

The open pit development at McArthur River Mining (MRM) requires 5.5km of the McArthur River and 3km of Barney Creek to be diverted as the zinc, lead and silver ore body lies directly under the river.

Rivers can often change their course naturally but have also been diverted or rechannelled for centuries as part of development projects. In the resources industry, the environmental science associated with diversions is well advanced. There are now principles and recommendations set by the Australian Coal Association Research Program (2002) paper "Monitoring and Evaluation Program for Bowen Basin Diversions" and River Landscapes (2006) "A Rehabilitation Manual for Australian Streams". The design planned by MRM meets these standards.

As part of its consultation program with the local community, MRM provided residents with the opportunity to travel to a coal mine development in Victoria to view a river diversion first hand. The Morwell River was successfully diverted as part of a mine expansion in a project similar in size to the MRM diversion and within 12 months of being completed, native animals like platypus are reinhabiting the river.

In preparing MRM's Public Environmental Report (PER), the design of the river diversions were changed to include the recommendations of Northern Territory Government independent adviser, Professor Wayne Erskine of the University of Newcastle. This increased the cost of the work by \$10 million and provided the benefit of ensuring the diversions will be secure and prevent erosion and contamination in all weather conditions.

As a result, the NT Environment Protection Agency said in its assessment report on the PER that it is satisfied the McArthur River channel design will be stable.

Diversion design

The new diversion channels will replicate the form and function of the existing river and creek. They are planned to a great level of detail to ensure they:

- Remain stable for all flood events and throughout the mine life and beyond
- Will not be subject to higher than natural levels of erosion and sedimentation
- Enable the river to, in parts, continue to flood naturally into the flood plain without affecting the mine facilities
- Re-establish the river vegetation so there is no fragmentation of fauna habitats
- Allow fish to continue to naturally pass through the channels.

In preparing the PER, MRM studied the McArthur River and Barney Creek. A helicopter survey of 40km of the McArthur River channel was supported by groundwork with specialists actually walking and mapping 10km of the river and creek to map the vegetation and record the formation of the channel and river flows.

The McArthur River is over 300km long. At the reach nearest to the mine, the river is at best a 15m wide, slow flowing creek for ten months of the year. At an average of one in every five years, it overflows the channel which can be up to 15m deep, and opens to a flood plain. These floods are generally shallow, slow moving bodies of water but do not last long.

Barney Creek is a small tributary of the McArthur River which flows around the northern side of the mine site. There are no permanent pools of water in Barney Creek and it only flows for relatively short periods following rain events. It can however, break its banks and open to the floodplain in a one in two year rainfall event.

The diversion channel design for both the McArthur River and Barney Creek copies the natural environmental conditions wherever possible in regard to the type of soil and rock used on the base and slopes, the depth and width of the watercourses, the speed of water flow and flood characteristics.

The main differences are in the use of bedrock on the river bed in some locations to help prevent eroded sediment flowing downstream and the use of artificial rock riffles which reduce the speed of water flow and in so doing, help revegetation along the channel banks. These rock riffles are similar to already naturally-occurring rock bars and will not disrupt fish passage.

Studies were also conducted of the habitats both in-stream, bank-side and in the vicinity of the river. These have again been taken into consideration in the design. The studies looked at ten sites along the mine reach of the McArthur River and two sites in Barney Creek. Each site was 100m long and was assessed from the ground and by boat.

The rehabilitation of the channels will provide a suitable environment for fish passage and establish a functioning riverine ecosystem through:

- Including large woody debris along the channel bed and creating shallow pools to provide micro-habitats for fish
- Revegetating the banks using seeds and seedlings from local species already growing along the river bank, using appropriate soils and fine sediments on the channel banks to promote root development, recreating rocky crevices and banks, maintaining,

monitoring and replacing plants and weeds as necessary.

Clearing of the riparian corridor along the river will be spread over a ten year period to provide a gradual transition for fauna populations and avoid any fragmentation of habitats.

2007 Work Plan

Barney Creek diversion

The Barney Creek diversion will be completed during 2007. The channel base will vary in width from 15m to 30m reflecting the natural variation of the watercourse which was shaped through heavy water flows. It will feature coarse rock lining to a minimum depth of 1m where the channel is excavated in weathered rock to help revegetation and protect against erosion.

The use of rock riffles was one of the key modifications in the diversion design. The riffles are 'U' shaped rocky structures which mimic the existing bedrock outcrops in Barney Creek.

The new channel will feature two rock riffles through the upstream section where sand and mud is deposited by flowing water. Four rock riffles will be constructed at selected locations in the remainder of the channel. Their purpose is to reduce water speed and stream power to control sediment movement. They also create pools in which fish can rest.

During 2007, work on the Barney Creek diversion will include pegging the area, clearing vegetation, developing haul roads for moving material for the diversion, stockpiling topsoils and constructing temporary workshops. A trial of the planned revegetation methods will also be conducted.

No work will occur in the area where Barney Creek meets either Surprise Creek or McArthur River until after the 2006-2007 wet season.

Barney Creek Bridge

Initially a road crossing was planned for Barney Creek for hauling materials to the overburden emplacement facility on the north side of the creek. This plan has been changed. A bridge will be constructed over Barney Creek and this is expected to be finished by October 2007.

McArthur River diversion

Around two-thirds of the McArthur River diversion will be cut out of hard rock. In 2007, this rock will be excavated from parts of the new channel and used to batter the sandy sections of the Barney Creek diversion and the mine levee walls.

All remaining works for the new McArthur River channel will be completed in the 2008 dry season. This will construct a channel with the following features:

- A channel of between 15m and 28m wide and up to 18m deep which is wider than the current channel but necessary due to the natural landform and in order to recreate the same performance characteristics
- 6m wide terraces on both sides of the channel similar to the current slopes
- Rock lining of channel banks through some sections
- Rock armouring and timber groynes at both ends of the channel and other localised protection measures where the channel crosses tributaries to ensure changes in flow direction do not generate erosion
- Geofabric and coarse rock armouring up to 1.5m thick to help revegetation and protect against erosion in the parts of the channel banks which are made from loose, sandy materials
- Shallow pools of around 0.5m deep in the base of rocky sections to provide fish habitats

- Large woody debris in the bed of the channel which assists rehabilitation, provides localised habitats and encourages sediment trapping.

Rehabilitation plan

The creek and river environments naturally change and regenerate as soils and seeds flow through the wet season and are deposited into the rocky banks along the way. The same will happen with natural revegetation of the diversion channels. However, MRM is also planning an extensive revegetation program to support the development of the new channels.

In 2007, this will begin to be applied to the Barney Creek diversion. It includes:

- Using felled timber high on rock batters as well as fine branches in the floor of the channel to help trap sediment, control water speed and recreate natural habitats
- Carefully reusing topsoil to make sure weed content is managed and soils more prone to erode are identified and used accordingly within the environment
- Ensuring soil is the right depth and anchored on the channel banks to help vegetation successfully establish
- Blasting the channel up to 2m wider than the cross section at rocky parts of the channel to help create fractured rocky sections to assist rehabilitation and form shallow ponds which provide habitats for key fish species when water levels fall
- Top soiling the rocky slopes at the end of the wet season to provide a base for tubestock to be planted into.

The revegetation plan for Barney Creek is different to McArthur River in that only 10-20% of the creek is

naturally shaded. This compares to 50-60% shading of the McArthur River channel. The types of vegetation are also different. Barney Creek runs through a riverine woodland dominated by *Casuarina cunninghamiana* and *Lophostemon grandiflorus*. By comparison, the McArthur River environment is dominated by *Barringtonia acutangula* and *Melaleuca argentea*.

Studies identified 24 varieties of plants that naturally occur around the waterways. Seed collection of these species has already begun and continues in 2007 as seeds of specific species ripen. A total of 5,500 trees are also being propagated as tubestock for the first stage of rehabilitation. A total of 35,000 tubestock plants are expected to be used in the rehabilitation of the entire project.

The tubestock will be planted at a rate of 1,000 trees per hectare and supported by direct seeding of native species. Eucalypt will be seeded at 3kg/ha, acacia seed at 1.8kg/ha and direct sown seed at 6kg/ha. This variety mixes both fast growing plants which will quickly re-establish the habitats, with larger slower growing varieties which bring long term stability to the environment.

As well as revegetating the creek and river slopes, a 20m wide strip of vegetation will be established above the slopes. This will help blend the new slope vegetation into the surrounding undisturbed environment. A 4m wide easement will be used at the top of the slope for watering and maintenance during the first two years after rehabilitation. It will then be planted or sown once the revegetation is safely established.

All revegetated areas will be protected with stock proof fencing until trees mature.

Mine levee walls

Levee walls will be built in two areas to allow mining to continue while the open pit development is completed.

The first is a temporary wall at the northern end of the open pit which will prevent waters from Barney Creek entering the pit in the 2007-2008 wet season. Part of this will later form the final northern levee wall around the pit. A second is planned at the southern end of the open pit. This bund wall will be moved as close as possible to the McArthur River. This will allow the open pit to be extended to the east and south.

The levee walls will be covered with non acid forming rock to provide protection against erosion by flood waters.

Environmental impact

Studies have shown that Barney Creek does not play a role as a migration corridor for fish or other fauna because of the lack of permanent pools of water. Clearing will be conducted over about two weeks to allow birds and other fauna time to move to other areas.

No impact is expected on surface water or groundwater levels.

Erosion will be prevented through various techniques including rock lining and the use of geofabric for the Barney Creek Diversion, sediment traps within run-off ponds and surface water quality studies.

Eight water trucks will be used to both suppress dust from construction works and also provide water for helping to compact the new channels and levee walls.

A Vegetation Clearance Plan has been developed for the clearing work. A permit will be issued prior to any vegetation being cleared to make sure it is not near any cultural heritage or environmentally sensitive areas. Habitat trees will be marked out by environmental staff and cannot be removed without environmental staff being present to assist any fauna.