



▶ MINE CLOSURE



# MINE CLOSURE AND RECLAMATION OVERVIEW

Adequate mine closure is an important part of the mine life cycle. Orphaned or abandoned mines pose environmental, health, safety, and economic problems to communities, the mining industry, and governments. Since 1960 Golder Associates has been helping the global mining industry with sound decision-making, cost-efficient planning, and sustainable reclamation of mines reaching the end of their useful life and abandoned mine sites, having completed hundreds of geotechnical and environmental mine projects in countries all over the world—our team has the skills and industry experience to see the big picture and find the right solution.

Today our work is balanced between proactive environmental management and reclamation planning for new and active mines, as well as closure design and implementation for inactive and abandoned mines. We understand mine development, mine operations, environmental operations, ecology, toxicology, geochemistry, hydrology, acid rock drainage, water treatment, and revegetation.

Golder has particular expertise related to our understanding of the key components of mine closure. Perhaps most importantly, from a financial standpoint, Golder has extensive construction and engineering experience and applies that capability to environmental management.

We have been retained by clients to respond to catastrophic mine facility failures resulting in environmental, social, public relations and fiscal impacts. Our size, focus on mining, and specific knowledge in the above disciplines has enabled us to be effective in these complex situations.

## GOLDER'S APPROACH TO PLANNED MINE CLOSURE

Golder has experience developing closure plans through every step of mine planning and the life of mine. This includes identifying and incorporating closure concepts into the prefeasibility and feasibility stages, developing closure plans to address environmental impacts for Environmental Impact Assessments, developing and refining closure plans during the mine life, developing detailed closure plans and construction drawings, and providing construction supervision and post-closure monitoring.

This experience in every step of the closure planning provides a well-rounded basis for engineering solutions to closure problems. Golder takes a risk-based approach to closure and reclamation planning, working closely with stakeholders to develop and implement closure and reclamation plans that aim to manage liability and optimise closure costs. Recognised internationally in the fields of



reclamation and closure planning and design for closure, our staff is experienced in developing strategies that minimise risks and costs associated with closure.

## GOLDER'S APPROACH TO CLOSURE AND RECLAMATION OF HISTORIC MINE SITES

Our approach to reclamation and closure planning for abandoned mine sites is based upon current technologies to achieve physical and chemical stability. Our professionals, staff with environmental engineering, biotechnology, ecological, and agronomic expertise, work together to determine the remediation criteria necessary to restore the site to agreed to end land uses which are consistent with surrounding land uses or to acceptable alternative uses.

## MINE CLOSURE ISSUES

- Stability and physical hazards
- Water quality and water management
- Extreme storm event management
- Long-term maintenance
- Financial Provision
- Change in socio-economics
- Regulatory changes
- Defer/reduce liability



**COPPER MINE CLOSURE IN NORTHERN CHILE** – Golder has prepared closure plans for various mines in northern Chile, including the pictured copper and molybdenum mine at 4,000 metres above sea level in the Andean Altiplano. This mine produces 450,000 tonnes of copper concentrate and 70,000 tonnes of copper cathodes annually. The social impacts of closure, as well as the cost of closure, were considered.

Golder recognises that development of a successful project requires a coordinated response to many complex issues. These issues often need more than simply a good technical solution; they demand a broad understanding of the project and its social, environmental, and economic parameters. Through our network of offices, we are able to efficiently deliver services to clients worldwide. Each office has local staff so that we can better understand and respond to local needs. These individuals are backed by a global team of specialists.



#### MINE CLOSURE & RECLAMATION SERVICES INCLUDE

- Baseline geology, climate, flora, fauna, soils, surface water, and hydrogeology characterization
- Risk Assessment
- Surface and geophysical surveys
- Waste characterization
- Hydrogeochemical evaluations
- Acid rock drainage assessment
- Stochastic and regional analyses of hydrologic data
- Groundwater modelling for dewatering and contaminant transport
- Closure alternatives analysis
- Cover Design
- Process solution disposal analysis
- Land sculpting
- Erosion and sediment control
- Revegetation
- Cost estimation

#### CLOSURE MANAGEMENT FRAMEWORK

- Define corporate and regulatory objectives
- Identify closure issues

- Identify and evaluate closure alternatives
- Perform decision analysis and select alternative
- Design and permit closure plan
- Implementation
- Long-term property management

#### CLOSURE PLANNING AND MANAGEMENT ISSUES

- Regulatory changes
- Corporate pendulum for closure
- Proactively eliminate liabilities
- Defer closure and manage liability
- Closure planning and implementation should be driven by liability reduction
- Mining companies generally in reactive mode

#### MANAGING FACILITY CLOSURE

- Define site conditions
- Review alternatives and evaluate trade-offs
- Develop plan and comprehensive cost estimate
- Update cost estimate annually
- Define responsibilities, track progress and milestones

Throughout our 50 years working in the mining industry we have had the opportunity to work on projects at every stage of the mine life cycle.



Golder Associates has an exceptional track record in achieving high mine reclamation and closure standards, with several award winning projects for Abandoned Mine Reclamation in Canada and the US.

MAKE YOUR BUSINESS DECISIONS ON A SOLID FOUNDATION.  
CHOOSE A COMPANY WITH THE TECHNICAL EXPERIENCE AND COMMITMENT  
TO SERVICE EXCELLENCE AND SUSTAINABILITY THAT YOU NEED TO BE SUCCESSFUL.

## JUST ASK GOLDER



**ENGINEERING EARTH'S DEVELOPMENT, PRESERVING EARTH'S INTEGRITY.**

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