Project partners celebrate a 10-year milestone

The Tasmanian Government and the Savage River mine operators are celebrating 10 years of an extraordinary partnership to remediate environmental damage caused by acid rock drainage from past mining operations.

The success of the remarkable alliance between regulator and miner was applauded by the major players in the Savage River Rehabilitation Project - Australian Bulk Minerals (ABM) and the Environment Division’s acid drainage scientific team.

With significant progress achieved in the past decade, the atmosphere was buoyant at a celebratory dinner in Burnie in 2007.

Director of Environmental Management Warren Jones and ABM Managing Director Dave Sandy hailed the project as a shining example of cooperative environmental management achieving mutually beneficial goals.
"I am sure that we would not have achieved the very considerable reductions in the pollution entering the Savage River that we have if ABM had not been operating the site."

Dave Sandy was equally enthusiastic about the winning partnership.

“There is a lot of duck shoving in environment matters over mining leases,” he said.

“The risk for government is that a new owner can come in and take full advantage of an indemnity clause.

“But we have gained the trust of the Tasmanian Government with our policy of openness and transparency.”

The success of the partnership agreement has been boosted on the ground with “intelligent” use of existing resources in the remediation works at the mine’s acid rock drainage “hot spots”.

The B Dump complex, a sizeable dump of acid-leaking waste rock, has been capped with clay and waste alkaline rock to reduce further acid drainage.

And in another major site rehabilitation initiative, a drain from the historic North Dump collects the acid rock drainage and transfers it to the South Lens Pit for treatment.

The remediation program has resulted in a significant reduction in the amount of pollution entering the river, and it is clear that aquatic life is returning, with fish seen in the river both above and below the mine.

Huge savings have been made by using on-site clay and alkaline rock to combat acid rock drainage and the techniques have been tailored to the unique climate and site.

The huge turnaround at Savage River and the achievements of the partnership are the envy of mining projects all over the world.

**Project background**

The Savage River mine is located in northwest Tasmania in steep, mountainous terrain surrounded by areas of high wilderness values, including the Savage River National Park. The original open cut iron ore mine was established in 1967. Operations during the first 30 years of the operation caused environmental harm to the Savage River and its tributaries.

In 1995, the 30 km stretch of the Savage River below the mine was found to have lost 90% of its invertebrate diversity and 99% of its invertebrate abundance, with fish life also greatly reduced.

The Tasmanian Government entered into the Savage River Rehabilitation Project (SRRP) with Australian Bulk Minerals (ABM), the current operators of the Savage River Mine, to remediate the pollution from past mining operations.

This partnership between ABM and government is based on a cooperative management and remediation regime initiated and negotiated by both parties in 1997, a year after the previous mine operators Pickands Mather Inc (PMI) closed the mine and returned it to the State Government. The new owner, ABM, is indemnified from the effects of historical pollution.

The SRRP has clear objectives, which are set out in the strategic plan focussing on developing long-term solutions for mitigating historic pollution by passive methods and by water treatment.
The objectives of the plan are:

- to promote the recovery of a modified but healthy ecosystem in the Savage River downstream of the mine, and permit native fish migration into the upper Savage River.
- to develop and implement an agreed long-term strategic plan for the rehabilitation and remediation of historical disturbances at the Savage River Mine and Port Latta plant.
- to integrate remediation works with ongoing mining operations wherever practical and to co-operate with ABM with the planning and implementation of projects
- to demonstrate best practice in all aspects of the project and to communicate progress and findings to the community.

**Environmental targets**

Environmental targets have been set based on toxicological studies conducted in 2001. The studies found that copper concentrations were often at toxic levels in the Savage River, and that copper toxicity was affected by calcium and alkalinity.

The following graphs show copper levels compared to toxicity targets at the ‘Savage River below South West Waste Rock Dump’ site, which is situated directly below the mine workings.

Since 2001, all environmental targets for water quality, including dissolved copper, aluminium and sulphate, have been achieved, with no water samples exceeding the threshold based on the toxicity to fish.

The SRRP continues to aim for further improvements as the toxicity threshold for more sensitive macro-invertebrate species, such as Ceriodaphnia, is generally exceeded during moderate to high flow conditions.

**North Dump Drain**

The North Dump Drain was constructed during 2006 to collect acid rock drainage (ARD) from the historic North Dump and transfer it to South Lens Pit for treatment.

North Dump is responsible for 17% of the total copper and aluminium load from the site. The seepage from North Dump previously entered the Savage River above the mine site and affected a large proportion of the river. This seepage was a major chemical barrier to the migration of native fish to the upper reaches of the river.

A feasibility study in 2003 estimated that significant reductions in direct acidity and heavy metal load into the upper reaches of the river could be achieved by diverting the North Dump seepage to South Lens.

As part of ABM’s mining operation in North Pit, pit water is pumped from the pit into South Lens. ABM’s mining fleet adds alkalinity to the water due to the effect of tyres grinding magnesite and calcite chlorite schist which are present in waste rock within the pit.

The SRRP agreed that it was not practical...
nor feasible to prevent further oxidation of this source of ARD and that the capture and diversion of ARD from North Dump via the North Dump Drain to South Lens, for treatment by the alkaline waters, represented the maximum practicable extent of treatment of that source.

The system is designed to convey flow of up to 180 L/s to South Lens for treatment.

Construction of the North Dump Drain took place during 2006

The North Dump Drain system consists of five main components:

- an acid rock drainage storage pond,
- a new access road to connect existing roadways,
- a 1600m long, 250 mm diameter, poly pipe delivery line,
- an intermediate pressure reduction tank, and
- a series of valves and instruments to monitor and control the flow.

The North Dump Drain discharges into South Lens pit for treatment

Construction of the North Dump Drain has reduced the pollutant load by removing more than 36,000kg of heavy metals per annum from the upper Savage River.

Concentrations of total copper in the river above the mine’s pump station water have dropped from between 32 and 59 µg/L to an average of 9 µg/L during the low flows of summer 2006/07.

B Dump remediation update

As reported in previous newsletters, ABM had begun rehabilitating B Dump, a historical waste rock dump that was emitting substantial quantities of ARD. Remediation of the B Dump complex is a high priority for the SRRP as it contributes around 40% of

The pressure reduction tank is one of the five main components of the North Dump Drain

The North Dump Drain has removed heavy metals from a large section of the Savage River
The project consisted of a water-shedding cover and an alkaline side hill cover. This will reduce the amount of water requiring treatment.

The cover system is designed to minimise infiltration of rainwater into the B Dump complex to reduce ARD generation in the underlying waste rock, and also to increase the alkalinity in rainwater where it is permitted to seep into the dump.

**B Dump prior to rehabilitation works**

The eastern side of B Dump was too steep to allow the construction of a water shedding cover so instead was encapsulated in a wrap-around cover of calcite chlorite schist, an alkaline waste rock from the mining operation. Water seeping through this alkaline cover drains into Main Creek.

The environmental benefits of an alkaline cover are:

- Reduction in oxygen to the underlying waste rock dump
- Introduction of alkaline water to the underlying waste rock dump through the infiltration of rainwater, to provide partial neutralisation of the ARD and possibly a reduction in pyrite oxidation by micro-encapsulation.
- Introduction of alkalinity into Main Creek below Townsend Creek, to reduce the toxicity of dissolved metals.

**The alkaline cover on the eastern side of B Dump**

The water shedding cover directs surface water off the dump before it can penetrate the cover, therefore reducing the volume of ARD requiring treatment. Early trials showed that it was not possible to achieve sufficient compaction of the material to obtain the required low level of permeability, and therefore the gradient of the top of the cover is around 4% to prevent runoff pooling on the surface.

**The B Dump water shedding cover**

A significant amount of reshaping of the dump was required prior to the capping works. Waste materials from South Deposit were used for the reshaping.

Construction of the water shedding cover was completed in October 2006.
The rehabilitated B Dump complex

Treatment of the reduced volume of ARD will take place at a later date. The SRRP plan to use the neutralisation system that is currently being developed, as discussed in the pilot plant article.

South West Dump alkaline ramp

South West Dump is an historic dump on the site that has undergone several remediation projects, including a water shedding clay cover over the upper area of the dump and revegetation on side slopes.

More recently, an alkaline flow-through cover has been constructed over a former haul ramp on the dump. The ramp has been placed to maximise contact with rainfall and stormwater flows. The objective is to provide a source of alkalinity to Centre Pit South, which is managed as an alkaline treatment pit, to reduce long-term neutralisation costs.

The ramp also intercepts acid seepage from the B Dump complex and transfers it to Centre Pit South.

The alkaline ramp is another example of the beneficial use of a waste product from the mining operation.

The work completed on the South West Dump represents the maximum practical extent of rehabilitation works at that site.

Pilot plant neutralisation trials

The SRRP has been developing an active treatment system for the neutralisation of the ARD on the site. Conventional treatment using lime is not affordable. A series of laboratory and mine site trials have been completed.

The concept involves mixing crushed carbonate rock with the acid drainage to neutralise the acidity and remove heavy metals. The aim of the reactor trials is to achieve sufficient removal of heavy metals via precipitation and production of a sludge that has characteristics favourable for disposal.

The laboratory scale studies commenced with the use of air diffusers for mixing, which proved to be effective, however problems with air blockages were encountered. Trials were then commenced using mechanical mixing, with axial flow mixers chosen because of their low energy requirements and high reliability.

The laboratory scale trials consisted of computer-controlled single or dual cell carbonate reactors using 1 L capacity vertically baffled Perspex jars with axial flow mixers. Waste carbonate rock sourced from a deposit in ABM’s North Pit, and commercially available Ag-Lime as a comparison, have been trialled as potential neutralising agents.
The laboratory scale trials used small computer-controlled reactors

Analysis of the treated water from laboratory scale trials showed that the main pollutants in the ARD (copper, iron and aluminium) can be reduced by over 90% using this method, with a lesser removal of zinc.

Following the successful laboratory scale trials, a larger scale plant, with a capacity of 175L, was built for field trials. Field trials were carried out on both the B Dump and the Old Tailings Dam seeps.

If the trials are shown to be successful, the SRRP plan to develop the system to full-scale, in order to treat the ARD from the Old Tailings Dam seeps and the B-Dump Complex at a later date.

Old Tailings Dam

Construction of the Savage River Old Tailings Dam commenced in 1962, with the dam being used as the disposal site for the pyrite-rich tailings produced at the mine until 1982. Tailings are now deposited into a new dam (Main Creek Tailings Dam) which is located immediately to the south of the Old Tailings Dam.

The tailings in the southern part of the Old Tailings Dam are exposed, while in the northern part of the dam the tailings are submerged beneath a 1 to 2 m deep lake. The dam contains approximately $14 \times 10^6 \text{ m}^3$ of tailings, to a depth of up to 30 to 35 m.

The oxidation of the pyrite in the Old Tailings Dam tailings, through exposure to water and oxygen, has resulted in streams of acid rock drainage that seep from the southern dam wall at both its eastern and western ends. These seeps have been flowing since the late 1970s.
Compared to the ARD from the waste rock dumps, the Old Tailings Dam seeps are high in acidity and iron but low in other metals. The seeps are responsible for approximately 50% of the acidity generated on site.

The seeps discharge into the Main Creek Tailings Dam. With the current operation of the mine, the alkalinity in the tailings discharged to the Main Creek Tailings Dam provides adequate short-term neutralisation of the seeps. This will not occur when the mine closes or the tailings dam reaches its full capacity.

The SRRP is considering options for addressing the long-term problem with the Old Tailings Dam. The current SRRP plan is to collect seepage and neutralise it in a carbonate reactor. The pilot scale neutralisation trials, as previously discussed, will provide the design data to enable the SRRP to move to a full-scale treatment plant at the Old Tailings Dam when required.

Future directions

In mid-2007, the owner of ABM, Stemcor, sold 90 per cent of the Savage River operation to Shagang Mining Pty Ltd, an Australian subsidiary of the Chinese steel producer Jiangsu Shagang Group Co Ltd.

The mine had been due to close in 2009 and the SRRP strategic plan had been developed on that basis. The change in ownership has now offered a long-term focus with a further 15 years of operation planned.

ABM have developed an operational plan to extend the life of the mine and its associated processing plants past 2020.

This provides an opportunity for the SRRP to review its strategic plan to incorporate the benefits of long term ABM occupation of the site:

- Ready source of labour and technical expertise
- Economic power supply
- Supply of alkalinity from operations in North Pit, Broderick Creek extensions, and addition of alkalinity into the Main Creek Tailings Dam.
- Active configuration of aspects of the mine plan to remediate impacts of past pollution.

An interim peer review will occur during 2008.

Independent Peer Review

The second independent review of the SRRP was completed in 2005. The panel was led by Dr David Williams (University of Queensland), with Dr Stuart Miller (Environmental Geochemistry International Pty Ltd) and Dr Ward Wilson (Unsaturated Soils Engineering Ltd).

The panel agreed that the SRRP has demonstrated industry best practice ARD management in the following areas:

- the identification and selective placement of waste rock types,
- operating to mitigate historical and future pollution,
- water management and treatment innovation and in particular the trialling of carbonate reactors, and
- advances in planning for closure.

An interim peer review will occur during 2008.

Further information: Environment Division (03) 6233 6518 or EnvironmentEnquiries@environment.tas.gov.au

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The Savage River mine now has a long-term focus, with a further 15 years of operation planned.