Red Creek
Water Solutions

Groundwater and Water Management Consultants

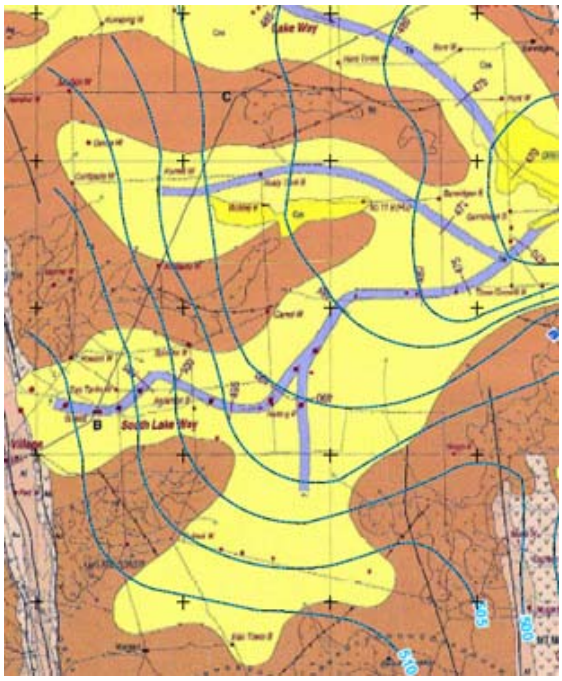
CAPABILITY STATEMENT

Groundwater Investigations

From concept to construction, Red Creek has the capabilities to carry out, direct or manage your groundwater investigations. Our capabilities include:

- Desktop studies
- Interpretation of geophysical surveys and borehole siting
- Provision of technical direction during drilling (drilling supervision)
- Plan and direct pumping tests
- Groundwater quality interpretation
- Conceptual model development
- Numerical groundwater development
- Report writing

Our staff has planned and carried out many groundwater investigations, sometimes in very challenging environments in remote locations.



The safety of everybody working on our groundwater investigation is of key importance to us. We take safety seriously and endeavour to identify all hazards prior to commencing work. We are also committed to supporting our clients with respect to their Health, Safety and Environment objectives.

We are fully trained in all aspects of project management and have the skills and tools to make sure your project is carried out on time and within budget

We can work in teams or we can pull a team together for you to carry out the necessary work.

We are well connected and know reliable contractors, suppliers and other professionals to work on your project.

We make sure there is clear communication throughout a project. We require field staff to submit a daily progress reports and to contact us *immediately* if there are any issues during a drilling programme.

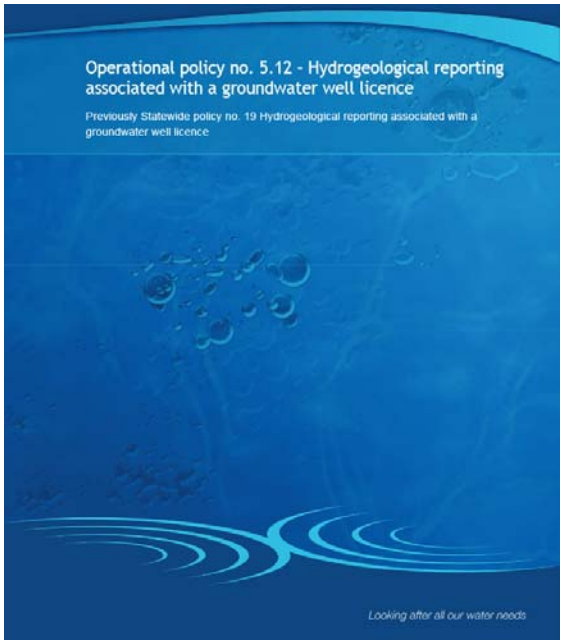
We make sure you are informed of all aspects of the groundwater investigation and will inform you immediately if there are any issues that might impact on the timely delivery or budget of your project.

T: +61 8 9291 3465
M: +61 422 241 191
E: jvermaak@redcreek.com.au

Regulatory Assistance

Red Creek are familiar with the regulatory requirements of Western Australia and can assist you with the following:

- H1, H2 and H3 level hydrogeological investigations
- Preparation of Annual Aquifer Reviews and Operating Strategies
- Preparation of Dewatering Management Plans
- Assistance with applications for licences to take water(5C licence)
- Assessing regulatory conditions that might be relevant at your site (e.g. proclaimed areas)
- Providing advice for direct discussions with regulators.



We can also assist you with environmental approvals related to water aspects such as:

- Minimising potential impacts on groundwater dependent ecosystems (e.g. wetlands)
- Minimising potential impacts on certain environmental receptors e.g. springs, rivers etc.
- Minimising potential impacts on groundwater dwelling fauna (stygofauna).

Have you received a "Request for further information"?

"Requests for further information" are normally issued either because of incomplete environmental submissions or because of an incident at your operations, e.g., an unintentional release to the environment. These questions often need to be addressed as part of reassessment of your site operating licence or other licences.

We can assist you with addressing these questions and to carry out any further investigations, where required. We can also assist you with the further steps, which could include:

- Targeted monitoring
- Risk assessment (the likelihood and consequence) of an event that may breach environmental conditions
- Mitigation and management options

Monitoring

Has your environmental budget been slashed again this year?

Ask us how we can assist you with optimising your monitoring network, potentially reducing the number of monitoring positions, frequency and optimising your water quality analysis.

Find out about setting site-specific trigger values for your site and reducing your reported "exceedences" in your annual aquifer reviews

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Groundwater Supply

Red Creek provide comprehensive groundwater supply services and our capabilities include:

- Desktop groundwater resource assessment
- Geological and geophysical interpretation
- Aquifer characterisation
- Groundwater supply well designs
- Planning and carrying out field programs for installing water supply wells
- Planning and directing pumping tests for assessing the well yield potential
- Assistance with regulatory approvals and licences
- Assessing potential impacts on third party users and the environment
- Due diligence assessment of existing water supply wells

Our strength lies in groundwater supply in arid and semi-arid environments. Our investigations go further than just locating groundwater, we also evaluate whether the well field would be sustainable and able to provide adequate yields in the long term. Our analysis and modelling includes aspects such as aquifer storage properties and recharge mechanisms.

Planning a groundwater supply well field in the Sahara Desert?

by Jan Vermaak

One of the highlights in my career was to be involved with a large groundwater supply study right in the middle of the Sahara Desert.

While working for Golder Associates, I was asked to carry out an assessment of an existing well field which is located relatively close to a much larger planned well field.

I spent four weeks at the offices of the existing mine at Zouérat, Mauritania, painstakingly going through all the pumping records, water levels records, borehole logs and pumping test data to come up with a realistic presentation of the groundwater setting and the relevant flow processes.

I then developed a groundwater model using Feflow software, calibrating the model to the pumping and water level data.

The main purpose of the model was to back-calculate the hydrogeological properties, in particular the specific yield, and to identify whether there are any hydraulic boundaries which might affect well yields in the long-term.

The results of this assessment provided further confidence and certainty that the planned well field will be able to supply adequate water over the life of the planned mining operation. The results also provided very important information for the planned well field design, in particular the optimum well spacing.

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Dewatering and Pit Slope Depressurisation

Red Creek provides solutions for below water table (BWT) mining and excavations. Our capabilities include:

- Assessment and preliminary estimation of groundwater inflow rates
- Planning and execution of field programs for characterisation and testing of dewatering wells
- Estimates of dewatering requirements using numerical models
- Developing a dewatering strategy suitable for site specific conditions
- Advise on the management of excess pumped groundwater.
- Conceptual and feasibility design dewatering systems
- Assistance with regulatory approvals and licences, including preparation of dewatering management plans
- Assessing potential impacts on third party users and the environment
- Review and advise on existing dewatering strategies and systems

Mine Dewatering

With the current focus on efficiency of mining operations, it might be worth your while to see whether the dewatering system at your operations are up to scratch.

Do you dewater from in-pit sumps or from in pit dewatering wells? Do you have problems with trafficability, wet blasting or maybe it is just a constant nightmare to manage the water infrastructure in the pit with the constant demands of production.

Let us have a look at your system and see whether there are any opportunities for improvement.

Civil Projects

Our people have extensive experience with dewatering projects in and around Perth City.

Not only can we assist you with your dewatering issues, but we can also assist with implementing depressurisation systems to avoid floor heave. Also, we can help you to maintain groundwater levels around the site using reinjection techniques.

Pit slope depressurisation

You engaged a geotechnical engineer or rock mechanics professional and they have advised you on the recommended pit slope angles. But did they consider the groundwater conditions?

Does the report state that they “assumed fully drained conditions” or they “assumed hydrostatic conditions”? This may not necessarily apply to your site

We work together with geotechnical engineers and rock mechanics professionals to make sure groundwater conditions have been adequately considered in their analysis.

We also carry out depressurisation investigations, working together with geotechnical engineers, which may improve stability of slopes at your site.

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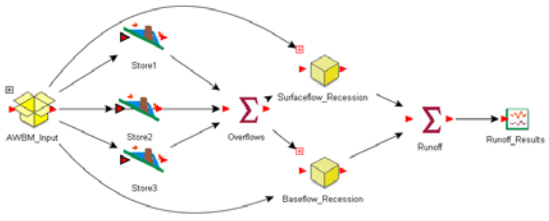
Red Creek can assist you with managing the water at your operations. Our capabilities include:

- Review of your site-wide water systems
- Conceptual designs of impacted and non-impacted water streams (process flow diagrams)
- Water accounting – identifying and balancing the inflows and outflows on the site
- Water balance studies of tailings storage facilities
- Assistance with the development of water management plans
- Development of site-wide water balance models
- Estimating the water make-up requirements (water deficit operations)
- Estimating water discharge requirements (water surplus operations)
- Evaluating options for discharging excess water from your operations
- Coupled flow and solute flow models to estimate water quality.
- Conceptual assessment of water treatment efficiencies in natural water bodies
- Water reliability and debottlenecking assessments
- Conceptual capital and operating cost estimates



Yes, things may look OK for now, but what happens if you are getting more water from your dewatering operations? Are you prepared for the possibility that you need to manage excess water on your site?

Comparing remedial measures for AMD affected surface water at a mine site.

Vermaak and Lindsay presented a case study at the 2006 “Water in Mining” conference in Brisbane.

The Stockton Coal Mine in New Zealand has been in operation for the past 100 years. Acidic seepage from the waste rock dump contributed to elevated acidity and metal concentrations into the surrounding water courses.

The model, using GoldSim software, simulates rainfall, runoff and stream discharge for 26 tributaries. It then calculates acidity and metal concentrations in all affected tributaries and the dilution downstream of the site. The model has been calibrated to measured flow and acidity and metal concentrations at monitoring sites.

Acidity and metal loads are removed from the system in accordance to with specified efficiencies and capacities of the respective conceptual remedial measures, or a combination of remedial measures.

The model predicts the acidity and metal concentrations at the monitoring sites for any remedial strategy selected by the user. It also calculates the capital and operational costs for that particular remedial strategy.

The client used the model to compare the efficiency and costs of various remedial strategies by running different ‘what if’ scenarios from the model interface.

Contact us to assess potential water disposal options for your site. We can assist with the approvals process of discharging excess water and can also assist with other options, such as water treatment and infiltration of water into the aquifer (managed aquifer recharge or MAR)

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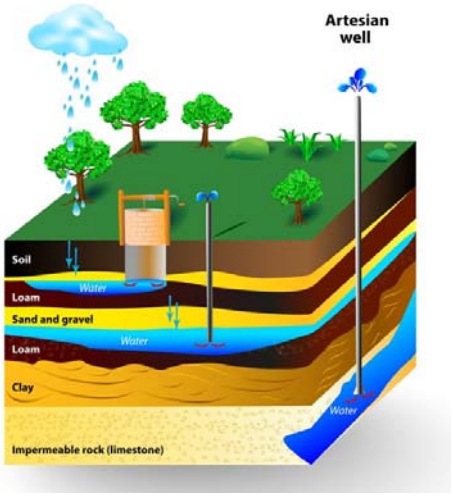
Numerical Modelling

Red Creek has the capabilities to develop numerical groundwater and process models for a variety of applications. Our capabilities include:

- Collation and interpretation of geological and groundwater data
- Model conceptualisation, which is the realistic presentation of groundwater systems
- Artistic renderings of groundwater settings for presentation and communication purposes
- Development of process flow diagrams for surface water applications
- Development of numerical groundwater models to accurately represent groundwater flow processes in accordance with the national modelling guidelines
- Proficient with the main modelling packages including FEFLOW, MODFLOW, GoldSim, Seep/W and SVFlux.
- Calibration of groundwater models to monitoring hydraulic head and flow data
- Development of sensitivity and uncertainty analysis
- Prediction modelling to represent how your activities would change the groundwater conditions at the site



Having developed many models and reviewed many more, there is no doubt that models seldom hit the mark where it counts. We have seen many complicated "calibrated" models being dead wrong – there are many ways to calibrate a model.

Our approach is to keep models simple and to use our experience to focus on the aspects of the model that matter. Our emphasis is to make sure the model represent the important groundwater processes correctly. We make sure you understand how reliable the model is, the uncertainties of the model input parameters, the impact of these uncertainties on model predictions and the implications if the predictions are different than expected.

DHI GoldSim

GEO-SLOPE INTERNATIONAL

SOILVISION SYSTEMS LTD.

Unsaturated flow modelling and atmospheric coupling.

Red Creek specialises in unsaturated flow modelling, including soil-atmospheric coupled models. These models are mainly used to assess the performance of soil cover systems to minimise rainfall infiltration into waste facilities or to minimise oxygen ingress into acid forming material.

These models are also used for tailings applications, to model the phreatic surface in tailings storage embankments which is an important design consideration.

The models are also very important in pit slope stability assessment, especially where the pit slope comprises non free draining material.

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Red Creek can assist you with your large projects, working in your team addressing water related aspects of your investigation.

Feasibility Studies

Red Creek can assist you with the following aspects, which are typically required for feasibility studies for mining projects:

- Feasibility level design of dewatering systems including estimates of dewatering rates, development of dewatering strategy and capital and operational cost estimates.
- Feasibility level design of groundwater supplies including fieldwork studies and design of wellfields and pipelines.
- Water management including design of impacted and non-impacted water streams, estimates of water return from tailings storage facilities and estimates of make-up water or water discharge requirements.

Environmental Studies

Red Creek can assist you with environmental impact assessments and similar studies:

- Estimating groundwater drawdown around mining developments and potential impacts on groundwater dependent ecosystems.
- Assessing the potential for groundwater mounding (rising) around tailings storage facilities and mine wastes and impacts on vegetation.
- Assessing the potential groundwater quality impacts resulting from the mining development.
- Assessing potential mining impacts on stygofauna and troglofauna habitats

Acid Mine Drainage

Working together with geochemists, environmental scientists and water treatment specialists, we can assist with the following:

- Management of acid mine drainage and impacted water for operational mines
- Estimating acid and contaminant loads from waste rock dumps, tailings storage facilities and heap leach facilities
- Assessing the potential impacts of acid mine drainage on groundwater (shallow and deep systems) and surface water
- Evaluation of options for minimising and preventing acid mine drainage impacts
- Water treatment options for AMD affected water.

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Mine Waste Facilities

Working together with tailings practitioners, geotechnical engineers and others, we can assist with the following:

- Tailings water balances and estimating the water return rates
- Estimating the phreatic surface in tailings embankments and evaluation of design options for controlling high phreatic surfaces.
- Evaluation of tailings design options for minimising seepage from these facilities
- Evaluation of seepage control and management measures
- Assessment of shallow and deep seepage from mine waste rock facilities and stockpiles

Mine Closure

Red Creek can work together with other professionals to assist you with the planning, design and implementation of closure measures. Our capabilities include:

- Closure of open pits, including assessment of the formation of pit lakes, filling rates and equilibrium pit lake water levels.
- Estimating the long-term water quality of pit lakes, considering aspects such as evapo-concentration
- Assessing options for the closure of tailings storage facilities, waste rock facilities and heap leach facilities.
- Assessing the performance of cover systems to minimise infiltration or limit oxygen ingress into acid forming mine wastes

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