Technology Data Sheet

Mine Dewatering

Groundwater is a common problem when mining, and developing a mine below groundwater level presents many challenges. Poorly controlled groundwater will have negative impacts on the safety, efficiency and economics of mining operations.

If groundwater can be controlled by a planned programme of dewatering, the mine site will typically see several benefits, including;

- More efficient working conditions: better trafficking and diggability, reduced downtime due to pit flooding
- Reduced blasting costs: lowering groundwater levels in advance of working will provide dry blast holes, reducing the need for more costly emulsion explosives
- Lower haulage costs: Dry ore and waste rock weigh less than wet material, so dewatering of rock provides a haulage cost saving
- Improved slope stability and safety: lowering of groundwater levels and reduction in pore water pressures can allow steeper slope angles to be used, while maintaining or increasing factors of safety.

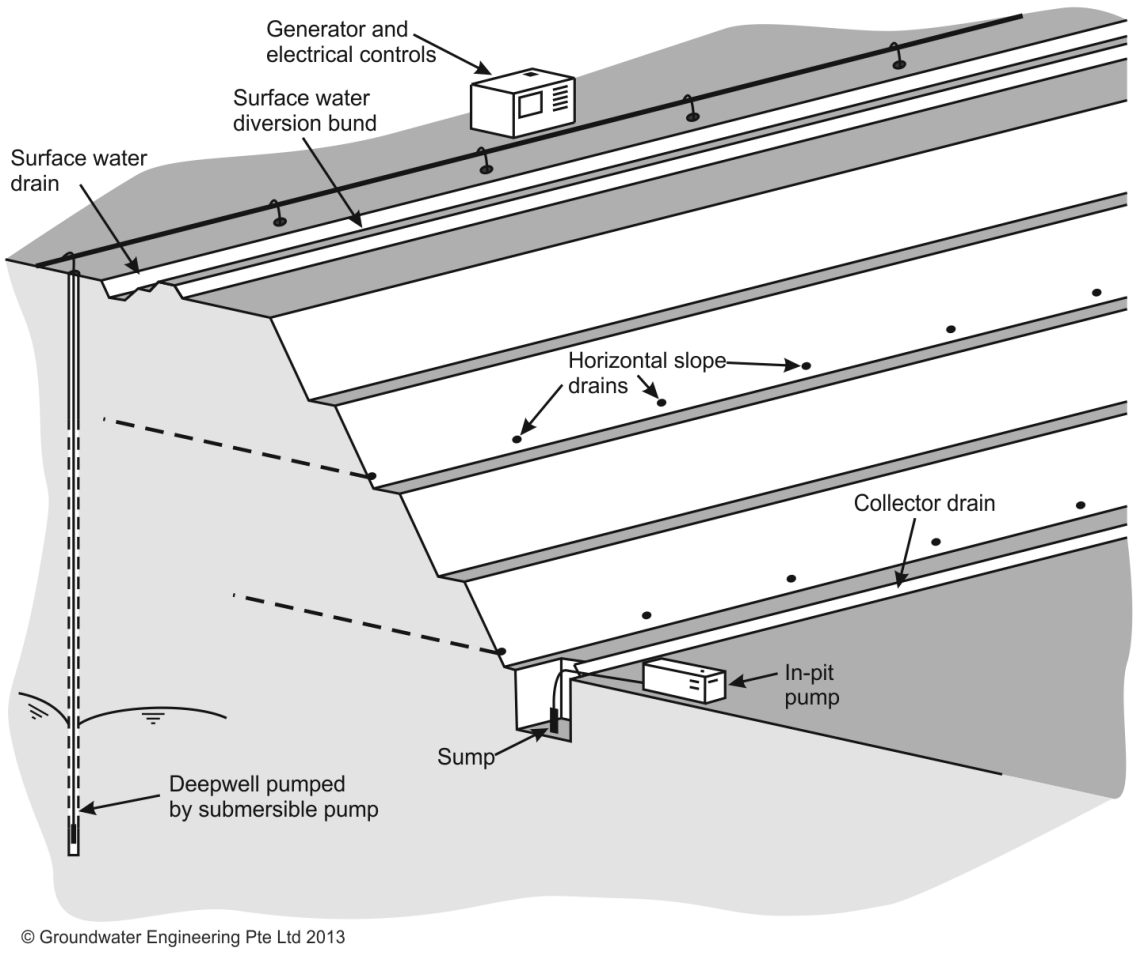
Successful dewatering requires a hydrogeological assessment of the mine site. This may be achieved through desk study, borehole investigations, pumping tests and numerical modelling. It is also essential that the most appropriate dewatering techniques are selected and used, because the choice of technique can have a huge influence on the effectiveness of the dewatering.

Mine dewatering can be achieved using a range of groundwater control techniques, depending on the geology and the type of mine:

- In-pit pumping – used to pump from sump areas within the pit
- Perimeter dewatering wells – used to intercept lateral groundwater flow into the pit and to lower groundwater levels in advance of mining
- Pit slope depressurisation drains – inclined or horizontal drains used to provide permeable pathways to allow trapped or slowly draining groundwater behind pit slopes to bleed off into the pit
- Cut-off walls – slurry walls used to exclude groundwater from shallow alluvial or drift deposits, or to seal off preferential flow along permeable strata
- Grouting and artificial ground freezing – used to seal off preferential groundwater pathways, or to reduce ground permeability in advance of shaft sinking or roadway development

Surface water must also be controlled to allow efficient mining operations. Runoff from the surrounding land surface must be diverted away from the mine, for example by using collector drains and diversion bunds. Within a mine any surface water must be controlled by the drains and sumps to collect the water away from working areas.

Want to find out more?
For Further details contact: enquiries@groundwaterinternational.com;



Examples of mine dewatering techniques at an open pit mine

Open Pit Dewatering Techniques

In-pit pumping

This is the simplest mine dewatering approach, with potentially the lowest capital costs. The method involves allowing groundwater to enter the pit, then directing it (via drains and ditches) to sumps, from where it is pumped away to the surface. The drawback with this approach is that water levels cannot easily be lowered in advance of mining, hence there will always be water and wet areas within the base of the pit, which can constrain the choices of mining methods and reduce operational efficiency. Furthermore, in-pit pumping will tend to produce 'dirty water', with significant suspended solids content, which may require treatment to remove sediment prior to discharge.

In-pit pumping is normally carried out by robust pumps capable of pumping dirty water. Pump sets may be of the electric submersible type or of the self-priming surface pump type. Mine dewatering pump sets typically have capacities in the range 20 to 200 l/s (72 to 720 m^3/h), with maximum delivery heads of 150 m. Higher flow rates can be achieved with multiple units in parallel. For deeper open pits, higher discharge heads are achieved by arranging pumps in series, with booster pumps located partway up the pit slopes.

Deep wells pumped by submersible pumps

This method involves drilling wells (most commonly using rotary drilling rigs), into which suitable perforated and unperforated well liner is installed, together with any necessary filter media. The wells are

then pumped by slimline borehole submersible pumps. There are two key advantages to this technique. Firstly, appropriately designed and constructed wells will normally produce 'clean water' with very little suspended solids, thereby reducing water treatment requirements. Secondly, an array of wells can be used as a 'pre-drainage' system to lower groundwater levels in advance of mining, and to maintain groundwater levels below the base of an open pit. This can allow mining to be carried out in very dry conditions, with corresponding improvements in efficiency for blasting, excavation and haulage. The downside of the use of deep wells is the relatively high capital cost associated with well installation.

Deep wells can be installed to depths in excess of 500m, with finished internal diameters typically in the range 150 to 450mm. Borehole pump capacities range from 1 l/s (3.6 m^3/h) to 100 l/s (360 m^3/h).

Slope depressurisation drains

In some hydrogeological settings, dewatering of the pit to provide dry mining conditions is not sufficient to ensure adequate geotechnical stability of the pit slopes. There may be geological features such as faults or bedding planes which prevent the slopes from draining into the dewatered pit, or it may simply be that the rock is of such low hydraulic conductivity that pore water pressure reductions are very slow. Drainage of pit slopes can be improved by drilling an array of sub-horizontal drains into the slopes to allow water pressures to reduce by bleeding off small quantities of water into the pit. Slope drains are normally drilled at diameters of 50 to 100mm using specialist horizontal drilling rigs. Drilled lengths to up to 300m are possible.

Specialist drainage methods

Less commonly, more specialist dewatering methods are used in open pit mines. The can include lines of wellpoints or eductor wells used to stabilise fine grained granular deposits (silts or sands) where they are exposed in the pit slopes, or drainage tunnels and adits driven near the open pit to promote drainage in fissured rocks of low hydraulic conductivity.

Groundwater Investigations

Groundwater investigations play a key role in the development of mine dewatering systems. Investigation options include:

Hydrogeological desk studies

Desk top studies and research into existing information such as geological maps, and information from neighbouring mines, can be a very cost effective way to identify groundwater problems at an early stage. Numerical groundwater modelling can be used to assess likely flow rates, distance of influence and the potential for adverse environmental impacts.

Installation of monitoring wells

Monitoring wells and specialist piezometers installed in advance of dewatering can provide valuable data on hydrogeological conditions, and can be used for permeability testing or groundwater quality sampling.

Pumping tests

Pumping tests are a reliable way of determining representative mass hydraulic conductivity of soils and rocks, and of providing other information on groundwater conditions. The tests involve pumping a well at a controlled rate, while monitoring flow rate and drawdown of groundwater levels. Pumping tests may involve between a few days to several weeks of continuous pumping.

Borehole permeability tests

A range of tests can be carried out in individual boreholes, including rising and falling head tests, constant head tests, Lugeon tests, Lefranc tests and packer tests. When carried out in accordance with relevant published standards and interpreted appropriately, such tests can provide some indication of hydraulic conductivity values and groundwater conditions.

COMPANY PROFILE

Groundwater Engineering is an international company specializing in dewatering, groundwater control and water well engineering for clients in the construction, mining and oil & gas industries. Backed by decades of industry experience and technical expertise we are committed to providing our clients with high quality and cost-effective solutions to their groundwater problems.

We pride ourselves on providing safe, technically sound and environmentally sensitive designs, and delivering them in the field, on time and on budget. Our teams combine geotechnical, hydrogeological, engineering and construction management skills, a strong supply chain, quality equipment and materials and skilled operatives to meet our client's needs.

Contracting

Groundwater Engineering provides a specialist contracting and construction service to design, install, commission, operate and maintain specialist groundwater, geotechnical and water supply systems, including:

- Construction dewatering and groundwater control
- Mine dewatering
- Water wells and water supply
- Geothermal systems

Consultancy

Groundwater Engineering offers a comprehensive design and consultancy service in the dewatering, groundwater control, water well, geothermal and groundwater remediation markets. We are able to provide robust, cost effective designs, and to innovate where it will benefit our clients.

Equipment sales and rental

Groundwater Engineering sells and rents a wide range of materials and equipment in the dewatering and water well fields:

- Dewatering pumps and equipment
- Pipework and pump controls
- Water well materials and pumps
- Well rehabilitation supplies

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