Seasonal Reductions in Water Yield due to Intensive Logging and Regeneration

Notes prepared for the South Coast Water Management Committee by Mick Harewood, February 2000.

Introduction.

The core business of the SCWMC this year will be to negotiate shares of available water between the environment and extractive users. As flow in streams falls during dry periods, the value of water to the environment and to extractive users increases. Therefore, any effect of forest catchment management that is likely to decrease the flow of water in streams during dry periods is going to have a profound effect on the economic and environmental outcomes of our negotiated flow- sharing arrangements.

As Part of the "Comprehensive Regional Assessment" of forests in NSW, the Ecologically Sustainable Forest Management (ESFM) committee has initiated projects that have modelled the impact of logging and regeneration on water yield and sediment generation. (NA61/ESFM: Sinclair , Knight and Mertz, 1998 and ESFM project : Water Quality and Quantity for the Southern RFA Region, Draft , SKM October 1999). State Forests has extended this by applying the same modelling techniques to the Bemboka Catchment, cited in their submission to the Health Rivers Commission Inquiry into the Bega River System.

In essence, these ESFM projects are fundamentally flawed because they only examine the impact of logging and regeneration on annual water yield. Below is a review of the literature which presents the evidence that the major impacts on water yield are likely to be on low flows during the warmer months, that is, during the periods of greatest hydrological stress.

If irrigators were prepared to take all their water at times of high flow during winter, this would not be a problem. If we had large, on stream dams, capable of holding a high proportion of average annual flows, water yield reductions during periods of hydrological stress, due to logging and regeneration, would not be so much of a problem. However, neither of these situations prevail in the coastal catchments of NSW.

The SCWMC should write to the RFA managers and point out the inadequacy of these ESFM projects. The SCWMC should also urge a precautionary approach to catchment management that favors either total protection from logging or low intensity selective logging over high intensity (woodchip-style) logging.

Hydrological Background

While most overseas studies on the effect of logging have focussed on the increase in runoff during the first few years after tree removal (Bosch and Hewlett, 1982), water yield reductions in later years have been evident from the mountain ash forests of Victoria following the intense wildfires of 1939. Intensive logging (and dense regrowth) produces the same kind of effects as a killing wildfire in ash forests and in other types of eucalypt forest elsewhere in Australia. (Cornish, 1993, Wronski, 1993, Lane and Mackay 1999, Vertessey, 1999). Kuczera reviewed the data from mountain ash forests in the Melbourne water supply catchments and developed a curve to predict annual water yield reductions following the conversion of oldgrowth ash forest to dense regeneration. The Kuczera curve shows an initial increase in water yield followed by a rapid decline to about half the pre-disturbance level, with the nadir at about 30 years and a return to oldgrowth water yield at about 150 years. (Kuczera, 1985)

Sinclair Knight and Mertz ESFM projects.

The SKM 1998 project has been extended to cover in more detail the Southern CRA region, using essentially the same methods as in the original project. (SKM 1999).

The SKM 1999 project refers to stress indicators for the subcatchments studied as utilised in the "Stressed Rivers Assessment Process" initiated by the NSW Government (section 2.1.2, page 5 of SKM 1999). Hydrological stress as defined in the stressed rivers assessment is the ratio of estimated monthly water extraction to monthly streamflow for 80th percentile of flows for the month where this ratio is greatest. (Note that where streams are dry at the 80th percentile, the streamflow at the 50th percentile of monthly flows is used). However, the SKM 1999 project thereafter completely ignores flow duration and deals only with annual water yields.

In the overview of catchment water yield, the SKM 1999 report states that "Review of the literature and analysis of the available data indicated that it is not possible to reliable assess the impacts on the seasonality or frequency of flows, and thus only the water quantity impacts were restricted to characterizing changes in annual yields only."

This is a cop-out. Analysis based on annual yield is useless unless there are very large on-stream dams (or unless irrigators are prepared to extract all their water at high flows, preferable during winter.)

While it is difficult to accurately quantify the probable magnitude of impacts on flow duration, there are some relevant data available and the basic physics implies that the impacts will be predominantly during the warmer months, when evapo-transpiration is greatest.

Water yield reductions in regrowth forests are due primarily to increases in evapo-transpiration and are in proportion to the increased total cross-sectional area of sapwood. (Jayasuria et al, 1993). Evapo-transpiration is driven by temperature and is very sensitive to temperature. For example, Moran and Ronin (1978) examined the effect of stand density on soil moisture depletion as measured by boreholes in Ash forests at Black Spur. They defined the summer drying period by visual inspection of soil moisture content to 5.2 meters depth plotted against time. Thus the summer drying period extended from late October until late March, when groundwater levels began to recharge.

Similarly, when examining the effect of a defoliating fire on water yield from wet sclerophyll forest in the Brindabella Ranges, O'Loughlin, Cheney and Burns (1982) could only demonstrate a statistically significant effect when summer and winter water yield data were analysed separately.

The Gutteridge, Haskin and Davey (1997) modelling study of the Bemboka catchment used a widely accepted hydrological model applied on a monthly time-step to apportion water yield reductions due to increased evapotranspiration losses in regrowth throughout the seasons. It found that if the water yield reductions due to full application of the Kurzera curve (Kuczera, 1985) to the upper 3 forested sub-catchments were assumed, then water yield during the summer months would be reduced by 50% and during the winter months by 25%, as a result of past and projected logging.

Vertesssey (1999) has reviewed the impacts of forestry activities on water yield. He cites a study by Watson et al (1999) which provides flow-duration curves for 5-year blocks pre and (various intervals) post-treatment. There is clear evidence that "low flows were more severely reduced than median or high flows, particularly in the later stages of forest regeneration."

Taking the above studies into consideration, it is clear that considering only annual water yields will minimise or hide the impact of forest regeneration on low flows during the irrigation season. Instead of adding to our understanding of the Bemboka Catchment, the new modelling provided by State Forests to the HRC Bega Inquiry is a step backwards from the insights gained in the GHD (1997) study.

Ameliorative Factors

Some studies have shown that thinning regrowth forests can increase water yields in the short-term. However, the growth response of understorey vegetation and retained trees has generally meant that the effect is not as great as one would expect from the proportion of the stand removed and tends to be short-lived.

Jayasuria et al (1993) examined the water yield response to thinning of mountain ash regrowth by either patch cutting or selection in 1976 for the years up to 1988. While there are significant water yield increases for the first 5 years, these effects disappear during the severe drought of 1982-1983. In the wetter years following the drought, the thinning effect is seen again, although at a reduced magnitude (see figures 4 and 5, pages 358 and 359 of Jayasuria et al, 1993). Therefore, thinning regrowth can temporarily ameliorate the effects of regeneration on water yields but only in wetter years. In dryer years, the effects of thinning disappear and statistically significant water yield reductions due to dense regeneration re-occur, within 7 years of the thinning operation.

In their submission to the Healthy Rivers Commission, State Forests have argued that "The catchment research projects cited above have all investigated the effects of logging oldgrowth forest, and therefore demonstrate maximal impact." This is untrue. The Tantawangalo study, in its section 2.4 "Vegetation", says that " The two principal pre-treatment stand types were type A, a dual aged stand comprising fire regrowth and old growth, and type B, a mixed forest with a range of stands but no vigorous regrowth. Most of the regrowth is thought to be in the order of 40-50 years old, as a result of bush-fires in 1939 or 1952." (Lane and MacKay, 1999 in prep.) The paper goes on to say that 73% of the control catchment basal area was type A, and 62% of the pre-logging basal area of the Wicksend catchment (subjected to integrated harvesting over 38% of its area) was type A.

Most of the forest areas in dispute in the Southern CRA region are in either an oldgrowth or disturbed oldgrowth condition. Only towards the south (i.e. nearer the Eden Chipmill) has there been relatively high intensity logging over extensive areas. Even aged fire regeneration is also relatively rare in these mixed species forests.

Recommendations.

The SCWMC should write to the CRA/RFA managers and express its concern at the inadequate nature of the ESFM projects on the water yield impacts of logging. The SCWMC should state clearly that we need to know the likely effects on flow duration into dry periods, not just annual water yields.

The SCWMC should further recommend to the CRA/RFA managers

- immediate cessation of high-intensity integrated harvesting operations

- an increase in royalties to pay for “regrowth spacing” (non-commercial thinning at <10 years age) in areas previously subjected to integrated harvesting.
- independent research into the effects of forestry activities on flow duration with a view to quantifying the financial and environmental impact and recommending appropriate compensation or ameliorative measures.

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