALANCE

The vast majority of water management tools in the mining industry focusses on the 'management' aspects of mine water. These traditional tools fail to recognise the importance of understanding the 'hydrology' of the mine site within a catchment context. A mine water balance is neither simply the groundwater balance at the mine site boundaries, nor a collection of storages in a spreadsheet. Rather, a fully integrated mine water balance must partition rainfall into runoff, infiltration and evapotranspiration. It must couple vegetation, evapotranspiration, surface water, soil water and groundwater together, in order to evaluate the feedbacks and interactions between the components of the hydrologic cycle. For example, soil moisture conditions will impact runoff volumes, and vegetation will impact recharge and the depth of groundwater.

Our approach is based on the 'Mine Hydrology' concept and uses holistic, physics-based modelling to understand water behavior in the catchment context. We utilise the MIKE SHE and FEFLOW models either independently or coupled together, in order to achieve a Mine Hydrology study.

A valuable contribution to calibrating an integrated MIKE SHE model is the qualitative information contained in the total water balance. A transient total water balance can be created over the whole model domain or any portion of the domain (for example a mine pit or the waste dumps). This provides an extraordinary insight into the relationships between the different model processes. MIKE SHE is the only integrated modelling code that can generate such detailed, specific water balances.



Mine hydrology model layout showing affected areas in the mine within a catchment context (highlighted in grey)

MIKE SHE

MIKE SHE is the most widely used software for simulating surface water, groundwater and groundwater-surface water interaction at the catchment scale. It is the global leader for modeling the impacts of dewatering on wetlands, streams, and the ecology.

MIKE SHE uses a finite difference solution to partition rainfall into runoff, infiltration and evapotranspiration, thereby allowing the simulation of

- surface runoff and flooding
- stream flow (including operational control structures)
- unsaturated infiltration and recharge
- spatially distributed actual evapotranspiration
- groundwater flow
- fully integrated, multi-species reactive solute transport

MIKE SHE includes a sophisticated, conceptual model-based, Graphical User Interface (GUI) and can be linked to external applications as well.

WATER MANAGEMENT SCENARIOS

Using the Mine Hydrology concept, the following typical water management strategies can be evaluated:

- Effectiveness of evapotranspiration and creating additional storages
- Design of dams promoting evapotranspiration
- Effectiveness of using reeds to enhance transpiration
- Minimization of recharge from dams and evaluation of linings
- Effective management of recharge by sculpting and covering spoil areas
- Compacting of backfill to reduce recharge and decanting
- Effectiveness of phytoremediation scenarios (including evaluation of different species and plant types)

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Contact: Stefan Szylkarski - sps@dhigroup.com
For more information visit: www.dhigroup.com