DHI CASE STORY

MINE DEWATERING IN WESTERN AUSTRALIA

Mine water management close to groundwater systems of varying salinity

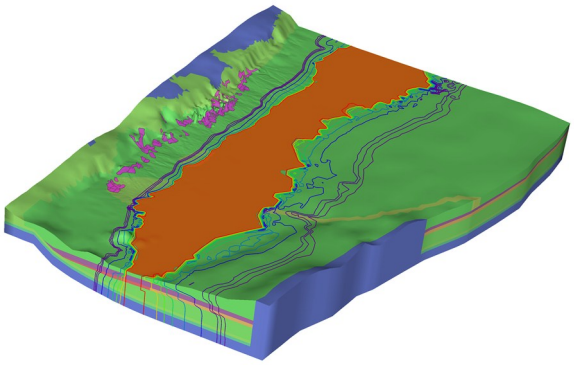
The Pilbara region of Western Australia doesn't make you think about water – unless you get thirsty looking at this arid landscape. However, the water that's hidden beneath the red plains poses a great challenge for local mining companies. Groundwater is an important natural resource in arid areas and 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.

FMG has two major iron ore sites in the Pilbara region. The two mines are located on a narrow east-west strip, bordered by Chichester range in the north and Fortescue Marsh in the south. Groundwater is hyper-saline (3-4 times sea water salinity) underneath the Marsh, but is fresh to brackish in the mining area. The interface between saline and brackish waters is located about 2 km to the north of the Marsh.

GROUNDWATER 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. Minimizing the ingress of highly saline water into fresh or brackish aquifers or into the mine pits is a prime concern and requires understanding the effects of dewatering pumping.

Previous hydrogeological analyses and regional scale numerical models predicted that the saline/ brackish interface would move towards the mining area under the proposed



Geology and salinity concentrations predicted from modelling

SUMMARY

CLIENT

Fortescue Metals Group (FMG)

CHALLENGE

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

SOLUTION

A high-spatial-resolution FEFLOW model that minimizes 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

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.

Stacker, reclaimer and conveyor system (Source: FMG). © FMG

GROUNDWATER MODELLING AS A BASIS FOR EFFICIENT MINE WATER MANAGEMENT

In order to optimize operations and understand the dynamics of the interface between the fresh, brackish and saline groundwater, FMG called on DHI to design a high spatial resolution salinity groundwater model (HSRSM) for the mining area. This would enable FMG to 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 re-injection.

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 alike and can cause significant frustration to project managers later in the project delivery cycle. As expected the HSRSM model resulted in increased run times but provided greater precision and accuracy in its predictions.

REALISTIC PREDICTION OF GROUNDWATER SALINITY IN HIGH RESOLUTION

The client had previously developed a density-driven groundwater flow and transport model. The clients model was used to predict mine dewatering volume and groundwater drawdown/mounding. 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 FMG models and gained an understanding of the challenges to be resolved.

DHI's detailed modelling enables FMG to quantify 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; and
- predict impacts of alternative hydrological or development scenarios to assist FMG in the decision making.

OPTIMISED MINE OPERATION FOR THE SAKE OF ECONOMY AND ENVIRONMENT

FMG was able to continue planning mine dewatering and reinjection operations while ensuring the environmental safety of this precious region. The HSRSM modelling confirmed that the FMG modelling approach was sound and additionally minimized the uncertainty. The work contributed to minimizing 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.

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