Australasian Groundwater & Environmental Consultants

Groundwater Modelling

Understanding and predicting groundwater flow

Groundwater models are powerful tools that simulate groundwater flow processes and help predict aquifer conditions. Conceptual, analytical and numerical models can be built to form solid foundations for your investigations, help you uncover answers and determine how groundwater will behave within the complex environment of your project.

Our clients come to us for groundwater modelling when they need to respond to a regulator, secure an environmental approval, identify and quantify environmental impacts or determine requirements for mine and infrastructure planning.

About us

We're Australia's groundwater specialists, providing groundwater and environmental advisory across Australasia for more than 25 years. We have a depth of experience and technical excellence borne out of more than 2,500 projects across major industries, agriculture, government and communities in Australasia and beyond.

We specialise in end-to-end groundwater services, from field work and modelling to analysis and reports, to expert advisory and peer review.That means we understand the commercial, environmental, government and community challenges you face when you need to determine how groundwater might be impacting your operation or how your operation might be impacting the groundwater system in which you're working.

Our expertise

Our AGE modelling team is the largest consulting modelling team in the country.

Developing useful numerical models requires a range of skills including an understanding of computer code, geology, geographic information systems, databases, statistics and mathematics. With a highly trained team of over ten hydrogeologists and engineers with these unique skills, we have the capacity to construct numerical models to assist with groundwater management challenges across a wide range of clients. Each member of our team brings their own specialities such as uncertainty analysis, calibration techniques and solute transport modelling.

We deliver a bespoke service to our clients and pride ourselves on providing useful models that are based on solid foundations. Our models help you uncover groundwater complexities, provide a deeper understanding and ultimately, progress your project.

Flexible approach

We're flexible in our techniques and the way we approach model assimilation, calibration and uncertainty analysis. We're adept at delivering outside of the usual graphical user interfaces (GUIs) which allows us to respond better to what you need and what the regulator is looking for. As things change along the way, you can be assured that we can easily adapt our modelling to meet your evolving project needs. It also means for complex projects such as a mine closure, we can look at a number of different options through scenario testing.

Software skills to unlock uncertainty analysis

We specialise in working with the MODFLOW family (industry standard modelling code), PEST software packages and advanced scripting. Our team is highly skilled in assimilating data. With a depth of understanding of the calibration process, we know how to get the most out of the data. We implement best practice and our approach allows us to assimilate a lot of complexity.

We excel at uncertainty analysis. We have our own proven methods required for state and federal government approvals. Our quality of outputs and very thorough approach has delivered prompt approvals for clients, first time around.

We know how important transparency is in what can sometimes be considered 'black magic'. We adhere to Australian guidelines in our processes and ensure to keep you in the loop of any developments along the way that might impact on your project.

Our services

We adapt how we design and construct your model depending on your needs and budget. We can deliver comprehensive and highly bespoke groundwater models or groundwater models that are simpler and lightweight. With the ability to make your models useful and helpful regardless of the complexity, we ensure they are designed optimally to identify impacts specific to your environment.

- Highly customised groundwater modelling that provides comprehensive and useful insights to help you navigate green tape and keep your wide range of stakeholders and regulators satisfied.
- Simpler and quicker lightweight groundwater models in the face of less complexity, less risk and less regulatory pressure, where we maximise value in your data to meet your needs.

Crucially, our models are not necessarily one-off creations. They can be effectively used in the future to help you make other decisions and evolve with projects to maintain compliance.

Our flexible, groundwater modelling services include:

Conceptual hydrogeological modelling

The key to developing a robust numerical groundwater model is a good conceptual model. This forms the foundations that describe how the groundwater system works and identifies the key components needed to replicate the natural system. A conceptual model is based on available data and is an idealised and simplified representation of the natural system. In some cases, we use software to create three-dimensional visual models of the groundwater system to assist with communicating our findings to a range of stakeholders.

Analytical groundwater flow modelling

A complex model does not necessarily provide better results or predictions than a simple model. We often first develop simple analytical models to represent groundwater flow processes and assess the impacts of major projects on water resources.
Analytical models can be developed relatively quickly and inexpensively and can be used to assess groundwater issues at a high level. If risks and uncertainty are low then it may not be necessary to develop more complex numerical models.

We understand your problems, we work with you to propose options that address your challenges and we formulate a modelling solution that informs key decisions and fits with your legislative requirements.

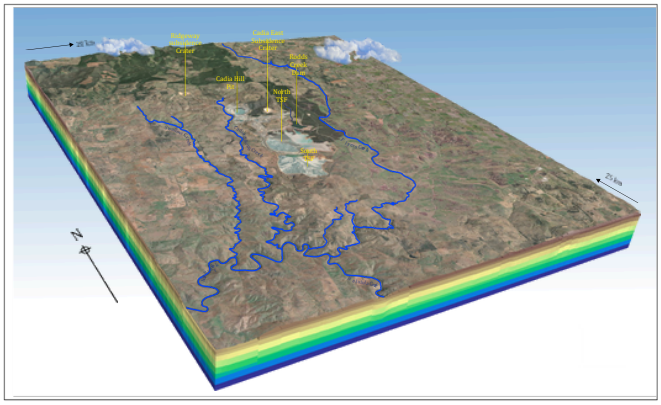
Numerical groundwater modelling

The key to developing numerical models is to ensure they replicate key underground processes as closely as possible.
Numerical models have many parameters that represent the groundwater system, and finding the optimal combination of these parameters can be a challenge. Our team regularly develop numerical models that represent groundwater flow processes in either one, two, or three dimensions. We use two-dimensional models to assess seepage through artificial embankments, tailings dams and water impoundments. Complex groundwater systems often require sophisticated methods to analyse potential impacts, for which we develop three-dimensional models.

Numerical groundwater modelling

With a significant track record of successful projects over more than 25 years, we're frequently called upon to conduct peer review and gap analysis of conceptual and numerical groundwater models and reports for other consultants. Independent and impartial, we follow Australian groundwater modelling guidelines and best practice, with a keen focus on high quality and attention to detail.

As early adopters of modelling techniques, we often work in partnership with leading academics in our field, working at the frontier of technology. Combined with our collaborative team of specialist modellers, we bring this expertise to our review of peer-developed numerical groundwater models.



Our experience

We have a significant track record and reputation with regulators across the country over more than two decades. Our strong team of modellers and supporting staff are very familiar with the challenges in green tape and regulatory requirements, as well as with the potential impact of groundwater in construction projects.
We've provided advice using groundwater models that have assisted stakeholder decision-making, such as regulatory approvals, across a wide range sectors, including:

- Mining and Quarrying.
- Oil and Gas.
- Infrastructure - buildings and roads.
- Tunnels.
- Government and Defence.
- Agriculture.

Our projects

Here's an example of just some of the projects we've assisted our mining, coal seam gas, and infrastructure clients with:

Shenhua Watermark Coal Project

Breeza, New South Wales

Regional groundwater model to assess impacts of mining in ridgelines on adjacent alluvial systems of the Liverpool flood plains. Model structure and initial parameters leveraged existing regional models of the alluvial system, producing a well calibrated simulation of the gradually declining alluvial groundwater levels in the Gunnedah Formation from landholder pumping. Robust, industry-leading calibration constrained Monte Carlo uncertainty analysis assessed potential groundwater drawdown, flow changes and inflow to the mine, setting a precedent for future uncertainty assessments, preceding and exceeding IESC uncertainty guidelines.

Newcrest Cadia Valley Gold and Copper Operations

Orange, New South Wales

Groundwater impact assessment for Cadia East EIS, including numerous project modification groundwater assessments for approvals, conceptual and numerical modelling, and field investigation activities. Numerical modelling simulated impacts of mining across the Cadia Valley Operations site, most recently using sub-layering to better represent the caving and fracture extent developing with time.

Senegal Sand Mining Dredge Modelling

Diogo, Senegal Coast

Developed modelling in conjunction with PSM combined MODFLOW and Matlab within a FORTRAN shell to simulate dredge pond water requirements (given mounding within groundwater) as it progressed along its path. The model helped design and test containment bores to protect market gardens from mounding groundwater levels in the elevated dunes, and simulated the return of intercepted water back to the dredge pond.

QGC Shallow Groundwater Modelling Project

Surat Basin, Queensland

Fully integrated groundwater/surface water model using MODFLOW-USG and SWAT+ to assess impacts of CSG depressurisation on a shallow aquifer system. The CSG reservoir was simulated using groundwater pressures from OGIA model through use of a time varying general head boundary package. The surface water system was coupled by automatically routing recharge, evapotranspiration and runoff outputs from the SWAT+ model into the RCH, EVT, and SFR packages respectively. Both the groundwater flow model and SWAT+ model were history matched to groundwater levels and baseflow curves and assessed through null-space Monte Carlo (NSMC) uncertainty analysis.

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Bowen Regional Groundwater Environmental Assessment

Bowen Basin, Queensland

Regional groundwater model in MODFLOW-USG to assess impacts from basin wide CSG dewatering. Mesh was refined around existing CSG wells to history match observed depressurisation at pilot wells and early-stage development. Revised field development plans were simulated via the WEL package and inflows were compared to reservoir modelling predictions. Undertook NSMC uncertainty analysis to assess impacts on groundwater water dependent ecosystems and surrounding groundwater users.

Toowoomba Bypass Tunnel

Toowoomba, Queensland

Hydrogeological input provided for the Toowoomba Warrego Highway Bypass Tunnel pilot tunnel design, including development of conceptual hydrogeological regime, analytical prediction of potential pilot tunnel inflows, numerical modelling of impacts of construction and development of groundwater monitoring program to assess impacts during construction.

Eastlink Tunnel Project

Melbourne, Victoria

Detailed review of existing geotechnical and groundwater related data to develop conceptual model and enable development of analytical and numerical groundwater models to assess impacts during and post construction. Numerical modelling included novel methods of addressing longitudinal transference of hydrostatic pressure which may result in saline groundwater discharges and increased hydrostatic loading on the tunnel liner. Both models were updated throughout tunnel construction as additional data was obtained.

Sydney Cross City Tunnel

New South Wales

Full review of groundwater conditions including impact of existing infrastructure (deep basement and existing tunnels) to develop a conceptual model that was used as a basis for two numerical groundwater models covering Cross City Tunnel alignment; Woolloomooloo Bay and Cockle Bay. Each model helped assess long-term groundwater inflow rates, as well as the level and rate of water level drawdown in overlying rock mass and unconsolidated, saturated sediments. This data then supported assessment of potential settlement and associated impact on existing infrastructure.

Our team

Andrew Durick

Director | Senior Principal Groundwater Modelling

Andrew has over 25 years' experience in groundwater modelling with intimate working knowledge of MODFLOW (industry standard modelling code) and significant experience in both the public and private sectors. He specialises in conceptualisation and modelling of complex groundwater systems, implementation of complex mine plans and third party review of models.

Keith Phillipson

Senior Principal Hydrogeologist

Keith specialises in the use of groundwater models to assess and manage the impacts of a broad range of developments on groundwater and surface water resources, with more than 25 years' experience working in jurisdictions including Queensland, New South Wales, Victoria and Europe. In particular, Keith has undertaken, overseen and peer reviewed a wide variety of modelling studies focused on assessing the cumulative impacts of large-scale water supply, coal mining and coal seam gas developments.

Dr Tariq Laattoe

Principal Hydrogeologist

Tariq has 14 years of combined industry and academic experience as a hydrogeologist specializing in groundwater modelling. His project experience is diverse comprising GDE impact assessments; resource characterization; dewatering/ injection optimisation; capture zone delineation; managed aquifer recharge operation; and seawater intrusion threat analysis across mining and agriculture sectors. Tariq has a keen interest in application of novel modelling, calibration and uncertainty analysis techniques, which promotes innovative approaches to solving a broad range of groundwater problems.

Dr Daan Herckenrath

Technical Modelling Lead | Principal Groundwater Modeller

Daan has over 15 years' experience in numerical groundwater flow modelling, uncertainty analysis and geophysics. He has extensive experience in groundwater impact modelling for coal seam gas and coal mine impact assessments, as well as presenting and communicating complex technical work to broad audiences. Daan is highly experienced with industry standard software and the application and development of cutting-edge approaches to numerical groundwater modelling and uncertainty analysis.

We empower informed water decisions that help our clients, communities and environment thrive.

If you're looking for an expert modelling partner to bring clarity to the uncertainty, get in touch with us.

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