Submission on Ecologically Sustainable Forest Management Five-Year Review for the Eden Regional Forest Agreement.

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Summary.

The information provided by State Forests on their website is essentially about what they intend to measure, rather than an actual collation of data on indicators of sustainability. What they intend to measure falls short of an adequate set of indicators that would give a credible assessment of ecological sustainability.

Such data as has been provided, in the "SEEING" report, is aggregated across the whole State so that the detail of regional impacts is lost.

An additional list of indicators is suggested below in order to more fully quantify the environmental impacts of intensive logging in the Eden region. The likely trends are predicted from local and other relevant research studies.

Critical impacts on flow duration from logged catchments, the populations of endangered wildlife and the sustainability of timber yields point to the need for immediate change in the intensity, scale and location of logging operations in the Eden Region.

In the absence of credible growth models for logging regeneration across the range of sites, or other site- quality parameters, we still do not know if integrated harvesting as practiced at Eden over the last 35 years has caused a significant deterioration in the productivity of the forest estate.

State Forests Indicators.

Indicator 1.1.b (Area of forest type by growth stage distribution by tenure) is a useful indicator of forest ecosystem diversity. However, in collating data for this indicator, State Forests are likely to assume that forests regenerate as the same type after intensive logging. This is not necessarily the case.

The early data from Bridges (1983) showed that the Sivertop Ash/Stringy bark forests of East Boyd and Nadgee regenerated with essentially the same dominant eucalypt species proportions before and after intensive integrated harvesting. However, these forests have had a long history of burning to increase grazing opportunities (Smith. P., in HDEIS 1986, appendix 8(e.)). This has favoured a species drift towards the pyrophyllic E. seiberi and E. agglomerata, so it is no real surprise that these have retuned after the severe disturbance of high intensity integrated harvesting.

When different forest types have been intensively logged, there has been a clear tendency for E. seiberi to regenerate in preference to other slower growing species. Data collected as part of Koala habitat surveys show a marked drift away from preferred Koala browse species (E. longifiolia, E.cypellocarpa, E. globoidea and E. bosistioana) to E seiberi, E. agglomerata and Allocasaurina littoralis. (Allen and Bertram, 1998). These data were collected for a different purpose but sampling was stratified across a range of site variables in the Murrah and Mumbulla State Forests and adjacent reserves.

In the case of wetter forest types, the regeneration of E. fastigata seems rather patchy on some sites, with E. seiberi and various peppermints predominating. Silvicultural prescriptions developed by some State Forests staff (e.g. "Notes on the Silviculture of Moist Tablelands Hardwoods, Anon, 197?) seem to have been ignored and a rather inflexible integrated harvesting prescription and timetable applied.
Given that E.seiberi is one of the poorest eucalypts at forming long-surviving nest hollows for the larger arborial marsupials and owls, this species drift is likely to have serious long-term consequences for nest-hollow dependent wildlife.

A supplementary indicator "Area of regenerating forest with a significantly different species composition to that of the oldgrowth /multi-aged forest subjected to logging operations" is hereby proposed. Assessment of dominant canopy species composition before logging and at, say 5 years post logging, would be appropriate.

Indicator 1.2.b. (The status (threatened, rare, vulnerable, endangered or extinct) of forest dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment.) is a key indicator of biodiversity conservation but inherently difficult to monitor. The small numbers of regionally rare species e.g Long - footed Potoroos and Koalas and the difficulty in their surveying populations. The low rate of detection of threatened fauna in pre-logging surveys (SEEING report, Appendix 17, page 21) suggests that they may lack the statistical power to provide useful data on regional trends in threatened fauna populations.
Some more widely useful data might be obtained by surveying across the landscape for threatened but more-easily detected wildlife such as yellow bellied or birds with distinctive calls such as the powerful and sooty owls or the white-throated nightjar.

Indicator(s) 2.
There is now a critical need for credible growth models for logging regeneration to be published, so that the sustainability of the cutting regime can be established, even before the end of the oldgrowth/multi-aged forest cutting cycle. Such data as have been made available in the past (e.g. Bruskin and Horne, 1990)
do not give any degree of comfort that wood supply commitments can be met.

In the absence of credible growth models for logging regeneration across the range of sites, or other site- quality parameters, we still do not know if integrated harvesting as practiced at Eden over the last 35 years has caused a significant deterioration in the productivity of the forest estate.

Indicators (3).
A further reason for surveying yellow-bellied glider populations is to examine the interaction between arboreal insectivores and bellbird/psillid mediated eucalypt die back. While Loyn (1983) and others have shown that territorial bell minors actively spread psillids,(then defend and area of forest against other birds and consume lerps without

eating the psillid secretor), the role of nocturnal insectivores, such as gliders, has not to my knowledge been critically examined.

There is anecdotal evidence to suggest that Yellow-bellied gliders can reduce the severity and rate of spread of bell-minor/psillid mediated die-back. The severity of the problem in parts of the Murrah-Mumbulla State Forests may be due to past practices such as "Timber Stand Improvement" (that is , the removal of all the "old stags", now more commonly regarded as likely den trees). The survival and recruitment of habitat trees in general may be a good indicator of forest health.

Fire.

Suppression of wildfires will be of paramount importance in determining the timber productivity, water yield and wildlife values of the regenerating forest. Rapid initial attack on ignitions will be important but is difficult to achieve in such a large and relatively rugged setting. Surface water resources, for re-supplying fire tankers or helicopters are relatively scarce and inaccessible, being mainly confined to small streams in deep valleys and gorges.

In the nearby Errinundra Plateaux region, "helicopter dams" have been constructed in higher country to provide more accessible water reserves. Where there is a combination of high bushfire risk (e.g. dense and vulnerable young regrowth) and a potentially large resource of quickflow runoff from roads, the construction of tanker or helicopter dams could be a worthwhile investment. There is an extensive basic infrastructure of wide roads in place, which could be adapted relatively cheaply to provide a managed catchment to fill a dam from stormflow runoff. In general, storing water as high as possible in the landscape is likely to favor the usefulness in initial or sustained attack on wildfire. This suggests that capturing quickflow runoff from compacted areas such as ridge-top roads could be the best strategy.

Surface water storages will have an impact on the local ecosystem. In particular, an increase in the grazing pressure by terrestrial herbivores is likely to result. This is likely to have a further beneficial effect on reducing wildfire risk because of the reduction in some near-surface fuel components. However, there will be an on-going need to control feral herbivores such as rabbits and deer, and their feral canid predators.

The window of opportunity for prescribed burning in regenerating stands is relatively small. The prescription developed by the National Bushfire Research Unit (Cheney et al, 1992) seems to have been ignored in some instances, with spectacularly disastrous results. For example, prescribed burning in recently thinned 1952 fire regeneration prior to the construction of the JALO armaments depot on the Edrom road seems to have resulted in the outright death of many crop trees and the regeneration of a worse fire hazard, with a great deal of bracken fern and coppicing eucalypts.

In studies leading to the development of the prescribed burning guide, there was a highly significant inverse relationship between rate of spread and <u>near-surface dead fuel moisture content.</u> Rate of spread was also positively related to near-surface fuel % cover, and near surface fuel height. Since this latter variable was easier to measure in the field, and the two were related, only near surface fuel height was included in the final model. Given that bracken fern and wire grass are pyrophiles, the prescribed burning regime might cause a species drift towards the worst fuel types.

Two indicators of the practicability of the fuels management regime could therefore be developed. One is the prescribed burning "window", based on meteorological statistics. The other is the extent of near surface fuels throughout the regrowth areas.

4.Soils and Water.
There is an urgent need to assess the impact of current harvesting methods on site quality. The data of Bruskin and Horne (1990) suggest that the mean annual increment on logging regrowth may be about 60% of that in even-aged fire regeneration (1982 Eden Native Forest Management Plan).

The proposed interim indicator (Montreal 4.1.d The total quantity of organic carbon in the forest floor (<25mm diameter components) and the surface 30cm of soil) should be monitored across a stratified random sample of sites, pre and post-logging at, say 5 year intervals. As an immediate project, older age classes of regrowth could be surveyed (without their pre-logging paired data) to give an estimate of future trends.

The area effectively removed from production by the construction of roads, snig tracks and compacted log landings has been variously estimated at 11 to 18%. Although this area produces some quickflow runoff, its contribution to the organic productivity of the forest estate is likely to be very small. Are these areas now no longer considered to be part of the net harvestable area?

Water.
Intensively logged and regenerated native forests have been shown to produce less water as streamflow than the oldgrowth forest they replace (Lane and MacKay, 2001, Cornish 1993, Kuczera 1985.Vertessey, 1999)). Because this effect is largely due to increased evapotranspiration, the water yield reductions occur mainly in the warmer months. This means that flow duration into drought periods is poorer when there is a high proportion of regrowth in the catchment.

Conservation reserves in the South-east of NSW do not, in general, include the land along the major river valleys, with the best soils and access to water resources. By and large, the most fertile, arable land along major streams has been selected for farming and European settlement. This implies that it is unlikely that native fish will be adequately conserved within conservation reserves.

Many species of native fish are diadromous. That is, they require opportunities to migrate between the estuary and upstream freshwater reaches to complete their breeding cycles. Therefore, protection of adequate habitat and flow regimes along most of the length of major streams is vital for their conservation.

For south-coast streams, flow regimes for river health have been expressed as “River Flow Objectives”,
set by the Environment Protection Authority (EPA) after public consultation. They include:

1. Protection of refuge pools in dry times
2. Protection of natural low flows
3. Protection or restoration of a proportion of moderate flows, "freshes" and high flows.

(Advice to Water Management Committee's No 6, 2002 version, Department of Land and Water Conservation)

The implications for land management and water resource use are that the flow duration of streams draining forest catchments is a critically important parameter in assessing how catchment values are impacted by contemporary practices.

Selecting an indicator that is measurable in a reasonable period of time is difficult. Ideally, a flow duration curve, constructed from a record of 20 years or so streamflow data, would be used to assess tends in baseflow. This is far too long a time scale for practical use.

However, an understanding of model parameters that can adequately describe catchment behavior could be useful if they can be objectively assessed in a shorter period of time. Key parameters in the widely accepted AQUALM (modified Broughton) model for determining flow duration are the size of the soil moisture stores and baseflow recession constant. A reproducible method of estimating the baseflow recession constant from a relatively short hydrograph has been recently published. (Podger and Best, in Catchword No. 134, February 2005).

By combining an estimate of baseflow recession with estimates of the size of soil moisture stores, robust predictions of the likely flow duration curve applicable at the time of data collection for a relatively short hydrograph should be possible. In order to express trends following intensive logging and regeneration succinctly, a new indicator, “flow duration index”, is proposed. I suggest that the flow duration index be defined as the ratio of the 95^{th} percentile of flows to the average flow. This index would not only capture trends in water yield reduction at low flows, it would also reflect increases in stormflow runoff.

Water Quality.

The comparison of flow event data with low flow data for most water quality parameters shows the value of both types of data when assessing the impact on both the catchment drained and the receiving waters. For example, data for nutrients and coliforms in Bega Valley streams show about a 7 fold increase for nutrient concentrations an about a 300 fold increase in coliform counts in streams draining agricultural lands when peak event-flow water quality is compared to a low-flow snapshot. (see Turner et al 1998 and Resource Allocation, 2000).

State Forests have in general avoided the publication of water quality data from flow events, although the impact of logging operations on suspended sediments and bedload sediment generation is likely to be overwhelmingly associated with the first significant rainfall events after logging or and/or post-logging burning. Limited data published from the Yambulla Catchment Hydrology project area show significant increases in turbidity, even though the Adamellite geology is likely to produce relatively little suspended sediment.

The IFOA protocols for protection of water quality prescribe streamside buffer and filter strips as well as cross banks on sing tracks, with the intention of preventing overland flows from disturbed areas from reaching streams. This is not a sufficient safeguard when more than about 15% of the canopy or basal area is removed in a subcatchment. Tree removal will result in less evapotranspiration until regeneration develops, and consequently a higher stormflow runoff response to subsequent rainfall. (Bosch and Hewlett, 1986). This will cause a measurable increase in stream bank erosion in most instances.

The EPA has required State Forests to measure event-flow changes in water quality from various experimental sites. Data for streams in shale (ordovicien metasediment) catchments have yet to be published, to my knowledge. These data should be made available forthwith.

An indicator which quantifies aquatic biota, such as macroinvertebrates, (e.g. Montreal 4.1.f) would integrate aquatic ecosystem impacts over time. Preliminary data from the site in Glenbog State Forest above the Cochrane Dam, cited in Growns, (1994), suggest a persistent impact from relatively recent logging.

Indicator 5.1.a (total forest ecosystem biomass and carbon pool) has not been quantified. The SEEING report examines only annual carbon sequestration in planted forests (Appendix 18, page 22).

Carbon cycle budgets should be fully defined and quantified to a reasonable approximation. This is a further reason for reporting on interim indicator Montreal 4.1.d (The total quantity of organic carbon in the forest floor (<25mm diameter components) and the surface 30cm of soil). State Forests would be well advised not to shy away from a careful evaluation of the relative contributions of CO_2 and Methane from forest ecosystems, since methane has about 21 times the Global Warming Potential of CO_2 and is produced by gut flagellates in termites, whose populations might well be higher in oldgrowth forests than in regrowth regenerated after intensive logging and post-logging burning.

A greenhouse impact budget for the full cycle of logging and regeneration is needed for evaluation of current management practices under this criterion.

7. Institutional Arrangements for assessing ESFM.

We now seem to be back to the bad old days when State Forests was both the proponent and the determining authority for logging proposals. Even when RACD in the Department of Planning was the EIS determining authority, complex issues such as quantifying water yield reductions due to intensive logging and regeneration were too hard for independent assessment. Subsequent reports by GHD (1998) and the Healthy River Commission (2000) have been inconclusive, partly because State Forests has succeeded in keeping relevant data out of the process for critical periods (e.g. Tantawangalo Catchment Hydrology research findings).

CRA efforts to examine this issue were either laughable or shamefully misleading. Beavis and Okey (1998), compared current water use with average annual streamflow, thereby ignoring completely the fact that most of the streamflow occurs on less than 10% of days, and long periods of low or zero surface flows tend to occur in summer, when water demand and evapotranspiration are highest. They even appear to have transcribed data from a NSW Water Resources Council document incorrectly, in a way that would give the reader the impression that water resources are abundant relative to demand. Their table 6 (under 1.9, surface water resources) says that mean annual streamflow in the Towamba River is 530,000 Ml/annum and the streamflow variability is 46 to 200% of average. However, the true annual streamflow variability for the Towamba River is 3 to 460% of average. Beavis and Okie appear to have substituted the figures for rainfall variability at Eden (Surface Water, NSW South East Region Water Management Strategy, page 59). In the context of an estimated annual water demand of 700 Ml in the Towamba Catchment (1998 estimate), their report gives the impression that minimum annual streamflow in the Towamba is 3483 times average demand whereas it was in fact 23 times annual demand. Of course, this demand is not uniformly distributed throughout the year but is highest in the warmer months.

In recent (dry) years, the Bega Valley Shire Council (BVSC) has attempted to operate the pumps at the Kiah borefield to maximum capacity, that is, about 4 Ml per day for 365 days per year, in order to fill off-stream storages and meet an increased demand for urban water use. Therefore, urban water extraction has been about double the CRA estimate for total water extraction from the Towamba River. In 2004, the BVSC drew down on the Kiah aquifer to such an extent that only two of 5 pumps were able to be operated and extraction was cut back to 1.5 Ml/day. A rainfall event of about 50 mm in July 2004 cased a fresh flow of about 10 ML per day at the Towamba gauge but failed to cross the borefield due to antecedent depletion. Thus a combination of catchment yield change and extraction by the BVSC and others has caused a failure to meet all of the first three River Flow Objectives set by the EPA for the Towamba River. While a cease-to-pump can be negotiated among extractors, there is no cease-to-pump for dense logging regeneration or pine plantations, (except perhaps wilting point?).

The CRA's for other forest regions had projects on water yield that modeled only annual water yields. This is in spite of the recognition that hydrological stress was defined as the ratio of total licensed allocation to the flow at the 80th percentile of flows in the Stressed Rivers Report. (see critique prepared for the South Coast Water Management Committee pasted below as appendix 1). This gives a misleading impression of the ecological and economic significance of water yield reductions during the warmer months, when evapotranspiration effects are greatest.

The Catchment Management Authorities may now try to deal with this issue. However, the water reform directors general prevented the South Coast Water Management Committee from dealing with the issue of water yield from regenerating forests and referred it instead to the Catchment Management Board, who did nothing.

I suppose an "institutional" problem is that State Forests gets revenue from timber products, not from water or wildlife conservation. State Forests has in the past played down the impacts of their operations on water resources and wildlife values. This is understandable but not acceptable in a democracy with responsible government.

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Appendix 1.

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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