MINE DEWATERING IN WESTERN AUSTRALIA

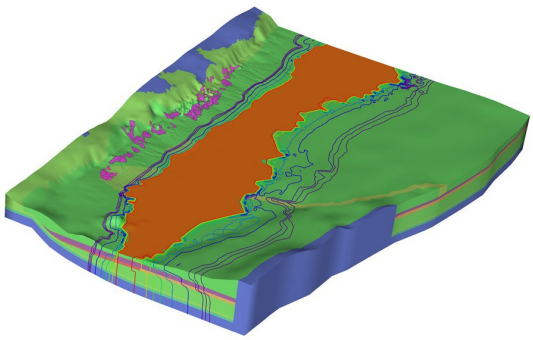
Mine water management in areas with groundwater systems of varying salinity

The Pilbara region of Western Australia doesn't make you think about water – unless you get thirsty looking at this arid landscape. However, the water that's hidden beneath the red plains poses a great challenge for local mining companies. Groundwater is an important natural resource in arid areas and is particularly important for ecosystems that depend on it. Modelling provides the basis for reliable water management plans to be developed, which ensures protection of environmental ecosystems that depend on the groundwater and a reduction in risk associated with the mine development.

The Fortescue Marsh is one of the many environmentally sensitive sites in the Pilbara, West Australia. Groundwater is hyper-saline (3-4 times sea water salinity) underneath the Marsh but is fresh to brackish in the nearby mining areas.

GROUND WATER SALINITY IS AN IMPORTANT FACTOR IN MINE DEWATERING

Many activities related to mining – such as pit dewatering, water treatment and reinjection of groundwater into different aquifers – can cause changes to the groundwater in surrounding areas. To allow for proper and prudent water management and mine dewatering plans, these effects have to be investigated. In addition, mines require the use of groundwater for their operational aspects. Minimising the ingress of highly saline water into fresh or brackish aquifers or into the mine pits, is a prime concern and requires an understanding of the effects of dewatering pumping.



Geology and salinity concentrations predicted from modelling
© DHI

Previous hydrogeological analyses and regional scale numerical models predicted that the saline/ brackish interface would move towards the mining area under the proposed mine-dewatering conditions for a new mining strip. However, the available information did not provide sufficient certainty to develop a reliable mine water management plan.

GROUNDWATER MODELLING AS A BASIS FOR EFFICIENT MINE WATER MANAGEMENT

CLIENT

A global mining company in the iron ore industry.

CHALLENGE

To develop a new groundwater model that would improve the salinity prediction precision and accuracy beyond previous developed models whilst maintaining computational efficiency.

SOLUTION

A high-spatial-resolution FEFLOW model that minimises numerical dispersion while delivering realistic predictions of groundwater and salinity movement. The model should run with a reasonable computational efficiency proportional to the complexity of the undertaking.

VALUE

- Provide useful insights for consideration in future operational planning
- Provide higher precision predictions on salinity movement into pit areas
- Support planning for mine dewatering and reinjection operations
- Reduce risk and uncertainty through improved reliable predictions of groundwater behaviour
- Reduce risk of unforseen impacts on environmental systems.

LOCATION / COUNTRY

Pilbara, Western Australia

SOFTWARE USED

FEFLOW

In order to optimise operations and understand the dynamics of the interface between the fresh, brackish and saline groundwater, DHI designed a high spatial resolution salinity groundwater model (HSRSM) for the mining area. The model can predict the movement of the saline/brackish groundwater interface as well as the quantity and salinity of dewatered groundwater in each mining pit under different mining plans. Moreover, the model can be used to assess the effects of various water management plans involving dewatering and water reinjection.

DETAILED—BUT COMPUTATIONALLY FAST

A realistic prediction of the groundwater salinity interface relies on high spatial resolution but, at the same time, needs to have reasonable simulation times to allow for the models to be effectively used as a tool. The challenge was therefore to ensure that we could increase the resolution and accuracy of the model whilst keeping simulation run times reasonable and proportional to the increased complexity. The model simulation time is a critical element for project delivery that is often overlooked by modellers and project managers and can cause significant frustration to project managers later in the project delivery cycle. As expected, the HSRSM model resulted in increased run times and at the same time provided greater precision and accuracy in its predictions.

REALISTIC PREDICIONS OF GROUNDWATER SALINITY IN HIGH RESOLUTION

The client had previously developed a density-driven groundwater flow and transport models used to predict mine dewatering volume and groundwater drawdown/mounding. However, the spatial resolution of these models was not sufficient to provide certainty with respect to predicted salinity changes associated with groundwater pumping from the mining pits. DHI performed a review and analysis of the models and gained an understanding of the challenges to be resolved. DHI's detailed modelling allowed for quantifying the amount of available fresh or brackish groundwater and to predict groundwater salinity reliably. The three major processes considered were density-driven flow, mine dewatering and groundwater injection of saline and brackish water.

Ultimately, the model could be used to:

- Design practical dewatering and reinjection solutions to meet specific water management goals
- Optimise designs for economic efficiency
- Evaluate potential effects of mining activities on environmental features such as the Marsh
- Understand and mitigate saline water ingress
- Predict impacts of alternative hydrological or development scenarios to assist the decision making

OPTIMISED MINE OPERATION FOR THE SAKE OF ECONOMY AND ENVIRONMENT

Based on DHI's modelling results, planning of mine dewatering and reinjection operations could continue, while at the same time ensuring the environmental safety of this precious region. The work contributed to minimising the risk and the optimisation of the mining operations – both economically and ecologically. This will ensure that Pilbara's iron ore deposits, which contribute significantly to the economy of Western Australia, can be exploited without sacrificing the region's environmental values.

Contact: info@dhigroup.com
For more information, visit: www.dhigroup.com