EARTH SYSTEMS
Environment · Water · Sustainability

# Preventing Pollution from Decommissioned Underground Mines

**Earth Systems has been a global industry leader in acid and metalliferous drainage/acid rock drainage (AMD/ARD) management for more than 20 years. We have developed an innovative and cost-effective alternative to 'water treatment in perpetuity' for dealing with AMD management at decommissioned underground mines.**

There are more than 100,000 abandoned underground mines worldwide. Many of these discharge drainage contaminated by acid, heavy metals and salinity. The poor quality drainage is a result of the exposure of sulfidic minerals (such as pyrite) within the mine to atmospheric oxygen. If not managed, pollution can continue for centuries. Solutions for the management of these legacy mines include hydraulic seals which flood the workings and prevent oxygen access to the reactive sulfides, or treatment of the discharge water via costly and ongoing chemical addition. Hydraulic bulkhead seals are difficult to engineer, can be expensive, and have some history of catastrophic failure due to the corrosive nature of the drainage and high working pressures. When water treatment is chosen, it is often considered necessary in perpetuity.

Earth Systems has developed an innovative alternative to water treatment in perpetuity that involves controlling the mine void atmosphere. In the absence of oxygen, the sulfide minerals can no longer react to produce sulfuric acid. In some scenarios, mine void oxygen concentrations can be lowered by sealing mine access points to air, while still allowing water discharge. In these situations, natural sulfide oxidation within the void automatically lowers internal oxygen concentrations, thereby lowering pollution generation rates. At sites where mine access seals are only partially effective, active injection of inert gases (nitrogen or carbon dioxide) into the mine voids may be required to further lower mine void oxygen concentrations.

## Staged Implementation

Inert atmosphere systems in underground mines are designed and implemented in a multi-stage process. Not all stages are necessary to achieve substantial pollution reduction. Solutions are site specific but can involve the following stages:

*Stage 1*: **Feasibility assessment**
- Water quality assessment
- Site investigation and risk assessment
- Down-shaft camera surveys to identify interconnection
- Geophysical investigations to locate underground workings;
- Predictive modelling of inert atmosphere performance
- Cost-benefit analysis

*Stage 2*: **Mine seal engineering design and construction**

*Stage 3*: **Mine seal evaluation and performance assessment**
- Internal atmosphere and discharge monitoring

*Stage 4*: **Assessment of the need for an inert atmosphere**

*Stage 5*: **Design, supply and installation of an inert gas generation system**

*Stage 6*: **Ongoing monitoring and data assessment**

## RELEVANT EXPERIENCE

- Co-authors of the Leading Practice Handbook, *Preventing AMD*, for the Australian Federal Government (in press 2016).
- First demonstration of a controlled atmosphere installation was implemented at a derelict underground mine in Tasmania, Australia with Australian Federal Government funding and supported by federal government researchers at ANSTO (Australian Nuclear Science and Technology Organisation). The mine workings were successfully sealed and acidity loads were temporarily lowered with a reducing atmosphere until budget limitations halted the project (see Taylor and Waring, 2001*).
- Stage 1 and 2 assessments were completed for a mine sealing and inert atmosphere system for a recently decommissioned gold mine site in Papua New Guinea. The system proposed to use carbon dioxide gas from local biomass processing. Mine seals were designed for rapid removal to permit easy reopening of the mine. The mine has reopened since completion of this work and at present continues to operate.
- Stage 1 and 2 assessment for a mine sealing and inert atmosphere system at the 100+ years old derelict Sunny Corner Mine Site in New South Wales, Australia. This staged mine sealing program is currently awaiting State Government funding to proceed with full-scale installation.

*Taylor, J., Waring, C., 2001. The passive prevention of ARD in underground mines by displacement of air with a reducing gas mixture: GaRDS. *Mine Water and the Environment* 20, 2–7.







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