THE IMPACT OF BAUXITE MINING ONWATER YIELD

FRANK BATINI FIFA

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I will concentrate on the impacts of bauxite mining on water yield for two reasons-(i) water is essential for ecosystem health and there has been a dramatic, negative step-change since 2000 and (ii) water is also a highly valuable product.

Since 2000 the Wungong, formerly a perennial stream (from 1909), has stopped flowing and is now dry for six months. In 2011 we recorded drought deaths of bullich (E megacarpa) in the stream zone located below bauxite pits. Drought deaths on shallow soils are common, but drought deaths in water-gaining areas are unusual.

Streams that flow at a rate of 100mmpa will yield 1000 m3 (1000000 litres) /ha/an. Some streams have delivered these volumes into dams for over 100 years. Current costs of desalination, an alternative source of water, are $2.50 to $3.50/ m3 (Watercorporation). Bauxite royalty to the State is about $100000/ha as a once-off. Water for irrigation is valued at $120-150/ha/an and logging may produce some $600 in stumpage every 25-30 years. However, as we shall see, silviculture is essential if we are to maintain stream, forest and ecosystem health.

Bauxite mining commenced in the jarrah forest in 1965, at a projected rate of 4 ha/an. There are now four alumina refineries and clearing is proceeding at a rate of some 700 ha/an. For Alcoa, whose operations are located primarily on harnessed catchments, a total of about 25000 have been cleared to date (19500 ha rehabilitated). Since only 20-30 percent of each catchment is cleared for mining, the total area impacted is about three to five times larger (75000-100000 ha).

Prior to mining the catchment is logged, the mined area is then cleared, the topsoil and subsoil removed separately, then 2-5 m of bauxite is blasted and trucked to a crusher, the subsoil and topsoil are returned, the area is shaped to retain water, it is deep-ripped to encourage infiltration and is then fertilised and seeded with a mixture of native overstorey and understorey species. The emphasis is to successfully return native species, to produce a self-sustaining ecosystem and to minimise erosion. In addition to the mine pits, areas that were affected by dieback disease are replanted and the logged-over areas are regenerated. Because access is more difficult there is a reduction in the areas that are prescribed-burnt. All of these steps increase crown cover.

The rehabilitation efforts have been spectacularly successful and Alcoa has received many environmental awards- state, national and international. However such success comes at a "water" cost. At age 16 a pit rehabilitated with jarrah-marri and native understorey may contain 2000 stems/ha, have basal area of 25 m2, a canopy cover of 45 percent and a leaf-area index of 2. It is estimated that such a stand would use about 900 m3 of water to produce one m3 of biomass (range 550-1200m3/m3). At current growth rates this stand would use about 6000 m3of water/ha each year (6000000 litres).

Schofield et al observed that as catchment canopies increase (from 25 to 50 percent, LAI from 1 to 2) the yield of water reduces by 80 percent. Alcoa have reported that over half of the rehabilitated areas are now above the 'desirable' stocking and CSIRO have measured increases in catchment leaf area between 1989 and 2007, even though rainfall had fallen. CSIRO also studied reductions in yield since the year 2000 from seven catchments that were mined (an average 66 percent reduction) which was larger when compared to four unmined catchments (an average of 40 percent). Also, the reduction in yield increased as the percentage of the catchment that was mined increased. Alcoa in 2007 reported that the decline in yield from five catchments, where mining had occurred on part of the landscape, was 40-50 mmpa greater than in the controls (range 4-67mmpa).

If we apply a reduction of 50 mm, as calculated by Alcoa, to the area impacted by mining (75000-100000 ha) the "loss" in yield lies between 37 and 50 GL. To produce this volume of water by desalination would cost the Watercorporation $ 90-125 million each year. Yet the royalties paid to the State in 2014-2015 by Alcoa and S32 (Worsley) totalled only $82.5million (DMP Annual Report).

The State and Alcoa have an agreed set of Completion Criteria, published in 2016, that cover several pages. Strangely, there is NO criterion that addresses water yield from mined areas. There are some aspirational targets set for stocking rates over time (these are way too high in my opinion) but there is no money allocated to thinning, even though, as John Clarke has pointed out earlier, this is seen as a desirable activity in the Forest Management Plan 2013-2014.

The solution is simple. Having established these good stands of trees, it is essential to provide money for their ongoing maintenance. There is a need to thin the dense stands to a desirable basal area, say 7 to 12 m2/ha, depending on species, age and site; to control any coppice from the stump; to rehabilitate some 30-40 percent of mine pits with understorey species only and to undertake much more regular prescribed burning.

An annual program to cover some 6000 ha would cost about $7million and that this should be repeated on a 10 yearly cycle. The Watercorporation has estimated the volume of water produced would rise gradually and reach 22GLpa by year 10. The Net Present Worth of this activity would be $ 132 million (at 5 percent discount, all costs and returns to year10). Break-even is reached by year 5, even allowing for no increases in flow in years 1 and 2 , so as to permit recharge of soils and of shallow water-table to occur.

In addition to this positive financial outcome there would be environmental benefits to streams, biota, trees and soil; there would be additional employment; the sale of forest products; the use of renewable biomass and a reduction in fuel loads. This is the "Complete package".

However implementation is far from certain and requires partnerships and a whole-of-Government approach. Similar proposals for silvicultural management of catchments were made in 1980 (Forests Department), in 1987 (Water Authority of WA), in 1989 (CALM and WAWA), and in 2005 (Watercorporation). Several research trials were established and data published. It is now 2016 and we still have no large-scale, adaptive, demonstration of what could be achieved. How much longer can we afford to wait?

Frank Batini

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