Australian Tailings Consultants

Down to Earth

MPA Williams and Associates

Newsletter of Australian Tailings Consultants and MPA Williams and Associates March 2007

IRAN UPDATE

Work on our three projects for the National Iranian Copper Industries Company (NICICO) continues. It is amazing to think we have been working there since 2000 and that current contracts have us committed to 2010!

Miduk was commissioned in May 2005. The tailings disposal scheme is a paste thickened DVD (down-valley discharge) operation. Four 16m dia. Dorr-Oliver Eimco paste thickeners are located 500m from the concentrator at the head of a valley.

An embankment of rockfill contains the toe of the tailings beach but allows water to percolate through to a water recovery dam. Early operations have involved ore with a high clay content and current work is focussed on flocculant plant modifications to enhance thickener performance.

At **Sungun**, in the north-west of Iran, commissioning is proceeding. This is a 7 Mtpa operation. Hand-over of the concentrator is about to occur. The tailings are thickened and then pumped to an adjacent valley where a cycloned sand embankment will provide containment.

Australian Tailings Consultants have been responsible for the design of the tailings pump station – no mean feat since it involves eight stages of Warman 10 x 12 high pressure slurry pumps, lifting the 45% solids slurry 300m and a distance of over 10km – and for the design of the cyclone station, the embankment, and the return water system. Now we are negotiating with NICICO to provide engineering management for the first five years of operation. Cycloned sand embankments are a new concept in Iran.

Sar Cheshmeh is an operating mine (since the early 1980s) and is the largest of NICICO's operations, currently 22 Mtpa and due for expansion to 33 Mtpa. With the original earth and rockfill embankment impoundment full, ATC's brief was to develop facilities for another 1000 Mt of tailings storage over the next 30 years. The solution was DVD paste thickened tailings, i.e. the same strategy as Miduk. A key driver of this, again as per Miduk, is to save water. Raw water supply for both mines comes from scarce alluvial aquifers.

On site, the main embankment raising is proceeding, contracts are about to be let for major changes and upgrading of return water pumping facilities and tenders for the paste thickener contract (involving perhaps ten 25m dia. units) are about to close. Design is being finalised for a new water storage dam on the Shur River which will be an 80m high rockfill structure with an asphalt core. Completion of the entire scheme is scheduled for 2010.

There has been a long interval since the previous **Down to Earth** newsletter, which is testimony to how busy the mining and construction industries have been. However, we have at long last girded our journalistic loins for Issue No. 7.

Apart from being very busy, there have also been some significant changes in staffing and location for the company. Of key importance is our expansion into the areas of tailings slurry handling – pumps and pipelines – and water management and distribution. The latter involves pumps and pipelines too, but also total mine water balance, resource management, water treatment, etc. In this department we have our mechanical engineer, **Ray Rieschieck,** together with **John Wemyss** and **Arash Roshdieh.**

These changes have also been accompanied by a change of office location in Melbourne. We had simply outgrown our Bonbeach premises, despite repeated extensions. The new office at Mordialloc is spacious by comparison, with room for further expansion; is a little closer to Melbourne, yet is still beachside on Port Phillip Bay. A nice combination. The laboratory has also moved to new premises nearby.

All of these developments are exciting and healthy, and position us well for ongoing service to our clients and for future growth. As ever, we hope you enjoy this special Paste 2007 edition of Down to Earth, timed to coincide with the Paste 2007 international conference in Fremantle WA.

Paul Williams

IN THIS ISSUE

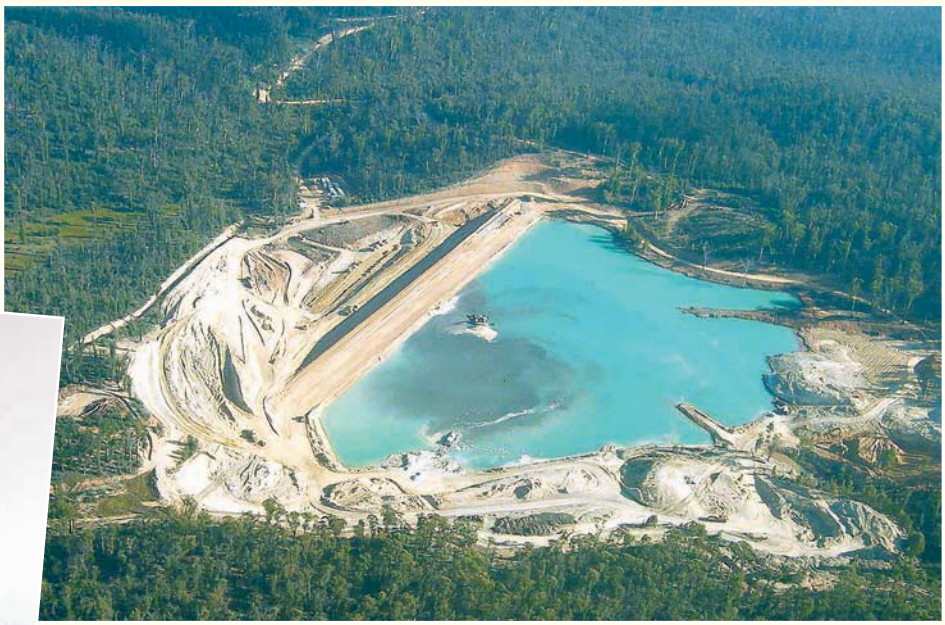
Benambra Mine Rehabilitation Project – Victoria

Australian Tailings Consultants recently undertook the design, documentation and construction supervision of the Benambra Mine Rehabilitation Project in Eastern Victoria.

The Project was completed in May 2006 and has been recognised by industry as an outstanding achievement and has received the following awards:

- The Victorian CASE Earth Award, for "Environmental Excellence", 2006.
- The National CASE Earth Award, for "Environmental Excellence", 2006.
- The Australian Mining Magazine, "Australian Mining Prospect Award" for "Excellence in Environmental Management", 2006.

Victorian Case Awards [L-R] Peter Reid (ATC), Fiona Warren (Abi Group), George Buckland (DPI)



Aerial view of the tailings dam at an early stage of construction.

Mining operations ceased without the undertaking of any environmental rehabilitation. A total of 970,000 tonnes of ore was mined during the life of the Mine, and the resulting 691,680 tonnes of sulphidic tailings are now stored in the Tailings Dam.

Australian Tailings Consultants (ATC) have been involved with the Benambra Mine project since the late 1980's when they undertook site investigation for the original Tailings Dam and subsequent design, documentation and construction management of the Tailings Dam embankment.

More recently however, ATC were engaged in 2005 by the Department of Primary Industries (DPI) to undertake design and documentation of a rehabilitation plan for the entire Mine Site including the Tailings Dam. The unplanned closure of the Benambra Mine created an array of environmental problems. The major issues of concern included the storage of potentially acid producing tailings in the un-rehabilitated Tailings Dam, hydrocarbon contaminated soils, remnant sulphidic ore stored on the site, untreated waste chemicals and hydrocarbons.

Re-levelling of the tailings with the utilisation of a dredge.

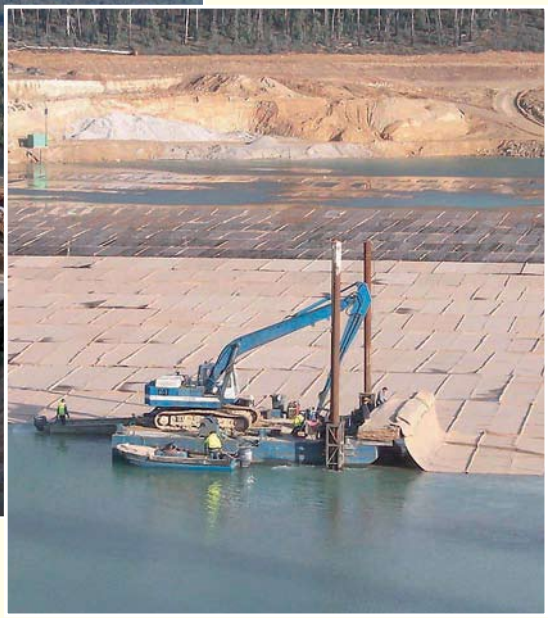
The Benambra Mine was located in the remote upper catchment of the Tambo River, approximately 60km east of Omeo in East Gippsland. The Tambo River feeds into the Gippsland Lakes, and provides the potable water supply for several local communities. Thus prevention of contaminants from leaving the site was of primary concern.

The Mine was operated as an underground base metal mine producing zinc and copper concentrate. The Mine operated for a period of four years from 1992 to 1996, after which the operation was placed into administration.

Tailings Dam site prior to rehabilitation. Note the poor distribution of the acid producing tailings.

Benambra Mine Rehabilitation Project – Victoria (Continued)

Construction of the re-engineered Tailings Dam nearing completion.



Placement of Jute Mat (total of 6.6ha) on the levelled (submerged) tailings surface.

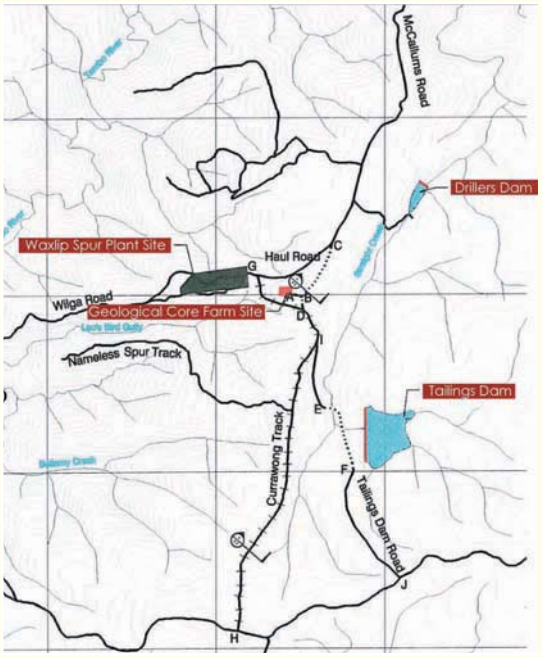
The rehabilitation plan for the site included:

- 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, to EPA approved land fill sites, of all hydrocarbons, hydrocarbon contaminated soils, chemicals, plastics and steel waste,
- crushing and co-disposal of all concrete,
- landscaping and revegetation of the Mine Site and associated access roads.

The key components of the Tailings Dam Rehabilitation included dredging and re-deposition of the tailings to create a level surface, provision of a year round minimum 2m cover of water over the tailings, buttressing of the Tailings Dam embankment, strategic placement of lime in the storage and appurtenant streams, placement of jute mat over the tailings, creation of an anaerobic wet land downstream of the embankment, and excavation of a spillway and dissipation structure to cater for a Probable Maximum Flood.

Despite its remote location, strict environmental requirements and sometimes adverse weather, the project was successfully completed within a time frame of 4½ months.

DPI's objective to achieve an environmentally self-sustaining and stable site that conformed to industry best practice and met stakeholder, community and legislative requirements is believed to have been met.

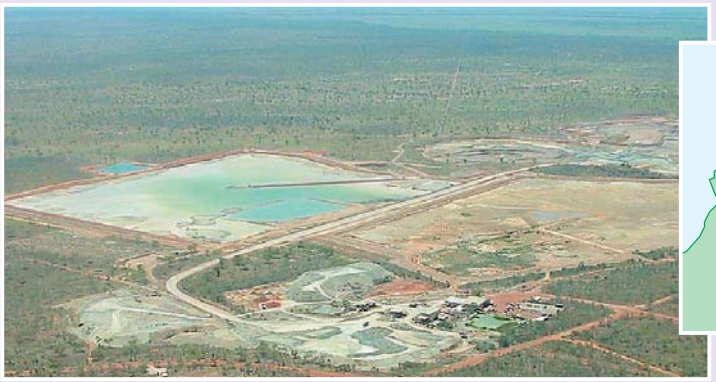


[Left] Anaerobic wetland at embankment toe under construction.

[Above] The Tailings Dam was one of several sites at the mine that were rehabilitated.

Rehabilitated tailings storage prior to revegetation.

Kimberley Diamond Company Adopts Thickened Discharge



ATC has been providing geotechnical advice and design services to Kimberley Diamond Company (KDC) at their Ellendale Operation since 2001 when preliminary exploration and bulk sampling operations were being undertaken.

The former CRA lease was abandoned in the 1980's, however KDC have identified significant diamond resources, principally at two Lamproiite pipes approximately 15 km apart, identified as E4 and E9, respectively.

At E4, a new 600 tph processing plant is nearing completion and construction of the first stage of a new thickened tailings scheme (TSF2A) has recently been completed. Tailings will be discharged down valley from the process plant at this facility. The tailings storage facility caters for a total thickened tailings discharge of 29Mt.

Assessment of design tailings properties over the anticipated mine life has been based on laboratory analyses of synthetic tailings prepared from bulk sampling boreholes constructed using a Bauer exploration drill rig resourced from Germany in 2003. The rig is capable of drilling 2m diameter boreholes to depths up to 60 m.

To date, conventional methods of tailings disposal have been used at E9. An original CRA tailings dam (TSF1A) was refurbished during pilot plant processing of bulk samples. Subsequently a new paddock type facility (TSF1B) was constructed in September 2002 with a 3 m upstream crest raise added in January 2004.

As the identified resources increased and the process plant facilities were upgraded, a second storage cell (TSF1C) was constructed in September 2004. Both TSF1B and TSF1C have subsequently been raised.

It is proposed to construct a large new facility (TSF1D) to the south of the existing dams, to cater for an additional 25 Mt tailings.

Raises of the existing TSF's have been undertaken using a combination of sandy beach tailings (4% upper beach slopes), and mine waste ("lights" and overburden). Upstream toe seepage collection drains have been installed in both facilities to prevent pore water pressure build up in the embankments. Seepage from those drains (of potable quality) is collected in a pond at the northern end of the tailings area.

Mine Water Evaporation Ponds ("Rice Paddies") at Woodvale, Central Victoria

Work has recently been completed on expanding the evaporation facility of **Bendigo Mining Limited** at Woodvale just north of Bendigo. ATC have been responsible for the design and construction management of the upgrade to the facility to accept increased mine dewatering from the Bendigo Gold Project, from which the first gold pour took place in July 2006. The challenge for the designers was to accommodate the expanded facility on a sloping site without the need for major earthworks.

The solution lay in creating a series of narrow terraces which allow for the water to cascade via spillways down the slope. By maintaining a relatively shallow water depth, and engineering a low permeability base, the evaporative capacity has been maximised and the potential for seepage minimised.

Also included in the project was an upgrade of existing ponds which were modified using the same principles as the new evaporation area.

ATC International Developments

South America

ATC has completed separate studies for two of CODELCO's existing copper mines in Chile.

Both studies were investigations into the advantages of introducing thickened tailings disposal systems to modify the mines' existing tailings disposal schemes.

For these projects ATC formed a joint venture with MN Ingenieros of Santiago, and we worked closely with Slurry Systems Pty Ltd. The projects were awarded after a rigorous tender process. In both cases the ATC/MNI proposal was rated as technically superior, and we were awarded the studies.

The mines are the two southernmost of the Codelco operations, being the El Teniente mine, located south of Santiago, and the Andina mine, to the north of the city.

At both sites the planned quantity of tailings is phenomenal, and the planning time period is in excess of 50 years. The quantities of tailings are in the range 2,500Mt to 5,000 Mt.

El Teniente:

At El Teniente tailings are transported 80km by flume, through a number of tunnels, for discharge into the existing Caren storage. After a review of possible alternative sites, the study focussed on the Caren site. Methods of utilising thickened and/or paste tailings to reduce overall construction and operating costs were investigated. The topography and the need to integrate existing infrastructure provided unique constraints.

A number of options proved to be feasible. The preferred solution is an innovative method that requires paste thickening of just a proportion of the total feed to the storage.

Andina:

The tailings discharge system at Andina is similar to El Teniente.

The tailings are transported approximately 90 km by flume to discharge into the Ovejeria storage. Water conservation is a big issue, and the objectives of the study were to maximise water recovery as well as to investigate a reduction in costs.

Multiple options were investigated, including thickener type, location, tailings transport methods (flumes or pipes), discharge and beaching methods, and possible variations in embankment locations.

The study indicated that significant savings should be possible compared to the present conventional methods.

The Ovejeria storage: Presently contains 5 years of tailings production, with an estimated 50 years still to come!

The Ovejeria embankment: The final embankment height will be significantly reduced by the introduction of a thickened tailings disposal scheme.

Europe

Lisheen, Ireland:

Paul Williams has been assisting the Lisheen mine in Ireland with closure options studies. During the course of this work it became apparent that more data was required on the tailings beach profile, including strength and density.

To provide this data Peter Lam has just spent a delightful few weeks (in the middle of a northern hemisphere winter) doing in-situ sampling of the Lisheen tailings. The ATC slurry sampling equipment was air-freighted to the site for the work, and back again immediately after. The mine constructed a purpose built barge to ATC specifications for over-water access.

Spain:

As this newsletter goes to press, we are waiting for an order to start work on a feasibility study into thickened tailings disposal for a site in Spain. Craig Noske will be working on this project.

Our New Office Premises and Laboratory

Our new office premises are located at 222-225 Beach Rd, Mordialloc, Vic (on the corner of Nepean Hwy opposite our new conference room – Doyles Bridge Hotel).

Our Laboratory is now located at 19 Beach Ave, Mordialloc, Vic, with improved facilities and the same professional service.

Please note that all deliveries of soil and tailings samples for testing should be sent direct to our laboratory.

Our Staff in Profile

Trevor Osborne grew up in the Bendigo region of Victoria and studied at the then Bendigo Technical College.

After a year with the Country Roads Board and 2 years of National Service he joined the specialist geotechnical contractor, The Cementation Co Ltd.

Short periods in Melbourne and Sydney preceded a transfer to Perth for 6 months which turned into 30 years. When Cementation Co withdrew from Australia in 1974 a group of ex employees set up shop in the gap left behind.

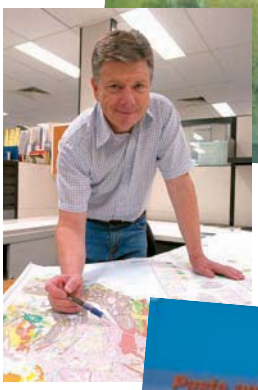
Trevor continued in geotechnical contracting until changing sides in 1989 and becoming an independent consultant still working in the specialist geotechnical field. 1993 saw another change when Trevor joined forces with Paul Williams and set up an office of MPA Williams in Perth.

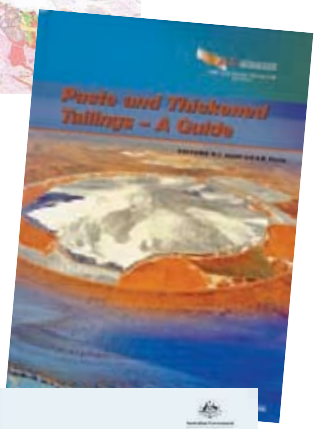
Probably the biggest change of all came in 1999 when Trevor and wife Lauraine moved back to take up residence at "Kamarooka Estate" (Lauraine's family property just north of Bendigo). His challenge now is to balance the pressures of geotechnical engineering with a rural lifestyle and growing collections of cheese dishes, butter churns, owls, Wedgwood ceramics and sundry other implements and utensils.

Australian Tailings Consultants and MPA Williams and Associates offer a wide range of services in the geotechnical and mining industry and specialise in the following areas:

- Site Investigation
- Foundations and Ground Improvement
- Hydrogeological Studies
- Water Resources Infrastructure
- Hydrology and Hydraulic Structures
- Landfill and Waste Disposal
- Mine Water Management
- Tailings Slurry Pumping
- Tailings Disposal
- Pavement Design
- Geotechnical Construction
- Grouting
- Retaining walls and Slope Stabilisation
- Civil Engineering
- Project Management
- Statutory Approvals
- Laboratory Testing

Staff News





- **Paul Williams** and **Steven Murphy** prepared a paper for and attended an international summit of Paste and thickened tailings, held in Ireland in April. Paul presented the paper on Down Valley discharge of thickened tailings at the Miduk Mine, Iran.
- **Steven Murphy** presented a case study on the Tailings Storage Facility at Century Zinc at Mine Tailings, February 2006.
- **Darren Pemberton** attended a report writing workshop presented by the ACEA in Melbourne in November.
- **Paul Williams, Steven Murphy,** and **Stuart Masterson** contributed case studies for the book **"Paste and Thickened Tailings – A Guide"** edited by Richard Jewell and Andy Fourie.
- **Paul Williams** has been sitting on a committee to prepare a handbook on the tailings aspect of sustainable development in mining.
- We congratulate **Phillip Soden** our senior GeoTech engineer and his wife **Zahra** on the arrival of **Alex**, born 30th January.
- ATC Melbourne welcomes new staff members **John Wemyss, Arunasalam Munhunthan** and **Deron Khoo**. John heads up ATC's fledgling water division, and Arun and Deron work in the tailings division.

Arunasalam Munhunthan

John Wemyss

Deron Khoo

More Information

If you would like more copies of this newsletter, more information about **MPA Williams and Associates** or **Australian Tailings Consultants** or further information about an item mentioned in **"Down to Earth"** please contact either our Melbourne or Perth office.

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