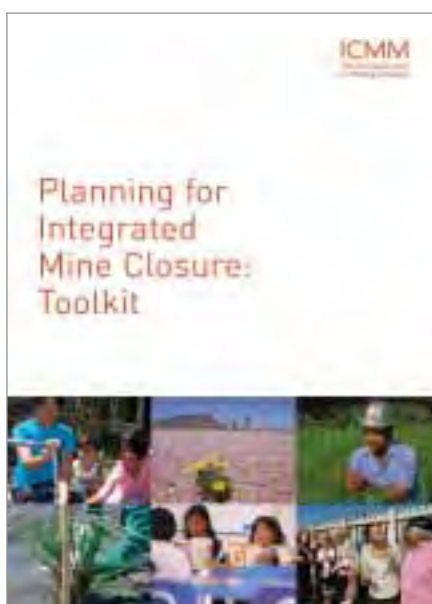


# Planning for the future

In most countries today, new mines have to have an approved closure plan before they can even start development. There are many areas to be considered and among the most important are the tailings, because their management needs may well continue after closure, and water emissions

In the introduction to ICMM's *Planning for Integrated Mine Closure: Toolkit*, the authors describe planning for closure as being "about how to design a mine operation in order to facilitate closure. When a project is designed, there is a lot of scope to do so with closure in mind. For example, considering the need to re-vegetate a tailings facility when deciding its position, or designing mine infrastructure in relation to the community's requirements. There are often instances where simple changes up front can have profound implications for eventual site closure."

Waters escaping from closed mines can easily be the most detrimental impact on the environment, particularly acid mine drainage (AMD). N.A. Water Systems, a Veolia Water Solutions & Technologies (VWS) company, has recently been awarded a patent for its AMDRO™ technology, a reverse osmosis (RO) process for treatment of acidic wastewater.



VWS says "the process significantly reduces the cost for water treatment chemicals and sludge disposal as compared to the conventional approach. The technology has low capital cost, and incorporates effective scaling control to minimise the cleaning frequency for the RO membranes.

"The patented process includes VWS' proprietary ACTIFLO® clarification technology and media filtration for pretreatment, followed by a double-pass RO and ion exchange polishing to produce a treated water stream suitable for discharge and re-use. The key to the technology is the operation of the pretreatment and the first-pass reverse osmosis process under acidic conditions to inhibit the precipitation of scale-forming compounds."

Alexco Resource is an unusual company in that it operates an exploration/mining business and an environmental remediation business. Alexco Resource U.S. (a wholly owned subsidiary of Alexco) has just been awarded a mine-water solids transfer and treatment contract at the Platoro underground gold mine located at 3,050 m elevation in the San Juan mountains of southern Colorado. The value of the contract is estimated at more than C\$1.1 million.

Alexco technology has been used to pre-treat water within the underground mine pool at Platoro since September 2000, and the

treatment results have been very impressive, the company reports, resulting in overall reduction of dissolved concentrations of arsenic and zinc of more than 90% using Alexco's patented technology for in-place immobilisation of heavy metals. The treatment has been implemented on a once-yearly basis with about two days of implementation time required. The reduction of heavy metal concentrations has enabled significant reduction in the volume of treatment residue subsequently generated in the lime-based water treatment plant, which is operated to provide hydraulic control on the mine pool water levels.

Based on the success of Alexco's technology in the underground mine pool, the current contract was awarded to treat and transfer the mine-water treatment residues that have been generated from the water treatment plant since 1985, when water treatment operations began, and to place these solids back into the underground workings. The slurry re-injection of the water treatment solids back into the mine pool will be beneficial to the continued pre-treatment of the mine pool, significantly reducing the required land footprint of the solid storage ponds, and is expected to reduce the overall closure liability. Another benefit to the local community will be the beneficial re-use of a byproduct of the potato processing industry as a part of Alexco's treatment process.

Alexco's technology converts the chemical form of the solids from metal hydroxides to metal sulphides, after treatment and placement into the mine pool. Metal sulphide formation when managed appropriately as described in Alexco's patents can result in soluble metal concentrations which are orders-of-magnitude lower than metal hydroxides over a wide range of pH conditions. Alexco is confident that the technology of mine pool treatment and sludge re-use that is now demonstrated effectively at Platoro will also be effective if adopted globally at numerous other mine sites with ongoing lime-based water treatment systems. "The industry and regulatory recognition resulting from the use of our patented remediation technologies at Platoro is an important step forward for strategic development of the company's environmental services business. We

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see significant potential in this technology application throughout the mining industry," says Clynt Nauman, President and CEO of Alexco.

Alexco Environmental Services offers patented technologies for environmental remediation. It undertakes mine site environmental management, reclamation, closure and is an industry leader in pit lake and underground mine pool treatment.

### Tailings management

Getting tailings deposition right first time can save a great deal of remediation time and expense at the closing of a mine. With tailings

thickeners, water re-use can be improved by optimising and automating flocculent dosing.

*The Vermejo Park Ranch project is to protect and enhance the natural environment at abandoned mine sites, while reducing erosion and sedimentation in Dillon Canyon Creek*

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Hawk Measurement Systems reports on a customer that wanted to optimise its tailings thickener on site. It wanted to improve the quality of the 'clarified water' flowing over the launders and optimise the 'bed' density.

Hawk Measurement's ORCA Sonar bed level transmitter can be used to monitor the process settling conditions in the thickener (compacted bed level, hindered interface layer and clarity of water/liquor etc, in the upper liquid zone). It can provide valuable feedback for controlling flocculent dosing, coagulant dosing and also provide some feedback control of the underflow pump.

Settling efficiency changes in tailings thickeners when different orebodies in the mine are being processed simultaneously. The different orebodies will produce different settling characteristics, so one flocculent dose rate for one ore type will not necessarily work for another orebody. To control the flocculent automatically based on settling characteristics, requires the sonar transmitter to monitor two independent interface densities; the bed level (heavy density compacted interface) and the mud layer (lighter density affected by settling changes).

When the mud layer interface rises away from the heavier bed level interface, Hawk Measurement gives information so that the flocculent dose can be increased. As the mud layer interface descends back to the heavier bed level the flocculent dose rate is decreased.

Hawk Measurement says "this is the only way to optimise the settling efficiency in a tailings thickener or paste thickener, to compensate for different orebodies. To optimise the bed density we must use the minimum flocculent as possible."

### Reclaiming the land

At Intermat this year, one of the world's largest trade shows for the construction industry,



## EFFECTIVE MINE CLOSURE

Carlson Software's Natural Regrade land reclamation software won a Silver Award. Carlson Natural Regrade was recognised as a laureate in the Services category. The winning products must be innovative and represent a significant advance in technical design and the technology used, or offer gains in terms of cost savings, operation, use or sustainable development.

Carlson Natural Regrade is particularly suited to dealing with closed mines, giving all faced with disturbed lands an affordable and natural way to achieve sustainability when doing reclamation. The software features the GeoFluv™ approach to stable landform design, using fluvial geomorphic principles – essentially designing the land to be as it would have naturally formed on that site over thousands of years. The US Department of the Interior's Office of Surface Mining, Reclamation and Enforcement (OSM) acclaimed Natural Regrade a "Technical Innovation and Professional Services (TIPS) Core Software" for mine reclamation design and review use in 2007.

Carlson Natural Regrade helps return the natural beauty of the reclaimed land while stability against erosion is established and the water quality remains comparable or better than surrounding undisturbed lands.

"You can do it right the first time with Natural Regrade," says Nicholas Bugosh, developer of the software and Natural Regrade Sales Director for Carlson Software. "Using Natural Regrade provides true sustainability – land that thrives despite the strong and often uncontrollable forces of nature."

In her new book *101 Things to do with a Hole in the Ground*, Georgina Pearman shows how many innovative projects have been built in disused mines – including a football stadium, film set, mushroom farm, sauna, wine cellar and airport – demonstrating that the impacts of mining can be converted to benefit surrounding communities.



The book is an engaging introduction to the incredible range of activities that transform old mines into new futures. Colour illustrations and brief descriptions take the reader on a world tour of heritage and tourism attractions, wildlife habitats, educational, sport and leisure facilities and dozens of industrial uses – demonstrating that the impacts of mining can be converted from liability to opportunity and benefit local communities.

Pearman works on a number of responsible mining initiatives based at the Eden Project in Cornwall – itself a disused china clay quarry. One such initiative is the Post-Mining Alliance ([www.edenproject.com/our-work/people/responsible-mining](http://www.edenproject.com/our-work/people/responsible-mining)), an expert team largely based at the Eden Project that works with partners and grassroots community groups to develop better solutions to the problems of mining legacy and mine closure. *101 Things to do with a Hole in the Ground* is the Alliance's signature book.

The book is sponsored by the European association of mining industries, Euromines, and the Rio Tinto-Eden Project partnership, which focuses on jointly developing initiatives to drive better performance by the mining industry.

Published by Post-Mining Alliance in association with the Eden Project 2009.

[www.edenproject.com/shop/101](http://www.edenproject.com/shop/101). ISBN: 978-0-9562213-1-5

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*Cleaning up at the abandoned Benambra mine in Australia*

Not only does it generally cost less to implement than traditional methods – repeatedly, users report that their projects costs come in less when using Natural Regrade – and the resultant landform does not require expensive long-term maintenance and repair.

In one project involving Natural Regrade, the state of New Mexico's Abandoned Mine Land Program awarded a state contract to Water and Earth Technologies, to identify methods to protect the public and environment from hazards posed by abandoned coal mines at Vermejo Park Ranch.

"Water and Earth Technologies began using Carlson Natural Regrade in 2006," says Bugosh. "They have used it successfully for major projects, bringing them in below budget and in much less time than was projected." These projects include reclamation of an area totaling more than 385 ha at Chevron Mining's McKinley mine in Gallup, New Mexico.

The Vermejo Park Ranch project is to protect and enhance the natural environment at abandoned mine sites, while reducing erosion and sedimentation in Dillon Canyon Creek. Natural Regrade will help achieve long-term landform stability against erosion - getting a result much like nature would over thousands of years - for drainage, earthwork, and stream restoration design. Owned by media magnate Ted Turner, the private Vermejo Park Ranch encompasses some 2,330 km<sup>2</sup>.



### Award winner

Unplanned closure can have many consequences, as in the example of the Benambra mine. From 1992 to 1996, this mine in East Gippsland, Victoria, Australia, operated as an underground base metal mine producing zinc and copper concentrate. In 1996, it was placed into administration and mining operations ceased immediately, without any environmental rehabilitation being undertaken.

The unplanned closure of the mine created an array of environmental problems and in 2005, the Department of Primary Industries (DPI) engaged ATC Williams (ATC Williams unites the companies of MPA Williams & Associates and Australian Tailings Consultants) to undertake design and documentation of a rehabilitation plan for the entire site, including the tailings dam. The company had been involved with the Benambra mine since the late 1980s, having undertaken site investigation for the original tailings dam and subsequent design, documentation and construction management of the tailings dam embankment.

The DPI's objective was to achieve a stable and environmentally self-sustaining site that conformed to industry best practice and met stakeholder, community and legislative requirements. ATC Williams' rehabilitation plan for the site covered a range of components, including:

- Re-engineering of the tailings dam to satisfy long-term closure design criteria and minimisation of contaminant production
- Creation of an anaerobic wetland, downstream of the tailings dam
- Disposal of remnant sulphidic waste into the tailings dam
- Removal and disposal off site of all hydrocarbons, hydrocarbon contaminated soils, chemicals, plastics and steel waste
- Crushing and co-disposal of all concrete
- Landscaping and re-vegetation of the mine site and associated access roads.

Despite the mine's remote location, the strict environmental requirements and sometimes adverse weather, the project was successfully completed within a 4.5 month time-frame in 2006. The project was subsequently recognised by the industry as an outstanding achievement, receiving a number of awards:

- 2006 - The Victorian CASE Earth Award for 'Environmental Excellence'
- 2006 - The National CASE Earth Award for 'Environmental Excellence'
- 2006 - The Australian Mining Magazine's Australian Mining Prospect Award for 'Excellence in Environmental Management'. **IM**

