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Review of the Draft Code of Practice for Private Native Forestry in NSW

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Review of the Draft Code of Practice for Private Native Forestry in NSW

Prepared for

Forest and Wood Products Australia

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Addendum

"The discussion within this report refers to the Draft Private Native Code of Practice that was withdrawn in August 2006. The current Code that was implemented 1 August 2007 contains only minor variations consequently the recommendations and conclusions expressed are applicable."

Table of Contents

Table of Contents	2
List of Tables	2
List of Figures	3
Executive Summary	4
1. Introduction (an outline of the current draft code and relevant dates).....	6
2. The effects of the Code (report on EUCAMIX simulations).....	11
2.1 Forests and their condition.....	11
2.2 CoP objectives and content.....	12
2.3 The economics of stand rehabilitation and a CoP.....	18
2.4 Evaluating Regional Impacts	25
2.4.1 Comparing impact of different regulatory provisions	25
2.4.2 Regional silvicultural impacts of regulations	26
2.4.3 Results of regional impact analysis.....	30
3. PNF Codes of Practice	36
3.1. Review of some international experiences	36
3.2 Australian Private Native Forestry Codes of Practice	39
3.2 Key legislation impacting private native forestry	40
3.2.2 NSW legislation	41
3.2.2 Victorian legislation.....	42
3.2.3 Queensland legislation	44
3.2.4 Tasmanian legislation	45
3.2.5 Western Australian legislation	48
3.2.6 South Australian legislation.....	49
3.2.7 Australian Capital Territory legislation	49
3.2.8 Northern Territory legislation	50
3.3 Codes of Practice	51
4. Incentives and other interventions for Improved PNF Management.....	55
4.1 Intervention to adjust supply.....	55
4.2 Incentives to promote good silviculture.....	56
5. Conclusions and Recommendations	61
References.....	66
Abbreviations & definitions.....	72

List of Tables

Table 1. Log Supplies in Selected NSW Regions.....	8
Table 2. Log Supplies in Selected NSW Regions.....	9
Table 3. Tree retention requirements for evaluating NSW PNF regulations.....	26

Table 4. Stumpage prices	30
Table 5. Results of regional analysis	31
Table 6. Hectares achieving stated net harvest income over two cutting cycles by High Grading and culling in Spotted Gum forest type, UNE NSW	33
Table 7. Hectares achieving stated net harvest income over two cutting cycles by Timber Stand Improvement in Spotted Gum forest type, UNE NSW	35
Table 8. Key Features of PNF Codes of Practice in Australia.....	51
Table 9. Private Native Forest Stewardship Mechanisms	59

List of Figures

Figure 1. Three common stand structures in north-east NSW. The horizontal axis is DBH class (cm) in 15cm intervals and the vertical axis is stand basal area (m^2/ha) . Average total stand basal area (BA) ranges from 16.8 to 27.9 m^2/ha	19
Figure 2. Modelled tree values over 30 years for a mixed-age Spotted Gum forest in north-east NSW with initial structure type 7 . Each data point is a “cohort-year”	20
Figure 3. Financial implications of the NSW CoP in the most common forest types and structures of NE NSW.....	21
Figure 4. Modelled Mean Annual increment of merchantable logs (MAI $\text{m}^3/\text{ha}/\text{yr}$) and net cash flow from harvest ($\$/\text{ha}$ NPV0% stumpage – cull costs incurred) for two forest types in NE NSW.....	24
Figure 5. Modelled tree years/ha* >70cm DBH and Stand Basal area (m^2/ha) at year 30 for two forest types in NE NSW	24
Figure 6. Hectares of site quality class on PNF land in UNE NSW	27
Figure 7. Hectares of PNF Forest Type and site quality in UNE NSW.....	28
Figure 8. Cumulative hectares of non-discounted net cash income in 3 regional forest types (H1&H2 NPV0% harvest income-cull costs).....	33

Executive Summary

Native forests cover about a third (27M ha) of the state of NSW with 6.5M ha of this being open eucalypt forests in private ownership. The area of private native forests of this type exceeds the combined areas in both the public native forest estate and in conservation reserves.

Private native forests are now a crucial component of the hardwood timber processing industry supply in NSW with every 1,000 m³ of logs processed generating more than 5 jobs in regional economies. The economic importance of the private native forest estate has increased largely as a result of Regional Forest Agreements (RFA) which resulted in a contraction of log supplies from public forests in the pursuit of conservation objectives.

One outcome of the RFA process was the intention to devise a Code of Practice to regulate private native forestry activity in NSW. This Code has been through several revisions and public exhibition periods and at the time of writing, the final version of the Code had not been publicly released.

This study reports on the economic and silvicultural implications of a NSW Code by applying the EUCAMIX native forest growth simulation model to eucalypt forests in the Upper North East region of NSW. Only the basal area reduction and large tree retention prescriptions were examined, though the Code also impacts on harvesting and silvicultural activities through stream buffer and listed ecological species prescriptions. The results are therefore likely to be an under-estimate of the Code impacts.

The basal area and large tree retentions required by the Code will create competition stress and reduce the growth rates of retained and regenerating smaller trees. In 200,000 ha of northeast NSW private forest, this could reduce the commercial volumes harvested by an average of 60,000 m³ per year over the next 30 years, cause a potential loss of \$100M in stumpage payments to landholders, and result in the loss of around 250 jobs

Moreover, the Code will reduce the likelihood of improved silvicultural management being undertaken as the financial wherewithal to undertake costly thinning operations is reduced and landholders are inclined to adopt a 'safety-first' approach to harvesting to ensure they remain within the basal area prescriptions. This means a continuation and quite possibly an acceleration of unsustainable 'high-grading' activities where the focus is on commercial tree removal with no restorative silviculture applied. The Code thus has a perverse outcome of degraded forest health, vigour and structure, and a decline in future timber supplies.

The environmental benefits of the Code and the issue of who bears the costs also require closer consideration.

A regulatory Code may be neither necessary nor the best policy instrument to improve or maintain environmental outcomes. General habitat values (as measured by scoring systems) do not appear to be affected by logging history. Any form of native forest cover on private land has habitat values which far exceed those of typical competing land-uses (i.e. cleared agricultural land, urban developments). Whilst a regulatory Code will result in more large tree retention (an important habitat attribute due to branch-hollows) and wider stream buffers, the costs of providing these 'public goods' are entirely borne by the landholder and ultimately the timber industry. It appears inequitable and perverse that landholders who maintained permanent native forest cover on their land for the purpose of generating income from selective harvesting will now be financially penalized. Alternative policy instruments may achieve similar or better environmental outcomes with lower total economic and social cost.

This report outlines the impacts of the Code, and the scope for addressing some of its inherent problems while ensuring improved outcomes for forest management and conservation values.

1. Introduction (an outline of the current draft code and relevant dates)

Native forests cover about a third (27M ha) of the state of NSW. Some three-quarters is open eucalypt forest of which 6.5M ha is in private freehold ownership¹, covering more than state forest and conservation reserves combined. Although less than half of the private native forest (PNF) area is suitable for long term timber production (because of low site quality, steep land, or non-commercial species), most areas can provide substantial scenic, habitat, biodiversity, and/or water benefits. The biodiversity role is important because a system of publicly-owned conservation reserves will not guarantee that there will be no loss of species (Goldingay & Newell 2000; Kallimanis et al. 2005). An expansion of conservation reserves (including defacto or forced reservations on private land) without adequate funding and management may actually result in the “benign neglect” of biodiversity, producing less beneficial and more costly outcomes than the alternative of continued broadscale forest harvesting at an appropriate intensity (e.g. south-east Queensland: McAlpine et al. 2005).

Ecosystem services are a key element of sustainable forestry on both public and private lands. Forests, even if greatly simplified in the form of monoculture plantations, provide far greater biodiversity conservation values than cleared pasture or cropland. (Borsboom et al 2002, Lindenmayer 2002). Private native forests, including those managed primarily for timber production and intermittently disturbed by logging operations, provide connectivity and structural and spatial diversity in the landscape matrix of reserved and managed forest areas, and thus make an important contribution to the conservation of regional biodiversity. PNF will continue to provide these environmental and habitat values for so long as landowners are motivated to retain large contiguous forest blocks and improve or maintain healthy productive condition in each stand.

Until relatively recently, PNF have been the neglected forests, with generally little attention paid by either the owners or the public to the forest’s potential to continue providing multiple yields and services over the longer term. On the landowners’ part, this neglect was fostered by low stumpage prices paid for PNF logs, an outcome arising from the price-taker position experienced by landowners in a market dominated by a single large public supplier (i.e. Forests NSW). For its part, the State was instrumental in encouraging clearing and agricultural development. Now permanent clearing of native vegetation has essentially been halted, and an increasing

¹NFI 2003 <http://affashop.gov.au/product.asp?prodid=12858>)

focus is being brought to bear on forest management practices on private land in a time when timber supply from public forests has been greatly reduced.

Some of this focus arises from a presumption that logging is either reckless or indiscriminate, and causes forest destruction or loss of natural values. This perception may arise because much of the literature about the ecological effects of timber harvesting in Australian native forests deals with short-term effects of clearfelling which maintains extensive areas of even-aged monoculture (Bennet and Adams 2004). Similarly, studies of fauna species responses to logging in NSW (Kavanagh 2003) have assumed that stand replacing events would occur, and discounted the potential ameliorating effect of the landscape matrix around the logged area. In this worst case scenario, fauna species which are sensitive to logging include large-hollow dependent birds and mammals, marsupial predators, species with naturally low population densities or highly specialised habitat requirements, or a social population structure. However in forests where the natural structure is mixed age and mixed species, selective logging is likely to have minimal ecological effects (e.g. Atleglim & Sjöberg 2004) except where there are landscape-wide changes which simplify stand structure and condition.

Where long-term empirical evidence is scant, ambiguous, or difficult to obtain, or there are significant risks of irreversibility in current practices, model-based approaches which integrate general ecological and physiological principles with expert understanding can be used to investigate logging outcomes. These are a practical way of adaptive management (Wilhere 2002), allowing policy makers to conduct “virtual forestry” experiments and explore outcomes and implications of various management options. Such approaches allow for continuing resource use with incomplete knowledge, while retaining the management flexibility to respond to new information as it becomes available.

Continuing resource use is an important consideration. Timber production from PNF in NSW is important to local and regional economies, and the economic benefits are additional to those from conservation and tourism. From 2002-2006 the average hardwood sawlog supply from public native forests in the whole of NSW was 640-700,000 m³ per annum from about 846,000 ha². The State has committed to supply some 350-500,000 m³ per annum from the coastal areas north of Newcastle³. Recent accurate disaggregated statistics for log supply from PNF in NSW do not exist. However industry experience suggests that, as for public forests, northeast NSW is the major source area for private hardwood log supply other than pulpwood. Additional jobs and regional income are generated by timber harvesting in private forests on the

² http://www.dpi.nsw.gov.au/__data/assets/pdf_file/101612/forest-facts-figures.pdf

³ NNFS 2005: www.privateforestry.org.au/forest_resource.htm

northern tablelands, the south coast and southern tablelands, in the riverina floodplains, and in the western cypress and hardwood areas.

In upper northeast NSW (UNE NSW is the coast and tableland areas north from Coffs Harbour) some 260,000 m³ per annum, or around half of the regional mill intake is drawn from PNF⁴. Many small mills are entirely reliant on the private resource (Table 1). The annual value of manufactured timber out-turn is about \$84M. Some \$26M per annum is paid in wages to about 650 employees in harvesting and sawmilling and a further \$15M is paid in stumpage to landowners (NNFS 2005), equivalent to another 375 jobs. Multiplier effects add to these outcomes. For example Thompson (2007) reported that for the upper northeast area of NSW in 1997/98, every 1,000 m³ of hardwood sawlogs processed generates \$454,000 of gross output, \$127,000 of household income and 5.07 jobs. These figures include all direct and indirect effects, and so provide a measure of the total economic impact of native forestry activity on the regional economy⁵.

Table 1. Log Supplies in Selected NSW Regions

Region	Forest type	Processor reliance on private timber in 2005	Change in public forest supply (pre-RFA to 2005)	Change in private forest supply (pre-RFA to 2005)
Upper and Lower North East NSW	Hardwood species (mostly eucalypts)	66% of mills totally reliant 18% of mills >50% reliance 16% of mills <60% reliance	Reduction from 630,000 ^a to 477,000 ^b m ³ (includes part of Northern Inland supply)	Increase from 350,000 ^a to 460,000 ^d m ³ (includes part of Northern Inland supply)
Northern Inland NSW	Hardwood species	89% of mills totally reliant (represents 22% of logs processed) 11% of mills <5% reliance (represents 78% of logs processed)		
Northern Inland NSW (Brigalow South and Nandewar)	White cypress pine	4 mills remaining post-Western Assessment decision, reliance up to 12%	Reduction from 78,000 to 40,000 m ^{3c}	Varies up to 5,000 m ³

a. CARE (1999a and 1999b)

b. Forests NSW (2006)

c. Ross Irvine, Forests NSW, personal communication

d. NRPF (2005)

⁴ <http://www.forest.nsw.gov.au/esfm/une/pdf/esfm-une.pdf>

⁵ Direct impacts measure the value of gross output, employment and household income attributable directly to activity in the native forestry sector. Indirect impacts are the value of gross output, employment and household income in other sectors of the economy that either supply inputs to forestry (known as the production induced effect) or in which forestry derived wages are spent (known as the consumption induced effect).

Timber supplies from private native forests also make a contribution to the log supplies of sawmills which have a log allocation from the public forest estate (Table 2).

Table 2. Log Supplies in Selected NSW Regions

NSW supply region	Log supply from private land (m³)	Log supply from public forests (m³)	Private forests share (%)
Central	59,500	258,500	19
North east	46,500	127,500	27
Southern	5,650	87,850	6
Western	15,100	40,200	27
Total/average	126,750	514,050	20

Source: Forests NSW, unpublished survey 2006

The economic activity due to PNF compares favourably to the value generated by National Parks and conservation reserves in UNE NSW. In this region, Government expenditure on wages and value-adding for conservation reserves amounted to some \$30M in 2005, providing some 265 direct and indirect jobs (NPWS 2006). Further income and jobs are also generated by nature-based tourism but overall the attractiveness of the region is likely to be strongly supported by the scenic amenity of private forests and mixed farming landscapes. For example, only some 7-11% of visitors to Northern NSW in 1999-2001 actually visited National Parks or went bushwalking. (Tourism NSW, 2001). Changing management practices in PNF is unlikely to affect regional tourism value.

This report will show that landowners and industry will soon be affected by regulations that reduce the available volume of PNF logs. The regulation of forestry activities on private land in NSW is in a state of flux. At present, private native forestry does not require regulatory approval provided it is (i) 'sustainable', (ii) does not encompass State Protected Land (mainly slopes of greater than 18 degrees), (iii) does not have a significant impact on listed fauna or flora species, and (iv) is allowable under local Council plans.

Over the last 10 years, numerous regulatory processes have been proposed, investigated, amended, or introduced in draft form. (Nichols 2007). This started with the introduction of SEPP46 (State Environmental Planning Policy No. 46 - Protection and Management of Native Vegetation) in 1996, followed by the Native Vegetation Conservation Act 1997 (NVCA) and then the Native Vegetation Act 2003 (NVA). The overarching principle in the NVA is that clearing is only to be permitted if it "improves or maintains environmental outcomes.....in accordance with the principles of ecologically sustainable development" (NVA sec 3(b) . To achieve this, the Act prohibits "broadscale clearing" of native vegetation, which is defined as "clearing" of "remnant" vegetation which existed before 1990. Certain exemptions

apply for “routine agricultural management activity”, but this does not apply to production of timber or logs for sale.

A perceived need to regulate NSW private forestry arose from concerns that (i) the ‘sustainable forestry’ exemption was being abused as a means of permanent (partial) land clearing, (ii) no statistics were available for the extent or nature of forestry practices on private land, (iii) rates of harvest may be exceeding the sustainable yield, and (iv) soil erosion, water pollution and habitat loss were a substantial risk with prevailing practices (Prest 2004). However, the move to regulate occurred with neither strong evidence about the extent or seriousness of these purported abuses, nor clear scientific rationale or support for the prescriptions intended to end them.

Another version of a draft Code of Practice (CoP) for Private Native Forestry was published in July 2006. This sought to remove the ‘sustainable forestry’ exemption and apply a number of conditions to forest management (Nichols 2007). The draft CoP prescriptions appear to be mainly a means of creating a quantitative (and thus legally enforceable) limit whereby regulators can be satisfied that landowners are meeting the statutory obligation of the NVA to ‘maintain or improve environmental outcomes’. However since tree retention *per se* may be only indirectly related to maintaining biodiversity or preventing soil erosion, the policy appears to be confusing “outputs” with “outcomes”.

The draft Code caused discontent amongst landowners and the forest industry, and was withdrawn in September 2006. The current exemption under the NVA continues to work as a savings provision from SEPP46, but a sunset clause in the regulation has the exemption expiring on 1 July 2007. If the exemption expires, PNF would be essentially prohibited outright since the NVA definition of broadscale clearing includes felling of a single tree.

Hence PNF in NSW faces considerable regulatory uncertainty. The obligations proposed by the draft CoP are perceived by many landowners as being beyond an ordinary “duty-of-care” and as posing a threat to freehold property rights. A behavioural response may well be to consider the next harvest as the last one allowed or affordable, meaning no investment in silvicultural improvement or concern for ongoing fire management. A perverse incentive from poorly constructed regulation may thus be far more destructive than ‘management-by-muddling-along’.

This study aims to analyse some aspects of the draft CoP and will focus on the upper north-east region (UNE NSW) as a case study area. One of the objectives is to provide background that will inform answers to questions such as “what is the likely future availability and supply from private forests under various policy scenarios?” and “what are the economic implications of adopting sub-optimal timber management

regimes?” The answer to these questions must be sought within a framework of long-term dynamic and complex interactions.

The study will identify and make quantitative estimates of possible impacts of components of Code regulatory prescriptions on forests and landowners, and to a lesser degree industry, and to compare these to some policy alternatives. It is hoped that this will lead to better-informed future policy directions. We adopt the position that forest management should be addressed at regional level and analysed in keeping with a public welfare approach, meaning that total benefits should exceed costs.

2. The effects of the Code (report on EUCAMIX simulations)

2.1 Forests and their condition

In NSW, PNF is practiced in North Coast Mixed Hardwoods, Tablelands forests, South Coast Hardwoods, River Red Gum, Cypress Pine, and Western Hardwoods. Rainforest and wetland forests (eg. Melaleuca) are usually not harvested for timber, or only in very minor amounts. Silvicultural and logging practices in NSW native forests are described by Bauhus (1999) and Nicholson (1999) with a brief overview in Jay *et al* (2007). To consider the likely effects of the CoP it is first necessary to consider the types and silvicultural condition of forests which are being harvested by landowners. Floristic mapping has been extensively undertaken for most of NSW forests⁶ but relatively little is known about stand structural condition⁷ and the spatial distribution of different structures across the landscape. The effects of the Code will vary across different forest types, however this discussion will focus on North Coast Hardwoods and Tablelands forests in upper northeast (UNE) NSW where some structural condition surveys have been undertaken (Jay 2005, 2006a).

In UNE NSW, the PNF estate is in generally poor productive condition, having had a long history of selective management and/or high-grading, meaning removal of commercial stock without due attention to silvicultural improvement treatment. Jay (2005) used cluster analysis to group 870 UNE NSW forest plots, a really-proportioned and randomly located in 12 stratified forest types, into 11 structural types. He found that only 26% of the plots had more than 2m²/ha basal area in any of the 15cm-interval size classes >70cm DBH (these plots had mean stand basal areas all

⁶ www.nationalparks.nsw.gov.au/npws.nsf/Content/Vegetation+coverage+of+NSW

⁷ A simple definition of stand structure is the distribution of total tree biomass across different diameter size classes.

>30m²/ha), and that the most common single structure (30% of all plots) had a low mean basal area (16.5m²/ha) and only a few vigorous trees >25cm DBH. The next three most common structures (38% of all plots) were better stocked with mean basal areas 24.4-27.9 m²/ha, although the majority of trees >25cm DBH were of secondary timber species and/or had poor crown vigour and/or form.

Hence more than two-thirds of the sampled stands had either a low total biomass (stocking), or had mostly defective trees or non-commercial species in trees >40cm DBH. In addition, a high proportion of the smaller pole stage trees (25-40cm DBH) are non-commercial species or defective in some way. Crown vigour in the sapling class (10-25cm DBH) is generally good for all structures, but the wide occurrence of poor log grades (form/defect problems) and low proportion of commercial species in the sapling size classes implies there will be limited future timber potential. These regional results echo those reported by Combe et al (1998) for a single large forest holding.

Future supply of commercial logs and of habitat values which are linked to the presence of vigorous trees of several species in a range of size classes, is thus fundamentally dependent on restoring these stands to a more vigorous and productive condition (Jay *et al* 2007). The extent to which CoP provisions will encourage this outcome will be examined after a review and commentary on the CoP content.

2.2 CoP objectives and content

The CoP has no specifically stated objectives or outcome targets other than to comply with the fundamental requirement of the NVA, which is to “improve or maintain environmental outcomes”. This requirement is broader than the definition used for PNF in the CoP, which is “the practice of sustainably managing a native forest for long-term timber production”. In fact most of the CoP deals with elements other than silviculture and timber production *per se*, eg. design and placement of roads, reservation of features considered important for wildlife habitat.

The essential features and requirements of the CoP are listed below, with a following critique

1. All commercial harvest, even of a single tree, will have to meet these requirements.

Comment: This seems unduly bureaucratic for small operators who occasionally sell fence posts and poles. Felling of trees to use timber for own on-farm purposes is exempt from the NVA. There appears to be little purpose or gain in requiring approvals for operations which sell less than say 25m³ (one log load equivalent) in any 12 month period.

2. The landowner must prepare a Property Vegetation Plan (PVP) and lodge it for approval. The PVP is a legally binding instrument registered on the land title for a maximum term of 15 years. The PVP identifies areas which the landowner is permitted to harvest in accordance with the CoP, and identifies and maps all exclusion areas. It is compulsory for a DNR⁸ officer to inspect the site prior to the PVP being lodged. A public register of all PVPs is available on the internet.

Comment: The 15 year time period is a major disincentive to invest in restorative silviculture. If landowners cannot be certain of harvest beyond the period of the current PVP, they are unlikely to retain any harvestable stock for future growth, nor manage for future productivity. Following gap creation for example, an 80 year period might follow before the regeneration matures and is ready for final felling again. Landowners are likely to bring harvests forward, before trees are fully mature, in order to remove all available timber before the uncertainty of a new PVP approvals process. Hence the sovereign risk created by the CoP might well accelerate the tendency to engage in bad silviculture ("high-grading" or removal of all economically viable material, and no thinning to avoid suppression in the regrowth).

3. The landowner (with DNR assistance available if required) must complete a forest management plan (if the area >100ha) and a harvest plan for all areas prior to commencing operations. The plans comprise both written and map components. The plans must comply with the CoP but do not need to be lodged and approved. However they must be provided to logging and roading contractors, and be available on site at all times (including up to 7 years after logging) in the event of an audit.

Comment: It is important that the plans should only be attached to a PVP in such a way as to allow on-going flexibility, and should not be disclosed to the public. The landowners costs of preparation and implementation should be restricted only to those elements that comprise a reasonable duty-of-care for timber production. Specifically this means reasonable roading standards to prevent off-site water pollution and erosion, and ensuring forest regeneration. It should not include the cost of planning for public benefits such as retaining HBT and recruits, wide stream buffers, and BA retention, or identification on maps of AGSS gap areas, or field marking of riparian buffers, or LSEP exclusions zone. All of the latter are public goods. Base maps and/or data should be supplied for free by DNR, and the written component of the Plans should be supported by on-site extension advice. Preferably, the advice should not be restricted to DNR input. Landowners needs may be better served by a voucher system

⁸ The Department of Natural Resources was intended to be the approval authority when the draft CoP was released. However DNR ceased to exist after the March 2007 state election and it is not yet clear whether forestry PVPs will be approved by a CMA (Catchment Management Authority) or DECC (Department of Environment and Climate Change). The DPI (Department of Primary Industry) will be responsible for public forestry operations.

which allows services to be procured from DNR, CMA, any other agency, or professionally qualified private consultants.

4. The landowner must notify the Department of Natural Resources (DNR) of harvest intent and report post-harvest volumes and areas and silvicultural treatment methods

Comment: The volume-harvested information is a valuable resource for future industry planning and policy development, and should be made publicly available in segregated form in such a way as to not identify individual properties. However some harvests are currently made on a lump-sum basis and the landowner may not keep or have access to records of volume harvested. Forcing the reporting of volumes of product and the development of forest plans may create a tax liability for some landowners⁹.

5. Exclusion zones of 10 to 40 m width are prescribed on each side of all mapped watercourses. The width increases with Strahler stream order.

Comment: Although riparian zones are known to be the primary source of most storm flow, hydrological science does not justify such total exclusions or the width of the proposed buffers for higher order streams. (Bren 1995, 2000, Walsh and Lacey 2003). Grass, rather than tree cover is most effective in trapping overland sediment (Sheridan et al 1999, Prosser et al 2002). The buffer rules exclude harvest on around 12% of the landscape as a whole (Jay 2005). However the yield and value reduction effects may be greater than 12% because growth rates and product quality is often higher in riparian zones. The "total machinery exclusion" provisions may also create a "buffer-on-buffer" effect where trees near to, but not within, a stream exclusion zone, are not able to be felled. Rules currently in place (BOS) for land >18° slope permit partial log extraction (30% canopy reduction) in stream buffers, and there is no scientific data to suggest this was not adequately serving the purpose of protecting water quality. It appears that in order to obtain the "biodiversity certification" which allows the CoP to serve as an automatic compliance with the Threatened Species Conservation Act 1995, the wider exclusion zones may be designed to function as wildlife corridors, not watercourse protection. As such they constitute a provision of public goods not a duty of care to prevent off-site water pollution.

6. When undertaking selection logging, prescribed amounts of basal area (BA from 12 to 18 m²/ha depending on forest type and tree height) must be retained. The width of canopy gap openings must be less than twice the mature tree height (eg. maximum

⁹ See Secs 57 & ff TR95/6

<http://law.ato.gov.au/atolaw/view.htm?locid=TXR/TR956/NAT/ATO'&PiT=99991231235958>

gap area 0.2-0.3ha) and amount to no more than 20% of the total forest area on the property.

Comment: These constraints are one of the worst features of the CoP. Coupled with the 15 year PVP, they create a very strong incentive to practice High-Grading, or the removal of commercial stock only, with little attention to ensuring long-term productivity. Even if a landowner was willing to overlook the sovereign risk and invest in silvicultural improvement in a structurally degraded stand, the required retentions would result in high stocking of non-commercial trees after logging, and these will severely impact on future growth and yield. Compared to a base case of Nil Code and business as usual, the silvicultural effects alone from the CoP will have the effect (Jay 2005) that Net Present Value of the production forest area (estimated at 35% of total PNF area) using a 5% real discount rate is reduced by at least \$65M in UNE NSW. The potential harvested log volumes at first and second harvest each fall by some 25% due to foregone harvest and competition effects on regrowth. These results will be demonstrated and discussed in more detail in the following section. The cost and volume reduction effects noted here do NOT include costs of planning and tree marking, the increased harvest difficulty of operating around retained trees, the cost of old-growth, stream buffer and wildlife habitat exclusions, nor the significant losses in downstream processing value and employment.

Notwithstanding the bad silvicultural outcomes likely from a prescribed BA retention system, there is a further question of just how BA retention would be interpreted and implemented. BA measurement is a sampling process, not a complete enumeration. The fastest and simplest way to measure BA is to use an optical wedge with variable radius sampling rather than laying out plots of measured size (eg. 0.1 ha) in which every tree must be measured. The variable radius method is precise, but is a point sample. A sample at another point, even 10 m distant, may provide a different result, as much as $\pm 20\%$. Two competent assessors may thus estimate different average BA, especially if inherent variability is high. Suppose for example, a logging compartment has equal areas represented by each of the 10 BA values in the series 10, 12, 14...28. (This is a relatively consistent sample for a post logging stand). The true mean is 19, but a simple T-test reveals that the mean of a random sample will be less than 18 for 30% of the time. Similarly if the values were 8, 10, 12...26 (a negligible difference to the first example), the true mean is 17 and a random sample mean would be greater than 18 for 30% of the time. The prospect arises that the first owner, who has complied, would be prosecuted for breach, while the second owner who has not complied, would be given a tick of approval. Since the nature of selective logging in natural forests is that removal and retention will vary widely from place to place, there must be parts of the forest where the retention is considerably less than average. It is not clear whether the below average parts of the

stand will constitute a breach of the CoP. It is also unclear whether a single tree selected outside of the general coupe extends the definition of "logging area" into better stocked stands and thus allows more intensive removal in other parts of the coupe.

7. A minimum of 10 hollow-bearing trees (HBT) and recruits per hectare must be retained in the logging area. Dead trees with hollows and HBT in drainage buffers and prescribed exclusions may not be counted toward retentions.

Comment: The blanket prescription for retention of 10 large trees per hectare across all forest types does not appear to have a scientific basis. On 38 Spotted Gum (Corymbia citriodora) sites in southeast Queensland for example, species richness and abundance of arboreal mammals did not increase when a threshold of 4 and 6 HBT per hectare respectively was reached (Wormington et al 2002). Current practices in PNF do not appear to be degrading general habitat values, nor does cessation of logging increase them. The evidence of this comes from a study by Jay (2006a). "BioMetric" is a points-based system which uses vegetation structure attributes and landscape connectivity measures to determine relative environmental value under the NVA (Gibbons et al 2005). HBT abundance amounts to some 41% of the total potential site score. The BioMetric site-scoring method and three similar metrics were applied by Jay (2006a) to 21 Spotted Gum (C. variegata) sites on four properties in NE NSW. All sites had a history of logging, fire and grazing, except one property which had not been burnt, logged or grazed for over 15 years. The sites selected on each of the properties encompassed a range of nominal structures from predominantly regrowth to forest with a visibly high frequency of big old trees, and included forest which had recently been selectively logged. The study also surveyed birds, reptiles and mammals. All sites scored relatively highly (70-90% of the benchmark ideal) except for the 7 sites which had fewer than the "expert consensus" benchmark 10 HBT/ha. Fauna abundance and species richness were not related to either site scores or nominal structure or logging history. Hence logging history and vegetation structure does not appear to be strong determinants of either general habitat value or fauna presence. The existence of contiguous forest per se appears to be the important factor providing habitat.

8. There are prescribed conditions for road construction, drainage, log dump sites, and forest regeneration.

Comment: The landowner's costs of protection and management should be restricted only to those elements that comprise a reasonable duty-of-care for timber production.

This might include rehabilitating compacted soil, snig tracks and log dumps, but not much more. Regulating to control on-site erosion or sediment deposition within property boundaries is arguably not serving a

public benefit. Off-site water pollution is already an offence under sec 120 of the Protection Of the Environment (Operations) Act 1997. The CoP creates additional process without necessarily producing outcomes. The roading and drainage prescriptions are useful as a guideline for management and perhaps as a prima facie legal defence, but in prescriptive form they just add to the regulatory compliance burden and sovereign risk in landholders management decisions. The aim should be to educate and advise, backed up by last resort penalties, not micro-manage by prescriptive regulation.

Forest regeneration is in principle a reasonable requirement to include in a CoP, as it demonstrates bona fide sustainability and intention to continue an existing use. However in the publicly released draft there were no details about how the requirements would be implemented and assessed.

9. For Listed Species, a set of Ecological Prescriptions (LSEP) applies where database records indicate the species occurs. LSEP includes expanded stream buffers, increased tree retention or harvest exclusion in a buffer zone around the record. Buffer zones must be marked in the field, and typical sizes range from 50 to 500m radius (200 m radius = 12.5ha) but may be as large as 1000m radius (315ha) for some owls.

Comment: *The landowners costs of protection and management should be restricted only to those elements that comprise a reasonable duty-of-care for sustainable timber production. Other costs of protection and management should be recognised as public goods and paid for by the public. This includes not only cash outgoings, but forgone income and growth potential.*

In place of prescribed exclusions, the alternatives are guidelines and education/assistance that will allow landowners to recognise the importance of particular species, their habitat needs and preferences, and incentives to support management activities which will promote the species reproduction and survival. It is presumed that basing the LSEP on database records rather than surveys is a measure designed to alleviate landowner costs. However there are serious questions about the outcomes achieved by such policy, and about the issues of "known records" and "site evidence".

The "known records" on the NSW Wildlife Atlas (www.bionet.nsw.gov.au) are only accurate to within 2 km in some cases. The CoP does not indicate how the record point and its buffer will be determined. It may be an administrative decision that varies according to the DNR or DECC officer making the field inspection. It appears that the costs and responsibility of marking the buffer in the field lie with the landowner. However not all landowners or contractors have a GPS or know how to use one, GPS does not always work properly under a forest canopy or in hill shadow, and it is

not easy to mark a 300m radius around a central point in a forest especially where there is dense undergrowth. A 300m radius circle has a perimeter of nearly 2km. Walking this distance through dense forest across steep terrain while accurately marking with paint is likely to take several hours. Since this is a public purpose the costs should be borne by the public, either by DNR officers doing the marking or a voucher system to engage qualified persons.

There is no due process to determine whether “known records” are accurate or up to date. If a landowner’s neighbour does not like the idea of logging and rings DECC to say a Barking Owl was heard last night near the boundary fence, or a Quoll was seen in the headlights, does this constitute a “site evidence” or a “known record” that will trigger a stop-work order? If it turns out to be a false record, who will bear the cost of downtime and disruption? There does not appear to be any formal mechanism or decision process to determine how DECC will distinguish between “nuisance” sightings of this sort and real records.

The process of exclusion in LSEP is likely to lead to new fauna sightings being hidden, and in worst cases, fauna habitat being deliberately destroyed. A fairly constructed incentive scheme could have the opposite effect, leading to valuable new information about fauna distribution and life cycles, and engaging landholders in encouraging and protecting the wildlife that are a source of income, enjoyment and pride.

2.3 The economics of stand rehabilitation and a CoP

As discussed previously, many PNF stands in NE NSW are in poor structural condition. Field observations and expert consensus suggest that this is a result of repeated logging cycles over a century or more, in which there has been little deliberate attempt to undertake silvicultural improvement or promote strong regeneration (i.e. High Grading, or removal of large commercial logs only). The causes of this are multi-faceted, but major factors are probably lack of knowledge by landholders, low prices paid for logs which are insufficient to encourage or pay for silvicultural treatment, low growth rates in the following crop, and cash flow disadvantages. The following analysis will show that a CoP will exacerbate these effects.

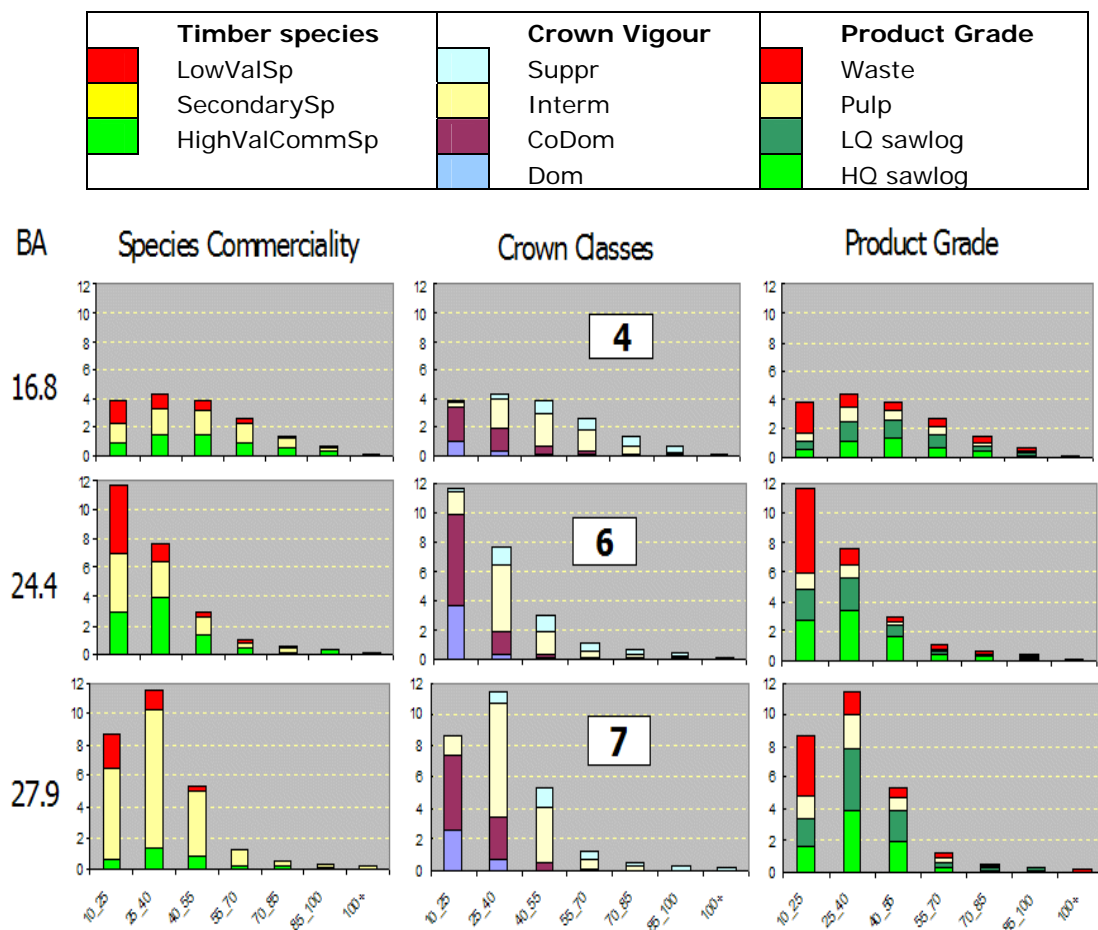
Jay (2005) showed that landowners who wished to obtain a reasonable cash flow and had moderately positive real discount rates, would be making an economically rational choice under current price conditions by High Grading. Logging which retains medium to large trees for on-growth will provide a relatively inferior economic outcome. This conclusion was derived by optimizing silviculture for a range of initial stand structures using the EUCAMIX model (Jay 2006b). It is rational

to invest in culling non-commercial stock at harvest time, where (i) real discount rates are very low (0-2% real); (ii) there is a reasonable component of potentially commercial stock in the regrowth, (iii) the site quality provides for rapid tree growth , and (iv) landowners immediate cash flow needs and perceived sovereign risk are low.

The most common forest types and structures in UNE NSW are now used to illustrate the economic factors which encourage High Grading with no culling.

Three structures (Figure 1) comprise 65-75 % of the inventory plots (n=493) located in dry Spotted Gum, dry Blackbutt, moist coastal Eucalypt, and semi-moist and tall dry Eucalypt forest types (Jay 2005). This combination of structures and forest types collectively represents 50% of the gross productive PNF land area in NE NSW

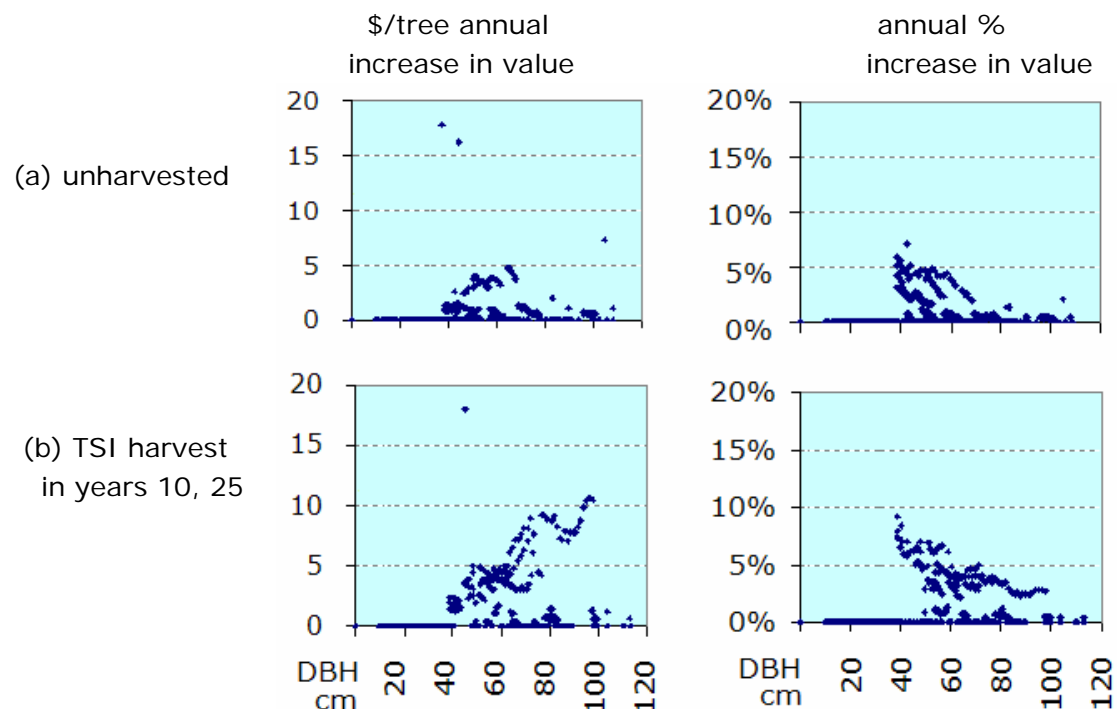
Figure 1. Three common stand structures in north-east NSW. The horizontal axis is DBH class (cm) in 15cm intervals and the vertical axis is stand basal area (m²/ha) . Average total stand basal area (BA) ranges from 16.8 to 27.9 m²/ha.



Using the EUCAMIX model, the value growth over a 30 year period of individual trees in a single stand is illustrated in

Figure 2. It can be seen that over the modelled 30 year life of this stand, the increase in value for even the best trees is less than 5% per year once the tree's diameter exceeds 60cm DBH. Removal of competition (TSI)¹⁰ can substantially improve the rate of \$ value gain by larger trees, but not by enough to exceed 5% p.a. Hence to maximise NPV a PNF landowner is acting "rationally" by removing all large trees if his/her real discount rate (opportunity earning rate) exceeds 5% and if the other perceived benefits of forest ownership do not add to the tree's value.

Figure 2. Modelled tree values over 30 years for a mixed-age Spotted Gum forest in north-east NSW with initial structure type 7 . Each data point is a "cohort-year"



After entering the common structures (Figure 1) and forest types into the EUCAMIX model, an analysis of financial outcomes from harvesting with and without CoP retentions are shown in Figure 3. Each data point is the average result from multiple stochastic simulations, undertaken for average site quality only.

¹⁰ Log prices and silviculture are described in the next section of this report which looks at regional impacts of a CoP

Figure 3. Financial implications of the NSW CoP in the most common forest types and structures of NE NSW.

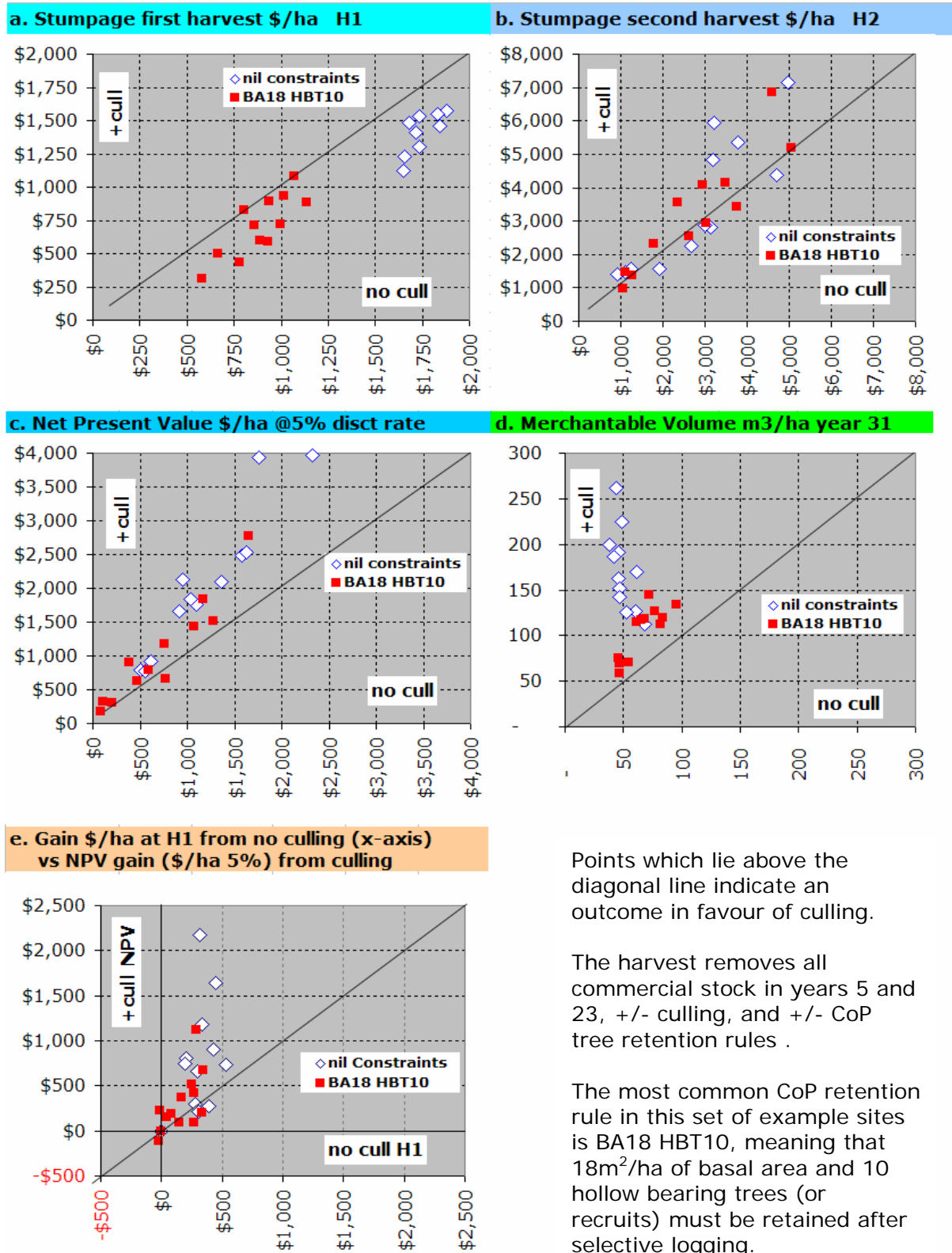


Figure 3 illustrates why (i) High Grading without culling has been a widespread practice and is likely to continue, (ii) the negative long term consequences of HG without culling, and (iii) why a CoP is likely to exacerbate the continuation of the practice.

At each harvest time, landowners have a choice of investing in silvicultural improvement, or forgoing that expenditure to invest or consume elsewhere. Figure 3c shows that, landowners who have a 5% real discount rate will always be better off over 30 years by investing in culling, except for one instance under the CoP. The financial benefit, in today's value, ranges from a few hundred dollars to almost \$2000/ha, and generally outweighs the cost of culling at first harvest (Figure 3e). The merchantable log volume is substantially greater after 30 years as a result of silvicultural investment (Figure 3d).

However these outcomes are (i) very obscure to forest owners with a rudimentary knowledge of silviculture and log markets, (ii) strongly dependent on the initial forest structure, and (iii) sensitive to the need for immediate cash flow (i.e. discount rate used). Figure 3a shows that the foregone cash at first harvest may be around \$250-\$500/ha, depending on stand structure, intensity of cull removals, and the cost of culling. (Cost used in this exercise is 5c/cm DBH, eg. \$1.20 to remove [poison axe] a 24cm tree). On a 40 ha logging operation, a landholder may thus have the choice of investing \$10,000 to \$20,000 now in silvicultural improvement and carry the risks of uncertainty about future benefits for both biological and institutional reasons, or use the funds for other purposes. Many landowners obtain their main livelihood from cattle, and a logging operation typically occurs when the season is bad or the livestock market is down. Under those circumstances, cash flow may be the main reason for logging and silvicultural investment is very unlikely.

The effects of tree retentions under a CoP will substantially reduce both initial cash flow and the long term NPV. In all the diagrams, a point which is closer to the bottom left corner, indicates a worse outcome. The CoP will reduce harvestable income by several hundred dollars per ha at the next harvest, (Figure 3a), reduce long term value and the relative benefits from culling (Figure 3e). By constraining the amount of culling permitted, it will also substantially reduce merchantable volumes over the longer term (Figure 3d). The CoP will also reduce both the absolute and relative NPV gain from culling compared the cash flow benefit of forgoing a cull at next harvest (Figure 3e). Even if sovereign risk were to be ignored, this is likely to greatly reduce the likelihood that landowners will invest in silvicultural restoration treatments.

The effect of delaying harvest by 5 years was also analysed. The results were similar to the essential patterns in the data and relative impacts of CoP shown in Figure 3, except that the NPV advantage of culling is reduced by some \$500/ha because of the longer period of competition and delay in growth response.

Jay (2005) used EUCAMIX to compare 4 silvicultural treatments, *viz* nil harvest (NilH), restoration (TSI), high grading with culling (HGc), and group selection (AGSS) in 7 forest types with 5 common stand structures and three levels of site quality (low, medium, high) for each type. Yield and financial outcomes for two of these, dry Spotted Gum and Moist Coastal Eucalypt types are shown Figure 4. The results show that factors other than CoP (for example site quality, silviculture and initial stand structure) can have a major influence on yields. However for most individual stands, non-discounted net income from harvest is typically such that $HGc > AGSS > TSI$, and growth rates of commercial quality logs are such that $AGSS > HGc > TSI > NilH$. CoP has negative consequences for both commercial growth rates and net income from harvest. When summed over two harvests (AGSS has one commercial harvest and subsequent thinning of regeneration) net income is reduced by CoP despite the constraints that reduce the allowable intensity of culling.

Figure 5 shows that a CoP does result in substantially greater presence of large trees in the landscape over time when HG or AGSS are undertaken. However the same result for large tree presence can be achieved by TSI (silvicultural restoration treatment) under the current SEPP46 exemption, although (as will be discussed) TSI is not financially viable or attractive under current market conditions. A stewardship payment for large trees may change the relative economics of this situation. The CoP has zero or negligible effect on the stand basal area of the forest in year 30,

Nil harvest produces very low levels of merchantable volume growth over time (Figure 4). Note that if some large trees are retained (either by TSI or CoP), harvests can in fact increase large tree occupancy, because the removal of competition allows trees to reach a large size in a shorter period of time (Figure 5). A policy which reduces landowner's engagement in forestry will therefore be likely to reduce the period of landscape occupancy by large trees.

The policy challenge is to achieve retention of larger trees for habitat purposes and promote and encourage restorative silvicultural treatments, without substantially impacting on landholders returns and timber production values.

Figure 4. Modelled Mean Annual increment of merchantable logs (MAI m³/ha/yr) and net cash flow from harvest (\$/ha NPV0% stumpage – cull costs incurred) for two forest types in NE NSW

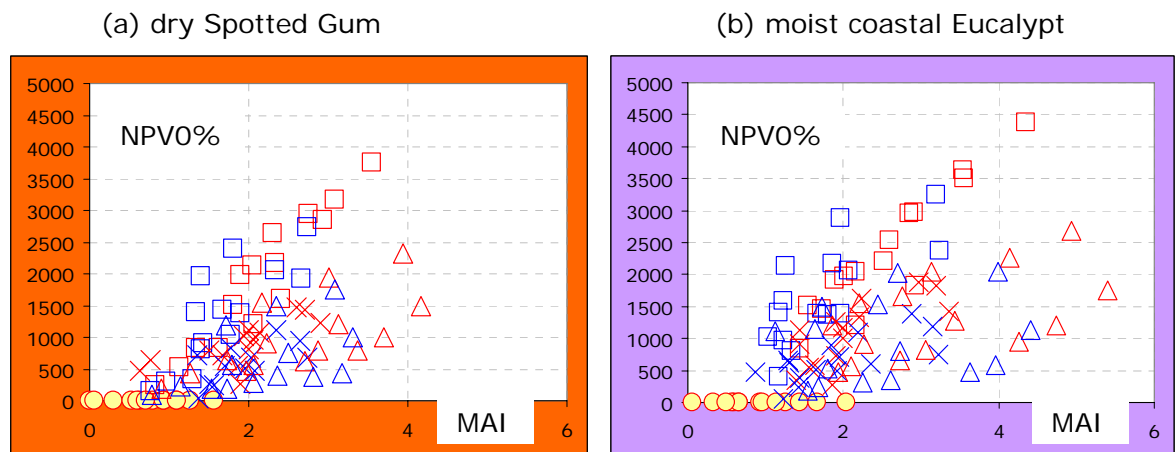
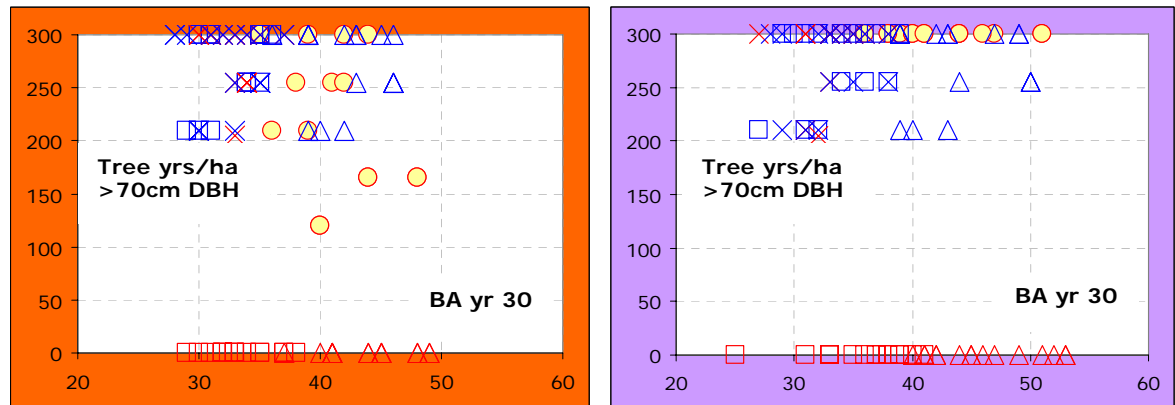


Figure 5. Modelled tree years/ha* >70cm DBH and Stand Basal area (m²/ha) at year 30 for two forest types in NE NSW .



SILVICULTURE

- nil harvest
- high-graded
- × stand improvement
- △ group selection

CODE version

- exemption
- CoP

* A tree year is the presence of one tree for one year.
If for example there were 10 large trees per hectare in the stand for 30 years, then total tree years is 10 x 30=300.

2.4 Evaluating Regional Impacts

Jay (2005) used the EUCAMIX mixed species forest growth model (Jay 2006b) to consider the impacts of the CoP at stand level, and added GIS information concerning forest types, site quality, structural frequency distribution and landholder participation to estimate impacts at the regional scale. 420 analysis units were created, being a combination of Forest Type (7) x Structure (5) x Site quality (3) x Silviculture (4), each of which was compared under three regulatory regimes. The study was undertaken as part of the authors PhD research at Southern Cross University.

2.4.1 Comparing impact of different regulatory provisions

A comparison was made between three regulations:

- (i) An earlier draft CoP which had many of the essential provisions of the August 2006 CoP;
- (ii) The still current Best Operating Standards (BOS) used by DNR for Protected Land (slope >18) consents, and;
- (iii) The SEPP46 PNF exemption which currently persists under NVA.

All of these permit group selection harvesting and culling of non-commercial trees. BOS and CoP require stream buffers and retention of trees in a logged stand in accordance with the provisions of Table 3.

Table 3. Tree retention¹¹ requirements for evaluating NSW PNF regulations

		BA retained			HBT/ha	min DBH	Stream Buffer m				BA
Forest Type	Code version	<i>SQ</i> <i>low</i>	<i>SQ</i> <i>med</i>	<i>SQ</i> <i>high</i>	<i>SQ</i> <i>all</i>	assumed for HBT	<i>by Strahler stream order</i> <i>1 2 3 4</i>				retained in buffer
All	SEPP46	nil	nil	nil	0	0	nil			20	100%
mBBT & dBBT	BOS	40%			10	70 cm	10	20	30	30	70%
FLG	BOS					85					
moistMix	BOS					70					
SpG	BOS					55					
dryMix	BOS					40					
tableASH	BOS					70					
tableDry	BOS					40					
		<i>m2/ha</i>									
mBBT & dBBT	CoP	14	18	18	10	0	10	20	30	40	100%
FLG	CoP	12	18	18							
moistMix	CoP	14	18	18							
SpG	CoP	12	16	16							
dryMix	CoP	12	16	16							
tableASH	CoP	12	18	18							
tableDry	CoP	12	18	18							

Abbreviations used for broad forest types

mBBT *moist Blackbutt*

dBBT *dryBlackbutt*

FLG *Flooded Gum*

SpG *Spotted Gum*

moistMix *Moist Mixed Hardwood*

dryMix *Dry Mixed Hardwood*

tableASH *Tablelands Ash*

tableDry *Tablelands Hardwood*

The CoP and BOS provisions to retain 10 HBT plus 10 recruits per 2 hectares was implemented in the model by retaining the largest HBT then, if necessary retaining the largest remaining trees until the total was 10 per ha. The BOS requires that HBT be retained “if present”. Although the structural data used for the study included HBT measures, the EUCAMIX model does not “grow” new hollows, so to calculate the BOS “if present” distinction, it was assumed that only trees above a given DBH for various forest types (as listed in the table) would have hollows.

Feed trees, forest oak, banksia etc also required to be retained under BOS and CoP are assumed to be included in the BA retention. The BOS requires that 40% of existing stand Basal Area be retained after selection logging, whereas CoP requires quantities of BA from 12-18 m²/ha, based on site height.

2.4.2 Regional silvicultural impacts of regulations

2.4.2.1 Land base

Jay (2005) used cluster analysis with approximately 870 UNE NSW forest inventory plots to derive 11 distinct structural groups. The five most common structural groups in each of the forest type accounted for 70-90% of all plots in that type. The total area of each forest type in the region was allocated proportionately amongst the 5 main

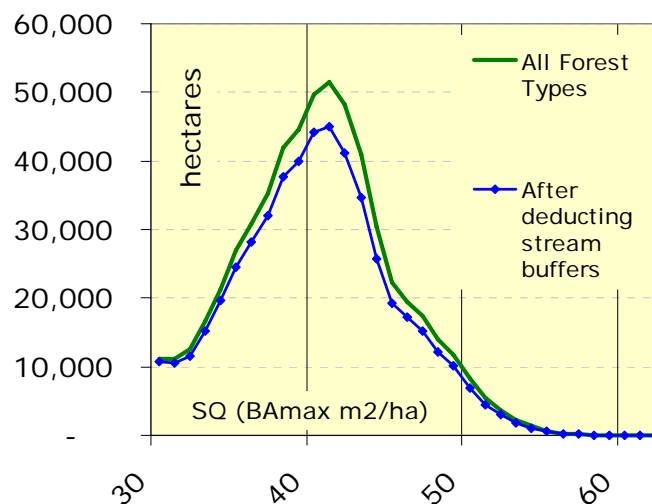
¹¹ A lowered limit for BA retention, with requirement 10-14 m²/ha rather than 14-18m²/ha, was also tested. The results are not reported here, but were generally intermediate between BOS and CoP.

structures. A sixth “structure” for the remaining 10-30% of PNF land in a given forest type was allocated outcomes as an unweighted average of the other five. The distribution of structure was assumed to be the same for all site quality classes.

Jay (2005) further estimated, based on landowner surveys, which some 200,000 ha of PNF was actively in use for production purposes. This represents about 17% of the gross 1.2M ha PNF estate, or some 35% of the estimated gross productive estate of 580,000 ha. The regional impacts below are based on the 200,000 ha figure, not the gross 580,000 ha. If the participation rate increases, then economic impacts will be higher than suggested.

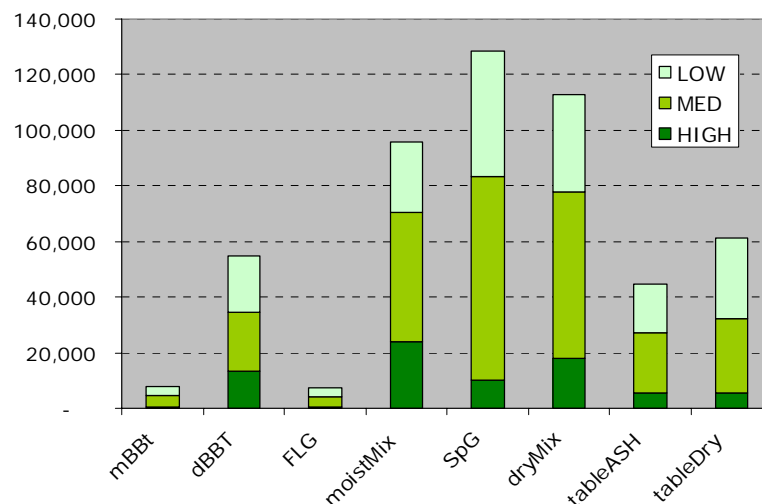
Site quality (SQ) is an expression of the potential productivity (eg. Net Primary Production NPP) of a plot, based on climate, soil and topography. For the EUCAMIX model, SQ is expressed as the maximum potential stand Basal Area (m^2/ha) in mature healthy forest in good silvicultural condition. $\text{SQ} < 30$ is considered to be not commercially viable for timber production. Jay (2005) devised an algorithm for estimating SQ based on physical and climate characteristics of a site, and used GIS climate and soil layers to construct and map a SQ layer at 25m resolution for the study area. The distribution of all SQ classes is shown in Figure 6.

Figure 6. Hectares of site quality class on PNF land in UNE NSW



Using layer intersections, a distribution of forest types x SQ on private land was then calculated. For regional analysis, PNF was allocated to Low, Med and High SQ. “Low” SQ was taken to be sites with less than a mean minus 0.5 x standard deviation for the given forest type, i.e. about one third of the estate for any given forest type (Figure 7).

Figure 7. Hectares of PNF Forest Type and site quality in UNE NSW



A total of some 580,000 ha of PNF in UNE NSW is on land which has mainly commercially useful species, has a site quality sufficient for commercial growth rates, and has slopes less than 18 degrees. 67,500 ha, or 12% of the commercial forest, is in a CoP stream buffer. The range for stream buffer reserves in various forest types is 9-17%, except Flooded Gum of which 28% lies in buffer zones.

For the following comparative analysis, the yield from stream buffers is *not* included in the output for SEPP46 or BOS. This means that silvicultural effects of BA and HBT retentions under BOS and CoP can be directly compared against SEPP46. It also means that the volume and value reduction effects of BOS and CoP are understated since the stream buffer provisions are not counted.

2.4.2.2 Silviculture

Typical silviculture procedures used on private forests were examined in the analysis, including:

1. **Nil-H** - No harvest or other treatment.
2. **HG** - High-Grading, harvest of all commercial stems >40cm DBH . Culling of defective trees is assumed to occur.
3. **TSI** - Timber Stand Improvement: Trees with high quality logs and good growth potential are retained, with commercial thinning and culling as required in suppressed trees and lower quality logs.
4. **AGSS** - Australian Group Selection System: commercial and non-commercial trees are removed to create canopy gaps which allow full light to regeneration and retained trees. Some small trees with high commercial potential are retained.

The EUCAMIX model (Jay 2006b) takes into account the dynamics of tree growth according to site quality and the competition between trees which is dependent on their relative size, species, stocking, and crown vigour. Regeneration and mortality are accounted for. EUCAMIX thus predicts growth after harvest, as well as harvested yield and value. Harvest can be simulated by removal of any fraction of existing trees specified by size, species commerciality, crown vigour and product type.

The EUCAMIX model can also create stand input data of representative trees for a given structure, with species mixes, diameter, crown class and log grade allocated by statistical draw and such that the aggregated parameters of the generated sample trees exactly match the original structure. However since each generated stand is actually unique, and the inbuilt stochastic growth functions create a unique outcome, 512 iterations per analysis unit were generated for this analysis. An iteration means the unit was grown in the model for 32 years, with up to two harvest within that period. AGSS had one harvest and a follow-up cull after 9 years .

Hence the analysis considered $420\text{units} \times 3\text{ regulatory schemes} \times 512\text{ iterations} \times 32\text{ years}$ = 20M years of virtual forestry experimentation.

EUCAMIX was instructed to harvest the forest as soon as it was feasible or deemed essential for silvicultural reasons. Feasible/essential means that at least one of the following criteria is true:

- non-merchantable volume > 50% total volume;
- stand value > \$1,500/ha commercial logs;
- harvest value > \$500/ha permitted trees; or
- BA > 80% SQ

All CoP requirements also had to be met. If the feasible/essential criteria were met but CoP requirements were not, the harvest intensity was reduced step-wise and the outcome re-evaluated. If the step-wise process failed to satisfy both the CoP and the feasibility criteria, timing was advanced one year and the process repeated. In most cases, harvest occurred in the first few years.

The results were recorded as a database of mean and standard deviation of outcomes for about 140 variables of interest. The variables included volume, basal area, product yields, economic values, products from logs sold at each harvest, MAI, floristic diversity, HBT and large tree abundances. For most economic variables, the standard deviations were about 10%-15% of the mean, meaning that the true mean was 90% likely to be within approximately $\pm 2\%$ of the calculated mean.

2.3.2.3 Prices

The price point used in the analysis is the forest landowners return, i.e. stumpage. The economic impacts are therefore not accounting for the value of harvesting, haulage and processing, or economic multipliers. Stumpage prices used in the analysis are simplified for products and species (Table 4).

Table 4. Stumpage prices

S

PRODUCT	min length (m)	stumpage \$/m3		LOG DBH
		Species		
		HighValue	Secondary	
Waste	-	0	0	small <40cm
Pulp	3.0	0	0	
LowQ sawlog	3.6	30	25	
HighQ sawlog	5.4	45	35	
Waste	-	0	0	large >= 40cm
Pulp	3.0	0	0	
LowQ sawlog	3.6	50	40	
HighQ sawlog	5.4	80	60	

Note there is assumed to be no market for non-millable logs. Fence posts can comprise half the value in a given stand (Ryan and Taylor 2002), but at a regional scale the market is probably not large compared to the volume of sawlogs. Poles, veneer and girders have been priced as if they are large sawlogs. For these reasons, the economic estimates will be very conservative.

Stumpage prices are typically around 10% of the final added-value manufactured product. The full regional impact is thus likely to be an order of magnitude greater than the landowner's impacts discussed in the next section.

2.4.3 Results of regional impact analysis

Table 5 shows selected results in aggregated form for the region and all forest types. Numbered variables from this table are referred to in the following text discussion as (v.N). A more detailed breakdown of impacts by forest type is shown in Jay (2005).

Note that conclusions about the outcome of High-Grading (HG) are based on an assumption that non-merchantable stock is culled at harvest times. This is discussed further at the end of this section. Discussion is focused on the outcomes due to regulation, however the silvicultural practices used are also important.

Table 5. Results of regional analysis

No	Name	Year	Units	Silvics	region-level outcomes (millions)		
					SEPP46	BOS	Jun05
1	Standing Bole Volume All Trees >10cm DBH	0	m3 VOL	ALL	12		
1		30	m3 VOL	Nil-H	18		
1		30	m3 VOL	HG	13	14	14
1		30	m3 VOL	TSI	14	16	15
1		30	m3 VOL	AGSS	20	19	19
2	Standing Merchantable Volume	0	m3 VOL	ALL	6		
2		30	m3 VOL	Nil-H	9		
2		30	m3 VOL	HG	9	10	8
2		30	m3 VOL	TSI	10	12	11
2		30	m3 VOL	AGSS	14	12	12
3	Standing value all commercial products \$M	0	\$ Value	ALL	250		
3		30	\$ Value	Nil-H	481		
3		30	\$ Value	HG	268	366	343
3		30	\$ Value	TSI	486	556	539
3		30	\$ Value	AGSS	541	468	468
4	Standing Non- merchantable Tree Basal Area	0	m2 BA	ALL	2.4		
4		30	m2 BA	Nil-H	3.7		
4		30	m2 BA	HG	1.9	1.6	2.2
4		30	m2 BA	TSI	1.6	1.4	1.5
4		30	m2 BA	AGSS	2.5	2.7	2.7
5	All Harvests Gross Stumpage \$M(NPV0%)	H1&H2	\$ NPV	Nil-H			
5		H1&H2	\$ NPV	HG	406	281	286
5		H1&H2	\$ NPV	TSI	212	160	153
5		H1&H2	\$ NPV	AGSS	268	197	192
6	All Harvest Net Cash: stumpage-culls \$M(NPV0%)	H1&H2	\$ NPV	Nil-H			
6		H1&H2	\$ NPV	HG	319	191	217
6		H1&H2	\$ NPV	TSI	145	78	77
6		H1&H2	\$ NPV	AGSS	179	117	113
7	Sum of Increase in Net Value \$M (NPV5%)	0-31	\$ NPV	Nil-H	-102		
7		0-31	\$ NPV	HG	79	12	3
7		0-31	\$ NPV	TSI	-22	-45	-52
7		0-31	\$ NPV	AGSS	81	8	4

No	Name	Year	Units	Silvics	region-level outcomes (millions)		
					SEPP46	BOS	Jun05
8	First Harvest Period Stumpage Volume	H1	m3 VOL	Nil-H	-		
8		H1	m3 VOL	HG	3.8	2.8	2.8
8		H1	m3 VOL	TSI	1.6	1.2	1.2
8		H1	m3 VOL	AGSS	5.6	4.3	4.2
9	Second Harvest Period Stumpage Volume	H2	m3 VOL	Nil-H	-		
9		H2	m3 VOL	HG	3.8	2.4	2.6
9		H2	m3 VOL	TSI	2.7	2.1	2.0
9		H2	m3 VOL	AGSS	-	-	-
10	Gross MAI	0-30	m3/ann	Nil-H	0.23		
10		0-30	m3/ann	HG	0.64	0.53	0.49
10		0-30	m3/ann	TSI	0.52	0.50	0.46
10		0-30	m3/ann	AGSS	0.77	0.63	0.62
11	Merchantable MAI	0-30	m3/ann	Nil-H	0.12		
11		0-30	m3/ann	HG	0.37	0.32	0.26
11		0-30	m3/ann	TSI	0.30	0.32	0.28
11		0-30	m3/ann	AGSS	0.46	0.37	0.36
12	Structural Diversity Index	0	biodiv	ALL	0.28		
12		30	biodiv	Nil-H	0.30		
12		30	biodiv	HG	0.17	0.24	0.23
12		30	biodiv	TSI	0.25	0.26	0.26
12		30	biodiv	AGSS	0.18	0.23	0.23
13	Floristic Diversity Index >=40cm DBH	0	biodiv	ALL	0.37		
13		30	biodiv	Nil-H	0.35		
13		30	biodiv	HG	0.03	0.27	0.29
13		30	biodiv	TSI	0.20	0.29	0.29
13		30	biodiv	AGSS	0.04	0.26	0.26
14	0-30 tree-years >70cm DBH	0-30	tree-yrs	Nil-H	44		
14		0-30	tree-yrs	HG	-	50	50
14		0-30	tree-yrs	TSI	51	50	50
14		0-30	tree-yrs	AGSS	-	50	50
15	0-30 tree-years >100cm DBH	0-30	tree-yrs	Nil-H	19		
15		0-30	tree-yrs	HG	-	11	11
15		0-30	tree-yrs	TSI	7	11	11
15		0-30	tree-yrs	AGSS	-	11	11

The conclusions from the analysis and results in Table 5 are now summarised:

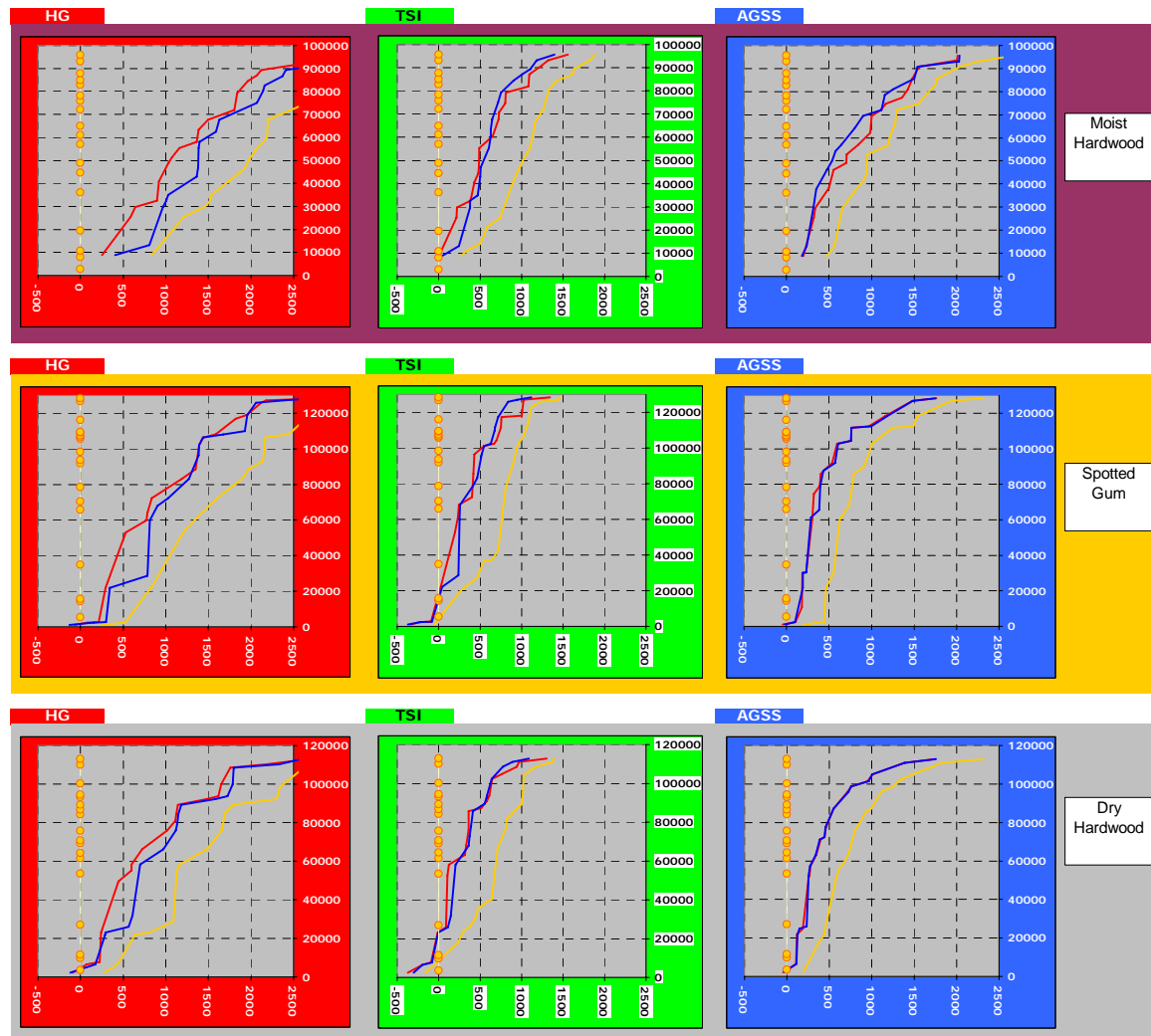
The current SEPP46 exemption (Nil Code) is sustainable (i.e. year 30 \geq year 0) in terms of gross forest biomass (v.1), merchantable volume (v.2) and financial outcomes (v.3). Harvesting using HG, TSI or AGSS under SEPP46 all show increased (accumulated) regional forest biomass and standing volume and value of merchantable logs in year 30 compared to year 0, notwithstanding harvest and cull in the intervening time. HG (with culling) does not appear to cause a decline in available merchantable volume. The CoP produces the least merchantable volume after 30 years (v.2, 8M m³, including all the compulsory retentions and HBT) because of the growth slowing effect of retained trees. Standing value is apparently increased by CoP and BOS (v.3) but this includes trees which are not available for harvest.

Note that Net Present Value (NPV) of the forest at 5% real discount rate, or NPV5%, of the whole production estate takes into account the negative value of cull trees. These are assumed to cost 5c per cm DBH to remove (eg. \$1.20 for a 24cm DBH tree). Net standing value in year 0 and 30 is calculated as NSV=standing stumpage value-culls value. Net value of harvests (v.6) = gross stumpage (v.7) – culls (not shown in Table 5). Hence NPV5% = the sum of NSV year zero + NSV year 30 + net harvests, discounted to year 0 value at 5%.

Both the CoP and BOS have significant financial impacts at the stand (landowner) level and at regional level. For example compared to the current situation under SEPP46 in the 35% production area, NPV5% is reduced by some \$25M to \$75M (v.7). Gross stumpage (v.5) falls by some \$50M-\$120M with BOS or CoP. Net harvest income after culls (v.6) is similarly affected. Harvested stumpage volumes at first and second harvest fall by 1.0 and 1.4 Mm³ (v.8, v.9) respectively for HG. The volume reduction for AGSS is also 1.3 to 1.4M m³ at first harvest (there is no second harvest since the stand does not reach merchantable size again within the analysis period).

The substantial reduction in aggregate harvest volumes (v.8, v.9) due to BOS and CoP is likely to be an underestimate. When the data is disaggregated, it can be seen that a large part of the estate has a substantial reduction in net cash from harvest because of tree retentions. Figure 8 provides a disaggregation of (v.6) for 3 commercially important forest types which constitute some 65% of the region's PNF. The charts show cumulative hectares of forest with a given NPV. The SEPP46 line (orange) lies well to the right of other Codes. This means that less of the forest estate under SEPP46 has a low net harvest income.

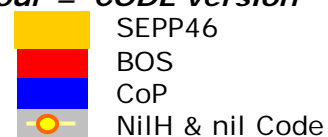
Figure 8. Cumulative hectares of non-discounted net cash income in 3 regional forest types (H1&H2 NPV0% harvest income-cull costs)



X-axis : \$/ha NPV

Y-axis: cumulative hectares

Chart line colour = CODE version



Nil H and nil Code = “benign neglect” i.e. PNF with no active management.

For example (Table 6), with HG and Spotted Gum there is substantially more area with low net harvest incomes under both CoP and BOS.

Table 6. Hectares achieving stated net harvest income over two cutting cycles by High Grading and culling in Spotted Gum forest type, UNE NSW

\$/ha net	Hectares		
	SEPP46	BOS	CoP
< \$500	2,500	50,000	25,000
< \$1,000	35,000	75,000	70,000

Note that this reduced net harvest income arises only from silvicultural and HBT retentions; it does not include stream buffers, planning costs, compliance risk, or increased operational cost leading to reduced stumpage. When a large part of the estate has a low net income more landowners are likely to decide that the marginal profits mean that forest harvesting is not worth doing. This means that regional harvest volumes could be even more substantially reduced than is estimated in v.8. and v.9.

CoP and BOS reduce the NPV5% of silvicultural restoration treatments (TSI and culling under other methods), (v.8) and would likely invoke additional planning and logging contractor operating difficulties and costs. TSI is already an uncommon process in the private estate. Since CoP and BOS make this form of forest restoration more costly, it is even less likely to occur. Note that the NPV5% of TSI if applied regionally across all forest types and structures is negative even with the current SEPP46 regulation. This reflects the cost of restoring forest condition by culling when there is little commercial stock available to harvest and offset the cost. Furthermore, most retained commercial trees in the TSI treatment stands are probably growing in value at less than the 5% discount rate used for analysis.

Codes may delay potential harvest times if the requirement to retain trees results in reduced m³/ha harvest volumes or harvestable \$/ha values at a given time. This has the effect of reducing average income and merchantable MAI (yield per unit area in a given period of time), since the growth rate in most forests declines beyond an early age.

Gross MAI (mean annual increment over whole of the 200,000 ha production estate v.10) is lowest (0.23M m³/yr) with no harvesting (NilH). Merchantable MAI is highest with AGSS (v.11), but CoP and BOS reduce the growth of saleable log volume by some 50,000 to 100,000 m³ per year (v.11). This is purely a competition effect of retained trees, not the reduction in availability for harvest. Note that, using Thompson's (2007) figure of 5 jobs per 1000m³ of processed sawlogs, this could result in a loss of more than 250 jobs.

BOS and CoP result in substantial gains to structural and floristic diversity indexes (v.12, v.13) and to total existence time of trees/ha >70cm and >100cm diameter (v.14, v.15), except when compared to harvests based on silvicultural restoration treatments (TSI). However TSI is not currently economically viable based on income received from stumpage sales. Even though individual operations may be profitable (Table 7, centre chart for SpG TSI), there is a very large area of marginal operations.

Table 7. Hectares achieving stated net harvest income over two cutting cycles by Timber Stand Improvement in Spotted Gum forest type, UNE NSW

\$/ha net harvest	Hectares		
	SEPP46	BOS	CoP
< \$500	30,000	100,000	100,000
< \$1,000	105,000	125,000	125,000

The low net harvest values and time discounting lead to regional NPV being negative for TSI (v.7), a situation exacerbated by BOS and CoP. TSI may be more commercially feasible if landowners received income for environmental services provided from the substantial gains to structural and floristic diversity indexes and to total time duration with at least 10 trees/ha >70cm diameter. A BioMetric type sustainability and environmental services (SES) score (Gibbons *et al* 2005, Oliver *et al* 2005) might assist in measuring such benefits of TSI in production forestry areas.

Financial impacts are strongly dependent on the current condition of the forest. For many current stand conditions, BOS and CoP may have major impacts but Codes are not necessarily the single most important determinant of future value. A large proportion (at least half) of the PNF estate contains stands which are dominated by trees which are small, crooked or defective with poor vigour, and/or non-commercial species. These stands will only have longer term commercial productive capacity if they receive some silvicultural release (usually at harvest time); otherwise the growing space will gradually be filled by retained non-merchantable stock. This effect is exacerbated by Codes, but will probably occur anyway under SEPP46 unless there is a market for biomass (pulp, biofuel).

Results for the worst-case scenario for future log supply (HG with no culling) have not been shown here. Unfortunately this practice is widespread even under the current SEPP46 exemption. Analysis by Jay (2006a) has shown that, while HG without silvicultural release will continue to maintain log flows in the near-mid term and maintain general habitat values (i.e. BioMetric, structural and floristic diversity indices) similar to unlogged forest which has the same starting condition, after the next 2 cutting cycles there is likely to be a long period of non-viable or marginally viable timber productivity over most of the regional PNF estate. Landowners, industry and government policy makers need to rectify this HG-without-culls practice sooner rather than later, since the longer it continues, the longer will be the eventual period of very low log supply from PNF.

Neither BOS nor CoP provide an incentive or an imperative to landowners to improve their silvicultural practices or stand structural condition. Landowners can avoid some of the short-term costs and risks arising from Codes by not culling unmerchantable stock while still harvesting in accordance with allowed silvicultural constraints. BOS and CoP thus provide a direct but perverse incentive for landowners to avoid any

deliberate silvicultural investment, and only “mine” or “hunt” the sparse results of fortuitous natural production, i.e. “high-grading” (HG) with no culls.

3. PNF Codes of Practice

3.1. Review of some international experiences

In many jurisdictions around the world, both public and private forests are managed in accordance with codes of forest practice in which the most common primary aim is to ensure sustainable timber production (Turnbull and Vanclay 1999). Amongst other countries, non-industrial private forestry (NIPF) is of major interest mainly in USA and Finland. The production forests elsewhere across the globe are largely in public, tribal/common, or large corporation ownership.

In USA, where NIPF ownership was 58% of the nations commercial forest acreage in 1988 (Max and Lehman 1988), codes are made at State level. California has perhaps the most heavily regulated NIPF in the US. Gasser (1994) describes how landowners are required to engage a State-registered forester to develop detailed timber harvest plans which incorporate sustained yield planning, develop at least 15% of their forested land as late-seral-stage forests, consider cumulative estate-wide impacts, protect archaeological sites and habitats, and meet any requirements of several government agencies which have standing in enforcement of the rules.

The beneficial impact of these rules for riparian zones and habitats was recognised in a poll of 30 forest managers, however several negative aspects were also identified and all of these appear to be relevant to the NSW Code. These include reliance on prescriptive rules rather than objective standards (i.e. a process rather outcomes focus), excessive documentation required to develop timber harvest plans accompanied by substantial time and effort diverted into compliance rather than management, continual rule adjustments for political reasons, undue exercise of bureaucratic power in “turf wars”, inequitable distribution of the regulatory burdens. It was suggested the latter was leading to one of two outcomes, either landowners cut their forests harder than might be silviculturally advisable in order to squeeze extra returns to pay for compliance costs, or they were driven out of timber production and converted their land to non-forest land uses (eg. vineyards).

Gasser (1994) states plainly “The stability necessary for forest investment has disappeared, and it is questionable whether a prudent land manager should invest in forestry.” He also makes some other points pertinent to the NSW situation: - “The problems in California forestry relates to overstocked forests, not understocked. Raging wildfires are ensured for decades, owing to continuous and expanding fuel loading. Requirements to carry higher tree inventories on forest sites may reduce both

productivity and quality in the long run. Sustained Yield Production plans are being developed for ease of regulation, and not to ensure proper forest practices.”

Zobrist and Lippke (2003) examined, via three NIPF case studies, the effect of Washington State’s recent “Forest and Fish” riparian buffer regulation. This regulation involves a three stage buffer based on predominant tree height, and is designed to protect and shade fish habitats. Limited log harvest is permitted in the outer buffers, under some rules which include a requirement that the residual stand will achieve (as determined by growth modelling) Designated Future Conditions. An impact mitigation programme includes a government advisory service and compensation (one off payment at time of upland harvest) for half of the value of “leave trees”, plus all retentions in excess of 26% of the total value of the landowners forest. They found that after accounting for the compensation payments, economic losses on the three case study sites of 13, 27 and 62 ha ranged from 33-75% of Forest Value (Harvestable Timber Value + Faustmann LEV) with no harvest in buffers, or from 15-30% if full degree of permitted harvest in buffers occurred. These figures did not include additional costs of planning, harvesting, roading or non-viability due to fragmentation which may also be significant. The authors noted that applications to date under the new rules had chosen to not do any harvesting in the buffer zone; they speculated this was because of transaction costs of various forms. The implications for log supply may be substantial in Washington compared to other States. In the southeast for example, implementing Best Management Practices to protect water supply resulted in only 2.9% loss of timber value.

In Finland the majority of forestry activity occurs on privately owned land. (MAF Finland 1997). Up until 1996 this was regulated by the Private Forest Act of 1928, the main thrust of which was to prohibit “devastation” or loss of regenerative capacity. The Act also contained silviculture guidelines and required regeneration of cut areas. A new set of legislation was enacted in 1996/97 and applies to all forests and all ownership groups, the private individual, government, and companies.

Silviculture measures, harvesting plans and the related documentation are handled by forest management associations. The Finnish Forest Management Association Act 1998 prescribes that the purpose of forestry societies is to promote the profitability of forestry practiced by forest owners, to help achieve any other forestry targets they have set, and to promote economically, ecologically and socially sustainable forest management and utilization. To reach their goals, forestry societies are entitled to forestry fees referred to in the Act.

The Act on the Financing of Sustainable Forestry 1997 guarantees State subsidies for management works in private forests which in themselves would not be profitable for the land owner. State financing is available, for instance, for slash burning, the

reforestation of farming land, young stand management, cleaning drainage ditches and maintaining forest roads. The funding is graded, so that forest owners in northern Finland may receive more than forest owners in the south. Ecological management in conjunction with silvicultural work may also receive funding.

It appears that a widespread public acceptance of forestry in Finland has led to a more equitable balance between regulation and payment for stewardship services. Finland is perhaps uniquely placed in this regard as it has a very high degree of private ownership of small forest holdings, and a cultural tradition of “everyman’s right” which allows people to walk or ski freely in the countryside as long as this causes no harm or nuisance to property or nature. These two factors provide for a close and sympathetic integration between the forest owners and public which may be difficult to achieve elsewhere.

Kilgore and Blinn (2004) reviewed a range of policy tools, (encompassing regulation, education and technical assistance and financial incentives), designed to encourage sustainable timber harvesting practices in USA and Canada. The majority (70%) of timber volume harvested by survey respondents was under systems of voluntary compliance, however many of these systems were backed by other legislation; in Georgia for example harvesting guidelines were voluntary, but it is an offence to cause excess water turbidity or temperature. Of the NIPF respondents, 70% in Northern and Southern States were subject to voluntary regimes, whereas regulatory regimes predominated (67%) in the West. Mandatory practices were only slightly more common for public lands.

Of the mix of policy tools available, the most common approaches used by 52 States or Provinces and directed at NIPF landowners were technical assistance (47/52), educational (46/52) and cost-share (28/52) programs; landowner grants to encourage use of guidelines were available in 9/52 regions. Policy tools aimed at encouraging loggers to conform to guidelines were also most commonly technical assistance (39/52) and education (46/52). Other methods used included preferential access to contracts (9/52), grants (7/52) and price premiums (6/52).

Agency administrators, (unfortunately landowners and loggers were not surveyed directly) rated technical assistance and cost-share programs as the most effective and efficient means to encourage landowners to follow sustainable guidelines, and loans as least effective. For loggers, the agency administrators perceived preferential access to contracts and premium prices as being most effective and again loans as least effective. The authors concluded that, while not yet used extensively, tax incentives and cost-share programs were the most highly rated (in terms of effectiveness and efficiency) means of encouraging use of sustainable harvesting practices, and that public funding of these programs was appropriate because of the

probable accrued social benefits. However they added the caveat that the relative value of such programs has not been established by empirical means (i.e. there was no hard evidence relating improved water or habitat quality to particular policy tools). Furthermore, the authors did not discuss the actual costs of the programs nor their possible benefit/cost ratio.

In summary, there are policy experiences outside of NSW that can be used to indicate the probable effects of various arrangements on landowner management behaviour and thence on regional industry. An objective policy analysis must include some reasonable basis for understanding forest growth in response to management.

3.2 Australian Private Native Forestry Codes of Practice

In Australia, CoPs have been implemented to deliver Ecologically Sustainable Forest Management (ESFM) outcomes in accordance with undertakings made in Regional Forest Agreements. In the 1995 National Forest Policy Statement (Anon 1995) the broad principles of ESFM were summarised as:

- Maintain or increase the full suite of forest values for present and future generations across the native forest estate. Aims for values include biodiversity; the productive capacity and sustainability of forest ecosystems; forest ecosystem health and vitality; soil and water; positive contribution of forests to global geochemical cycles; long term social and economic benefits; natural and cultural heritage values.
- Ensure public participation, access to information, accountability and transparency in the delivery of ESFM.
- Ensure legislation, policies, institutional framework, codes, standards and practices related to forest management require and provide incentives for ecologically sustainable management of the native forest estate.
- Apply precautionary principles for prevention of environmental degradation.
- Apply best available knowledge and adaptive management processes.

State and Federal parliaments have recognised, in legislation, that a key plank in the implementation of ecologically sustainable development is the need for improved valuation, pricing and incentive mechanisms whereby environmental factors are transparently valued in pricing of assets and services. Sect 6(2) of NSW Protection Of The Environment (Administration) Act 1991 (POEAA1991) concludes that:

“environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems”.

Clearly, parliament has perceived that equity and efficiency are important elements of ecologically sustainable development, and that regulatory mechanisms alone will be ineffective.

ESFM is a primary driver of public forest management in UNE NSW (SF NSW 2004, 2005). The NSW government has also confirmed its commitment to *“the achievement of [ESFM]... on Private Land ...”* (RFA clause 46, RACAC 1999). The signed RFA document further noted that arrangements for attaining ESFM on private lands would comprise:

- a process of encouragement of private landowners (cl. 55);
- a Code of Practice for PNF (cl. 57);
- voluntary participation by landholders in schemes to achieve conservation objectives (cl. 56);

and, that conservation levels achieved in the CAR reserve system on public lands would not be used as a basis for preventing timber harvesting on private lands (cl. 59).

This section now provides an overview of the legislation and any existing Codes of Practice (CoP) which govern the harvesting and silvicultural operations in native forests on private land throughout the Australian States and Territories. CoPs are the regulatory instruments which govern PNF activity at the operational level.

3.2 Key legislation impacting private native forestry

The following sections provide an overview of the most significant pieces of legislation which regulate private native forestry operations in Australia. This is a precursor to a more detailed examination (Table 1) of relevant CoPs, where they exist. A recent review of eastern States policies can also be found in Aenishaenslin *et al* (2007)

3.2.2 NSW legislation

NSW does not currently have a PNF CoP. A draft CoP has been developed and is undergoing further development. Assuming a CoP is ratified, separate CoPs will exist for native forestry on public land and for plantation forestry on private and public land.

PNF in NSW is primarily regulated through the *Native Vegetation Act 2003* (NVA). At the time of writing, PNF is an exempt activity under the NVA and this situation persists until a CoP has been determined¹². The exemption carries over from a 1996 State Environmental Planning Policy (SEPP46). DLWC (1997) sets out four criteria which provide an administrative (but arguably not legally enforceable) definition for 'selective logging on a sustainable basis'. These are the maintenance of:

- habitat value;
- an uneven aged forest structure;
- more than 50% retention of trees greater than 40cm dbh on a broad area basis in each logging cycle; and
- the forest in a state from which it can recover to a similar structure before next logging cycle.

Landholders also have to satisfy themselves that they are adhering to the requirements of the *Threatened Species Conservation Act 1995* and legislation pertaining to aboriginal, heritage and soil and water protection issues.

The SEPP46 exemption does not apply to forestry activities on steep land (greater than 18 degrees slope) or on 'protected land' as defined by the (now defunct) Department of Natural Resources (DNR). In these instances, an approval from DNR is required. At the time of writing, DNR had recently undergone a restructure, with its staff being distributed to three other state government agencies (Department of Primary Industries, Department of Environment and Climate Change and Department of Water and Energy). It is presently unclear where responsibility for PNF will lie. For this reason, this section of the report will continue to refer to DNR.

In some local government areas (LGAs), the private landholder may require development approval under the *Environmental Planning and Assessment Act 1979*, in addition to satisfying themselves that they meet the PNF exemption. LGA

¹² As noted elsewhere in this document, a Draft Code of Practice was developed for public exhibition in August 2006. At the time of writing, this CoP is being re-written in light of the public comment received. A copy of the draft is available at http://www.dnr.nsw.gov.au/vegetation/pdf/pnf_code_practice.pdf

approval may be required when (i) the councils' Local Environment Plan does not permit forestry without consent and (ii) PNF is either not an existing lawful activity or the proposed activity entails a change of land use (intensification, expansion, or change in nature of use), or the PNF use has been abandoned for more than 12 months.

For native forestry, the “abandonment” criterion is difficult to apply because, even where no forestry activity (harvesting, thinning etc) has occurred for many years, it is reasonable to argue that forestry *is* still being carried on since trees have been retained while they are growing to a commercial size.

In essence, the current regulatory environment for PNF in NSW is unclear and open to various interpretations. Under the proposed NSW PNF CoP, landholders would apply for a PNF Property Vegetation Plan (PNF PVP) which, if granted, sets in place a mechanism ensuring they comply with several other pieces of legislation specifically mentioned in the draft CoP including:

- *The Threatened Species Conservation Act 1995* – this act lists Endangered Ecological Communities, Endangered Populations, Vulnerable Ecological Communities. Their existence may exclude or require the modification of PNF operations.
- *National Parks and Wildlife Act 1974* – places restriction on PNF operations near defined aboriginal objects or places.
- *Heritage Act 1997* – places restriction on PNF operations near listed heritage sites.

3.2.2 Victorian legislation

Unlike NSW where State government largely administers PNF regulations, in Victoria, local government is the authority responsible for PNF. However, in practice many PNF proposals will be referred back to the state Department of Sustainability and Environment (DSE) for approval prior to a planning permit being issued (Vaughan personal communication).

Regulation of PNF and native vegetation regulation on private land falls under the *Planning and Environment (Planning Schemes) Act 1996* and is administered by local government. Each local government area has a planning scheme, which is constructed from the Victoria Planning Provisions (VPP) and a Local Planning Policy Framework.

The VPP contains a State Planning Policy Framework, standard zones, overlays, particular provisions, general provisions and definitions. The Council for each municipality is both the planning authority that prepares and amends the planning scheme; and it is the responsible authority for making decisions under the planning scheme provisions.

The Code of Practices for Timber Production (1996) and the Native Vegetation Management Framework (2002) are incorporated documents of the VPP. The Code of Practices for Timber Production was revised in 2006. The revised Code is expected to replace the existing Code in 2007. The Code was ratified under the *Conservation, Forests and Lands Act 1987*. All PNF operations must adhere to the Code .

In Victoria, a conscious decision was made to move away from prescriptive based Code where possible. Prescriptions can restrict innovation for achieving a better environmental outcome and may not always lead to good environmental management. Operationally there are numerous instances where prescriptions are met but the outcome was not (Vaughan personal communication).

Until recently, proposals for harvesting or thinning of PNF over 10 hectares were referred to DSE (Vaughan *et al* 2006). However, a lack of local government resources to deal with applications under the 10 hectare limit led to the development of a Planning Practice Note that refers many PNF applications to DSE. (Vaughan personal communication)

Local government through their Environment Officers may check compliance of the operation with the planning permit conditions. Given the large number of planning permits for other activities they also administer, the audit occurrences are low (Vaughan personal communication).

Although an application for PNF can be lodged within any forest type, harvesting will generally not be permitted in forests with Very High or High conservation significance, unless harvesting is allowed on similar forest on public land within the same bioregion. These conditions are driven by the Native Vegetation Management Framework. The Code provides mandatory actions and guidelines for good environmental management while producing timber products. (Vaughan personal communication)

As is the case in other states, there are numerous additional pieces of legislation which may be relevant to PNF operations (eg. *Aboriginal Heritage Act 2006*, *Catchment and Land Protection Act 1994*). However the legislation with primary operational impacts on PNF operations is that described above.

3.2.3 Queensland legislation

A Code of Native Forest Practices for PNF exists in Queensland and is specific to native forestry operations on private land (ie. it does not encapsulate plantations or operations on public land).

(<http://www.nrw.qld.gov.au/vegetation/forestpractice.html>)

In Queensland, the *Integrated Planning Act 1997* (IPA) and the *Vegetation Management Act 1999* (VMA) are the two key pieces of legislation covering PNF operations. The IPA allows PNF to operate as an exemption on land subject to the VMA regulations. Under this arrangement, PNF does not require development approval if the operations comply with the Code. However a 2006 regulation under the Nature Conservation Act 1992 overrides the Code and may affect forestry activity. In a designated koala habitat area (such as the whole of southeast Queensland), no person may destroy (poison, ringbark, fell) a koala habitat tree unless a person who is certified as a Koala spotter is present. A koala habitat tree is any *Angophora*, *Corymbia*, *Eucalyptus*, *Lophostemon*, or *Melaleuca* over 10cm dbh.

Private landholders wishing to operate under the PNF CoP must notify the Queensland Department of Natural Resources and Water (NRW) of their intentions. Unlike Victoria, there is no formal approvals process for the PNF operations. This is similar to the situation which was mooted for NSW, though discussions surrounding the NSW process indicated random audits of the PNF operations to ensure CoP compliance (note that audits are not mentioned in any of the CoP supporting material on the NSW DNR website). To date, there has been no audit process in Queensland, though an audit could be triggered through third party complaints or where the two yearly satellite surveys of canopy cover reveal anomalies (Ryan, personal communication).

In contrast to the Victorian situation, there are no forest type exclusions in Queensland – PNF operations may be undertaken in all forest types regardless of their conservation status, though the CoP sets out various management practice limitations which apply to some forest types.

As for NSW, existing use-right provisions may be relevant in some circumstances. The Queensland Code only applies to mapped remnant forest under the ecosystem mapping system (remnant vegetation is classified as 50% original canopy cover and 70% of original height). Private forests that have not been mapped therefore potentially come under the local government approvals process if landholders wish to conduct PNF and it has been noted (Ryan, personal communication) that local government is increasingly interested in the PNF approvals process. However, under

the IPA, there are existing use provisions which over-ride recently developed local government strategic plans and for this reason, given that most private native forest in Queensland suitable for timber production has a history of harvesting, existing use under the IPA may prevail.

Confusion sometimes exists where local governments under the IPA have strategic plans which specify vegetation protection zones. This may bring them into conflict with landholders wishing to operate under the PNF VMA exemption and existing use rules.

It is notable that the Queensland CoP explicitly excludes the production of woodchips for export (NRW 2007). The Commonwealths' Export Control (Hardwood Wood Chips) Regulation 1995 only allows export of woodchip sourced from private land where land is subject to a reforestation program via regeneration and management or by plantation establishment (NAFI 1996).

3.2.4 Tasmanian legislation

Tasmania has a forest practices system and forest practices code (FPCode) which covers all land tenures for both plantation and native forestry and deals with all aspects of a production forestry operation; clearing for road access, roading, use of quarries or borrow pits for roading, harvesting of timber, conservation of natural and cultural values, regeneration or planting seedlings and management of fuels, oils rubbish and emissions.

Tasmania is unique in the PNF regulatory context as Tasmanian legislation allows the declaration of a Private Timber Reserve (PTR) under the *Forest Practices Act 1985*. Where a PTR has been granted, forestry operations on the land are exempt from planning impositions which may otherwise impact on the operations under the *Land Use Planning and Approvals Act 1993*. Approval to undertake a forestry operation is not required from a local planning authority if the land is declared a PTR but under the Tasmania forest practices system and FPCode there is a requirement to notify local authorities of the intention to undertake forestry operations. There is also a requirement local authorities are consulted, especially if the operations are within 2 kilometres of a town water intake, in areas with landscape protection provisions in planning schemes, if operations would potentially affect water quality in a listed town water supply catchment and for construction of new access or major upgrading of existing access for timber harvesting on to local government roads. PNF operations on areas not declared as a PTR require local government approval (a development application process).

For many private forest owners in Tasmania, seeking to have their land declared a PTR is a first step as it secures their right to use their land for forestry purposes in the long term. Local government planning schemes are required by planning legislation

to be reviewed and it possible that a rezoning may result in forestry as a land use becoming prohibited or restricted in some manner, whereas as on a PTR, the right of the owner to use the land for forestry purposes is protected.

As at June 2006, 421,709 hectares of forest and plantation are declared as private timber reserve which represents 41 percent of the total area of private forest in Tasmania.

If the area is not a PTR a development permit is generally required. There are some planning schemes in place that allow forestry operations as a 'permitted right' with no requirement for a development application to be lodged..

Under a planning scheme, land uses in various areas or zones are permitted, discretionary or prohibited. Recently the planning schemes are designed to be outcome or performance based and the terms such as 'acceptable solution' or 'permitted and meeting performance criteria' or 'discretionary'.

If forestry as a land use in an area or zone is **permitted**, the development is allowed but the local authority can attach conditions to the development permit. It is possible to appeal to a planning Tribunal (Resource Management and Planning Appeal Tribunal - RMPAT) in relation to the conditions imposed. If forestry use is **discretionary** the local authority may or may not grant a development application, with or without conditions. It is possible to appeal to the RMPAT in relation to the decision to refuse an application and any conditions imposed. Third parties can become involved in the process and have the right to appeal to a planning Tribunal. Where forestry use is **prohibited** in an area it can not proceed. The planning scheme would need to be amended to allow that development to occur.

To prepare or amend a planning scheme there is a legal process, detailed in the *Land Use Planning and Approvals Act 1993*. The legal process requires schemes or amendments to schemes to be on public display and the Resource Planning and Development Commission (RPDC) to assess the schemes or amendments and hold hearings. The decisions of the RPDC and the RMPAT can be appealed in the Supreme Court.

A land owner makes an application to have an area of forest, or land to be planted, declared as a PTR. Under the *Forest Practices Act 1985* local and State authorities, persons with a legal and equitable interest in the land or trees, and neighbours within a 100 metres of the area to be declared a PTR, can lodge an objection to the application.

Under the Tasmanian *Forest Practices Act 1985*, a Forest Practices Plan (FPP) is required for forestry on all land tenures (public and private) for both plantations and native forestry. The FPP can be prepared by anyone but are usually prepared by

person with training in forestry and knowledge of the forest practices system. A FPP must be certified by a Forest Practices Officer (FPO). The plan is certified as meeting the requirement of the forest practices system and the FPCode, and the plan is a legally enforceable instrument. The Forest Practices Authority (FPA) manages, monitors and audits the regulation of forestry operations.

A FPP is required regardless of whether a PTR is declared or not and as noted above requires notification to the local council. The plan sets out the operational requirements to comply with the forest practices system and Forest Practices Code. The forest practices system has been designed and managed to ensure that compliance with the forest practices system and FPCode is recognised for the purposes of other Acts such as the *Nature Conservation Act 2002*, *Threatened Species Protection Act 1995*, *Aboriginal Relics Act 1975*, and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

The level of scrutiny applied to the FPP is significantly higher than for other States. A plan is certified by a FPO but requires the consent of the landholder, usually provided as a signed statement giving written consent to the plan. In addition, various persons or contractors, responsible for various aspects of plan are identified in schedules associated with the plan and are usually required to sign those schedules. Contractors operating on-site are required to have a copy of the FPP. Under this arrangement, any breaches of the plan can be traced back to the responsible party.

In addition, the FPA undertakes an annual audit of plans. Both the plan provisions and the implementation of the provisions of the plan on the ground are audited during field inspections. The results of the audit are reported in the Annual Report of the Forest Practices Authority.

There are regulations associated with the Forest Practices Act 1985 that exempt small scale operations, generally less than 100 tonnes per year per property and clearing less than one hectare, from the requirement for a FPP.

It is notable that the Tasmanian FPCode is far more detailed than the NSW and Queensland Codes and contains a large number of diagrammatic representations of environmental protection requirements. The Victorian Code is similar to the Tasmanian CoP in this respect. The Tasmanian and Victorian Codes thus incorporate educational and advisory components rather than being purely a set of prescriptive rules.

The Tasmanian code is however, only one component of the Tasmanian forest practices system. The Tasmanian forest practices system includes a statutory

authority - The Forest Practices Authority to administer the Act, a Chief Forest Practices Officer and a Forestry Practices Advisory Council.

3.2.5 Western Australian legislation

There is no formal Code of Practices for PNF in WA. Approvals for PNF activity may be required to satisfy clearing requirements (a Clearing Permit), the sale of commercial timber products (a Commercial Producer Licence), a Country Areas Water Supply Clearing Permit and local Shire requirements.

Where timber products will be sold as a result of the PNF operations, a Commercial Producers Licence must be obtained from the Department of Conservation and Land Management. However this licence only covers the commercial harvest and not any non-commercial silvicultural activities. Consequently a Clearing Permit is likely to be required also.

As is currently the case in NSW, PNF involves the removal of native vegetation (harvesting, silvicultural operations and regenerative burning), so is defined as clearing in WA. However, unlike NSW where a PNF exemption operates, in WA PNF operations will require a clearing permit from the Department of Environment under the *Environmental Protection Act 1986* (Bradshaw 2005). In general, a permit would not be approved if the native vegetation to be “cleared” (ie used for private native forestry):

- Comprises a high level of plant species diversity;
- Comprises significant habitat for indigenous fauna;
- Impacts upon rare flora;
- Comprises a threatened ecological community;
- Represents a significant remnant that has been extensively cleared;
- Is part of a watercourse or wetland;
- PNF activity would cause appreciable land degradation;
- PNF activity would impact on environmental values in adjacent areas;
- PNF activity would reduce water quality;
- PNF activity would exacerbate flooding.

Where it can be shown that the PNF operations will provide for the sustainability of these features and represents a temporary disturbance only, or may enhance these features, a ‘clearing permit’ is likely to be approved (Bradshaw 2005).

The clearing permit application process involves public comment, is subject to third party appeals and requires provision of a plan of sufficient detail to indicate the forest

management intent. This statement of intent will impact upon the decision to approve the Clearing Permit. A permit is issued with conditions and endorses the supplied management plan for 2-5 years. Even where a Clearing Permit and/or Commercial Producer's Licence have been approved, local shire approval may also be necessary depending on the location of the forest. In addition, PNF operations in some water supply catchments may require a Country Areas Water Supply Clearing Licence (Bradshaw 2005). This licence involves prescriptive minimum basal area retention rates (Beatty, personal communication). Retained overstorey will limit the rise of saline groundwater, but will also reduce catchment runoff and negatively affect seedling growth (Stoneman *et al* 1994)

If the PNF activity involves the sale of products for wood-chipping, an additional licence from the Commissioner of Soil and Land Conservation is required.

It is estimated that about 80-100,000 ha of private forests in WA are subject to PNF activity, representing approximately 15-20% of total log harvest from native forests. These private forests are quite degraded and in need of silvicultural restoration. The majority of the PNF activity is for the production of on-farm timber such as fencing material, firewood and low grade sawlogs (Beatty personal communication).

3.2.6 South Australian legislation

There is essentially no private native forestry activity in South Australia other than some firewood collection (Bulman personal communication). Forestry activity is confined to plantations. Native vegetation regulation is legislated under the *Native Vegetation Act 1991* which controls native vegetation clearing activity. The Native Vegetation Council makes decisions regarding native vegetation clearing activity and only provides approval where the clearing is "is not seriously at variance with the Principles of Clearance" (DWLBC 2007). These principles appear to exclude PNF activity in the South Australian context. For example, vegetation should not be cleared if:

- It has significance as habitat for wildlife;
- It comprises a high level of diversity of plant species;
- It is significant as remnant vegetation in an area that has been extensively cleared; or
- Impacts rare, vulnerable or endangered species.

3.2.7 Australian Capital Territory legislation

There is no private native forestry activity in the ACT. All land occupied by private landholders in the ACT is leasehold and a decision was made in the 1970's to have no native timber harvesting in the ACT (Shakespeare, personal communication). The

key pieces of legislation that would impact on forestry in the ACT (these would be solely plantation operations) are the *Land(Planning and Environment) Act 1991*, *Heritage Act 2004*, *Nature Conservation Act 1980* and the *Environment Protection Act 1997*.

3.2.8 Northern Territory legislation

There is essentially no private native forestry activity in the NT, with almost all timber production based upon plantations (*Acacia* species for pulp, African mahogany for higher value timber uses). The key native forest species with timber use potential is cypress pine (*Callitris intratropica*). Often, these native forests are cleared for plantation development or agriculture/horticulture and the timber burnt. If timber is sold from leasehold land, the landholders is required to pay a royalty to the Territory government (Reilly, Whitehead and Bowland, personal communication).

The key piece of legislation relating to native timber harvest in the Northern Territory is the *Territory Parks and Wildlife Conservation Act 2000*. While tree species are not protected under this Act unless they occur in a park, reserve or sanctuary, a permit is required under section 55 of the Act if they are to be taken for commercial purposes.

A draft management program for the commercial harvesting of timber from native vegetation in the Northern Territory is under development, but at the time of writing had no formal status. The broad objectives of the plan are to:

- Maintain viable wild populations of all timber species throughout their range;
- Ensure that water, soil, geomorphology, flora and fauna are not adversely affected in the long-term by harvesting of trees;
- Regulate and monitor the sustainable harvesting of tree species throughout the Northern Territory; and
- Provide incentives and mechanisms for conservation benefits to accrue from harvesting on freehold and leasehold land (Parks and Wildlife Commission 2004).

3.3 Codes of Practice

There is some variation across the Australian states and territories with regard to the issues addressed in PNF CoPs, the level of planning and reporting required and the level of prescription involved. A summary of these issues is set out in Table 8.

Table 8. Key Features of PNF Codes of Practice in Australia

Code Features	NSW¹³	Victoria	Queensland	Tasmania	Western Australia, South Australia, ACT, Northern Territory
Harvest plan	Harvest plan required	Harvest plan required	Not required	Forest Practices Plan (FPP) required – may include harvest prescriptions such as basal area retained or retention of trees in various growth stages	No PNF Codes of Practice in existence
Forest management plan	Forest management plan required if operations exceed specified scale	Not required. However, the Code specifies desired outcomes for good forest management.	Not required	FPP required – may include management prescriptions for regeneration. Must contain regeneration/replanting provisions if land declared a PTR	
Reporting	Annual report to state government agency if PNF operations performed in previous year	Local government may audit planning permit conditions	Not required	All FPPs, when completed or lapse, require a compliance certificate to be issued	
Audit	No formal audit process	No formal audit process	No formal audit process	Auditing of 15% of plans	
	Prescriptive ¹⁴ silvicultural	No prescriptive silvicultural	Prescriptive silvicultural	No prescriptive silvicultural	

¹³ Requirements under the draft CoP for NSW, August 2006

Code Features	NSW ¹³	Victoria	Queensland	Tasmania	Western Australia, South Australia, ACT, Northern Territory
Silviculture guidelines	limitations apply to: <ul style="list-style-type: none"> • Basal area reductions • Canopy openings • Regeneration capacity • Hollow, recruitment, feed, roost, nest trees • Clear-felling not allowed 	limits apply. Outcomes based actions which ensure regeneration, protect stands from fire, encourage stand health and timber production and minimise impacts on non-harvested stands. Replanting in native stands is acceptable if local provenances used. Clear-felling allowed – area restrictions apply	limitations apply to: <ul style="list-style-type: none"> • Habitat, recruitment, feed, shelter, nest trees • Group selection • Clear-felling not allowed Non-prescriptive silvicultural rules apply to: <ul style="list-style-type: none"> • Ensuring adequate regeneration of the forest 	limits apply, only outcomes based actions which are consistent with long term environmental and productivity protection. Includes fire risks and regeneration. Replanting in native stands is acceptable if local provenances used. Within a plan a number of silvicultural system may be employed (clearfell, patch cut, seed tree, shelterwood, single tree selection, group selection, coppice regeneration, overstorey removal, thinning, advance growth retention and potential sawlog retention.	
Environment protection guidelines	Prescriptive environmental protection rules apply to landscapes: <ul style="list-style-type: none"> • Listed Endangered Ecological Communities 	Prescriptive environmental protection rules apply to: <ul style="list-style-type: none"> • Rainforest (no operations allowed). 	Prescriptive environmental protection rules apply to landscapes: <ul style="list-style-type: none"> • Wetlands, lakes, springs • Snig track, road, log 	<ul style="list-style-type: none"> • Prescriptive environmental protection rules apply to landscapes: • Watercourses - Stream side reserves where reserve size is 	

¹⁴ Prescriptive means numerical limitations apply to the activity

¹⁵ Non-prescriptive rules mean general objectives or goals are stated, but no numerically based limitations are specified to meet those objectives or goals.

Code Features	NSW ¹³	Victoria	Queensland	Tasmania	Western Australia, South Australia, ACT, Northern Territory
	<ul style="list-style-type: none"> • Listed Endangered Populations • Listed Vulnerable Ecological Communities • Rainforest • Old Growth • Wetlands • Heathland • Rocky outcrops • Cliffs • Steep slopes (>30°) • Aboriginal sites • Heritage sites • Areas of existing mass movement • Dispersible, erodible soils 	<p>Non-prescriptive¹⁵ environmental protection rules apply to:</p> <ul style="list-style-type: none"> • Protection of significant flora, fauna and habitat 	<p>landings</p> <ul style="list-style-type: none"> • Streams • Steep slopes (>25%) • Soil disturbance (slopes >10%) • Acid sulphate soils 	<p>linked with stream size and catchment and modified by erosion risk factors</p> <ul style="list-style-type: none"> • Steep slopes (general >19° but dependent on rock type present on site.) • Operations in wet weather (soil protection) • Threatened Species and Inadequately Reserved Plant Communities – endorsed management prescriptions (not specified in the CoP) to be included in the FPP. • Aboriginal sites • Cultural heritage sites • Erodible soils <p>Non-prescriptive environmental protection rules apply to:</p> <ul style="list-style-type: none"> • Non-endangered flora and fauna • Landscape (visual impact) • Karst areas • Chemical use • Fire management • Pest, disease, weed control 	

Code Features	NSW ¹³	Victoria	Queensland	Tasmania	Western Australia, South Australia, ACT, Northern Territory
Forest infrastructure guidelines	<p>Prescriptive forest infrastructure rules apply to:</p> <ul style="list-style-type: none"> • Forest roads • Riparian & protection zones • Road drainage • Drainage feature crossings • Log landings • Portable mill sites • Snig tracks • Machinery use in some regions under specified conditions 	<p>Prescriptive forest infrastructure rules apply to:</p> <ul style="list-style-type: none"> • Streams and drainage lines for water quality • Log landings & dumps • Snig tracks <p>Non-prescriptive forest infrastructure rules apply to:</p> <ul style="list-style-type: none"> • Water yield protection • Steep slopes • Landscape values • Fuel dumps and machinery servicing • Operations in wet weather • Site rehabilitation • Personal safety • Roading 		<p>Prescriptive forest infrastructure rules apply to:</p> <ul style="list-style-type: none"> • Forest roads and road drainage • Snig tracks • Log landings • Watercourses <p>Non-prescriptive forest infrastructure rules apply to:</p> <ul style="list-style-type: none"> • Management of fuel, oils, rubbish and emissions 	

4. Incentives and other interventions for Improved PNF Management

This section first describes some analysis made of regulatory interventions in the US non industrial private forestry (NIPF) situation. It is rare to find reviews of this nature, not least because of the difficulty of finding cases which can be validly compared and are comprised of many small holdings that characterise a true market. The US, with a high degree of NIPF ownership and diverse legislation across geographically small jurisdictions, offers some important lessons.

4.1 Intervention to adjust supply

Boyd and Hyde (1989) made a very comprehensive review of forestry sector interventions and the impacts of public regulation on social welfare. They chose 22 example regulations for analysis that (a) relied on the 3 standard arguments for intervention, i.e. market failure, distribution and stabilisation, and (b) affected either demand (wood processing) or supply (log production) sides of the market. Using general equilibrium models for analysis, and NPV (including non-market items and transaction costs where possible) as a summary measure of impact, they found that the economic impacts of two of these regulatory interventions viz preferential capital gains (p.275) and departures from market-optimising timber management criteria on public lands (p.277), were greater than the sum of all other market distortions that were examined.

State Forest Practice Acts were one example of regulations examined which affect the supply side. Such Acts, like the proposed NSW PNF Code are initiated and justified on the market failure argument. In USA this was initially more to do with the belief that a timber famine would arise because of overcutting, but more recently because of the belief that markets fail to value environmental, aesthetic and other utilities/services which may be reduced by timber harvest.

It is difficult to discover the impact of a regulation directly since there is no “without regulation” control in a given State. However, Boyd and Hyde were able to compare the standing volume of private forests in two neighbouring states (Virginia and North Carolina), one of which had measures to retain trees. The comparison was made retrospectively over 35 years (roughly one rotation period for the predominant timber species), regressing volume against biological, market and ownership variables and a dummy variable for State. They found that all important coefficients had the anticipated sign and were significant at the 1% level, except the State variable. Furthermore, there was no evidence of variation across within-state regions. The

coefficients on the State variable were small and were not significant in any of the four variations on the regression. They concluded “we cannot reject the hypothesis that Virginia’s Forest Practice Act has had no measurable impact on standing timber inventory...”. However they found that net social losses had arisen because of compliance and administrative costs.

It appears that regulation over along period of time had no effect in developing greater standing volume, but had a significant cost associated with compliance. This result is similar to that shown for the UNE NSW regional analysis earlier in this report.

4.2 Incentives to promote good silviculture

We now turn our attention to direct encouragement of better silviculture.

Previous studies have demonstrated that internal incentives for restorative silvicultural practices in NSW private native forests are lacking (Jay 2006a, Thompson and Connell 2006, Thompson 2006). This is due to a combination of:

- A general lack of landholder understanding and forestry skills;
- A lack of markets for lower quality wood (often, only sawlogs are sold - markets for lower quality sawlogs, fencing material, pulp and bioenergy are required to make the silvicultural removal of the lower quality wood financially attractive);
- Poor returns for the higher quality wood (often due to landholder ignorance of market prices and the volumes and quality of wood removed from their property);
- Often the forest manager is the local sawmill or contractor whose goal is to extract the maximum amount of commercial timber at least cost and hence has no incentives for thinning/culling;
- The poor condition of many forests from decades of high-grading means commercial yields are low and they require expensive silvicultural treatment to return them to productivity;
- The long-term regulatory uncertainty surrounding rights to harvest (eg. in NSW) which deter investment in good silviculture for long-term timber production.

In this operating environment, CoPs which place further prescriptive limitations on silvicultural operations in the pursuit of biodiversity/habitat goals are likely to exacerbate the situation. In particular, where the forest owner or manager has limited knowledge of forestry management techniques or measurements (for example, basal area measurement), they are likely to adopt a ‘safety first’ approach, focusing on the

action of the commercial timber to ensure they remain within the CoP tree removal limits.

Moreover, as highlighted by Jay (2006a), CoPs which require the retention of large trees (which are good indicators of hollow bearing trees, an important habitat feature) can have a significant negative influence on future timber productivity due to their suppressive competitive effects.

Clearly, there is a trade-off between the retention of some habitat features in private native forests and the potential of the forest to be run as a profitable timber producing enterprise. The multi-functional nature of private native forests and their capacity to generate both private and public goods is a feature recognised in European forest policy where financial incentives are created to manage the forests for long-term multiple uses (Southern Cross Group 2006).

In some European countries, these private forests may generate up to a third of the farm's income (Brandl 2002) providing ample incentive for their careful management, but in Australia, their management is largely opportunistic and *ad hoc* – a result of operating in an incentive framework where the public (environmental) benefits emanating from these forests are unrewarded and mostly unrecognised, and where the private (timber) benefits usually offer poor financial returns.

This situation has long been recognised by foresters and even NSW public forest agencies reduced the level of silvicultural treatment in public native forests in the 1970's and 80's due to a perceived lack of benefit relative to the costs (Brandis, personal communication).

In 2006, the Southern Cross Group (2006) called for a new approach to the management of private native forests and began to investigate options for making stewardship payments to private forest owners to encourage improved silviculture and pay them recompense for conserving important biodiversity features. The process involved considerable debate about the mechanisms to be used, especially the issue of simple versus more complex measures of forest structure. A summary of the issues discussed during the development of the stewardship document (Southern Cross Group 2006) is provided in Table 2. (see also Vanclay 2007)

A suite of Joint Venture Agroforestry Program projects conducted during 2005/2006 investigated PNF sustainability issues, the use of habitat metric scoring systems and their potential for use in private native forests (Jay 2006a, Vaughan *et al* 2006, Thompson and Connell 2006, Peacock 2006, Lindenmayer *et al* 2006). An interesting finding which may complicate the issue of using incentive to improve PNF management was that across a wide range of forest management histories including

silviculturally undesirable high-grading actions, all sites examined scored well (Jay 2006a). In Victoria, clear-felled sites returned to 50% of their pre-harvest scores within the required 10 year period which confers 'sustainability' under Victorian regulations. Moreover Jay (personal communication, results shown in Thompson *et al* 2006) demonstrated how virtually any forested site produced habitat score in the order of three to five times higher than cleared grazing or cropping land.

This suggests that even poorly managed forests maintain a relatively general high habitat score (using the scoring systems examined) and therefore the increment of public good to be gained through incentive payments for improved forest management may be low.

However, refuting this claim is the view held by some ecologists (eg. Lindenmayer *et al* 2006) that general habitat scoring systems and general habitat preservation are not as important as protection of specific habitat niches for species of key local importance. This is where a payment for conservation of important habitat features as outlined in Table 9 could be of relevance.

Table 9. Private Native Forest Stewardship Mechanisms

Mechanisms	Advantages	Disadvantages
Regular annual payment for a simple forestry statistic (eg. basal area)	<ul style="list-style-type: none"> • Simple, easy to measure • Provides immediate, ongoing incentive • Good surrogate for forest productivity • Automatically adjusts for land quality • Can be self-assessed by landholders after minimal training • Easy to audit (satellite imagery) to avoid fraudulent claims • Simple method for teaching landholders about basic silviculture • May encourage landholders to nurture more trees and trees of larger size (greater basal area) • Provides regular cash-flow • Provides incentive for woody weed control 	<ul style="list-style-type: none"> • Does not directly reward key forest features (eg. large habitat trees) • May involve a higher budgetary outlay • May result in forest lock-up rather than more active silviculture (may be paying landholders for what already exists rather than encouraging better management, especially in highly degraded forests) • May be viewed as too simplistic and 'blunt' • Public (and hence government) support may relate more to special species than general habitat
Payments for endangered species and ecological communities on the basis of contiguous areas of suitable habitat for those species	<ul style="list-style-type: none"> • May have more public appeal • Will encourage budgetary focus and the need to identify the most important species rather than an intractable 'everything is of equal importance' approach • If equal funding allocated to each important species, rarer species will attract larger payments • Requires authenticated record of species which will improve rare species distribution knowledge • Will educate landholders about rare species on their properties and how to manage their habitats • Will highlight to the public the high levels of important habitat and conservation in private forests • Payments based on habitats avoid expensive surveys • Makes rare species an asset rather than a liability • Provides incentive for feral predator control • May encourage development of habitat corridors between farms 	<ul style="list-style-type: none"> • From past experience, some landholders may not want governments and the public to know about rare species on their properties • May limit productive activities in those habitats – payments would have to be sufficient to recompense for this loss
Payments for specific forest habitat features (eg. large trees which develop hollows)	<ul style="list-style-type: none"> • Specifically targets important habitat features • Reward good past forest management over those who have high-graded • Large trees easy to monitor 	<ul style="list-style-type: none"> • More complex to administer • Need to carefully set the payments so large tree retention does not preclude improved silviculture • Need to consider a range of attributes (eg. feral control, nectar flow for nectar

Mechanisms	Advantages	Disadvantages
	<ul style="list-style-type: none"> • Higher marginal value for each tree means these trees are more relevant in the management decision 	<p>feeders, woody debris)</p>
Using auction systems rather than fixed payments	<ul style="list-style-type: none"> • May achieve a given level of environmental benefits at much lower budgetary cost (eg. see Stoneham <i>et al</i> 2002) • Better aligns the payment to landholders with their marginal costs of undertaking conservation • If auctions used to pay for rare species, helps establish their relative worth • 	<ul style="list-style-type: none"> • More complex and costly to administer • More complex for landholders to participate • Public objections to allowing a bidding process to 'value' rare species • May favour those who 'learn to play the tender game' rather than those who have the most valuable forest to manage • May require heterogeneity of compliance costs and large number of participants for effectiveness (Scottish Executive 2006)
Compensation for loss of commercial timber harvest	<ul style="list-style-type: none"> • Explicitly recognises the private values in private native forests • Informs governments of the timber values in these forests • Improves farm cash-flows • Encourage governments to think about public-private good trade-off issues 	<ul style="list-style-type: none"> • Does not promote improved silviculture • May lead to a diminution of the productive potential of private native forests for timber • Governments don't like then notion of compensation • Does not assist industry with log supplies • Does not improve industry log supply certainty
Outright purchase of private forested land	<ul style="list-style-type: none"> • Allows full control over high conservation value forests and species • May allow some landholder to exit the industry with dignity • Requires governments to define high conservation value accurately 	<ul style="list-style-type: none"> • No evidence that placing these forests in public ownership will improve their conservation status • Increases the public cost of forest management • Reduces log supply to industry

5. Conclusions and Recommendations

Private native forests comprise a significant proportion of the total native forest estate in NSW. Timber supplies from these private forests are an increasingly important component of the log throughput for many NSW sawmills. For example, approximately 50% of logs processed in northeast NSW are sourced from native forests on private property. Mills which have a substantial allocation from the public estate supplement these supplies by, on average, 20% from the private estate.

In the post-RFA era where the areas of public native forests available for timber production in NSW have contracted, it is likely that PNF will become an increasingly important component of industry log supply, particularly if continuing pressure is brought to bear on NSW governments to limit forestry operations in the public forest estate. It has already been demonstrated (in 2003 in the upper north east NSW RFA region, where an additional 65,000 ha of production forest was reserved subsequent to the RFA), that public timber supply areas can be further reduced beyond those agreed in the RFAs.

The RFA process required that a Code of Practice (CoP) for private native forestry be developed within 5 years of the agreements. In NSW, the CoP has been through several revisions and has been rejected twice after a public display and call for submissions process. At the time of writing, the CoP had not been enacted. This study has examined the silvicultural and economic impacts of the most recently publicly displayed draft CoP.

Analysis was conducted based on PNF in north east NSW using the forest bioeconomic simulation model EUCAMIX and considering only the new basal area and large tree retention components of the draft CoP.

An analysis of silvicultural impacts and outcomes makes it clear that in its current form, the CoP increases the risk of continuing forest degradation, creates a substantial loss of landowner income, and will result in a very significant decline in the log volumes and qualities which are essential for a viable, valuable regional industry. On the other hand, the CoP will be effective in achieving an increase in stand structural and floristic diversity, presence of large trees, and retained tree cover in the 12% of the landscape classed as riparian edge zones. The policy challenge is to provide for the latter without lessening other desirable outcomes, and without having the full costs borne by private landowners and the parts of the regional community and economy which depend on the timber industry.

Implementing the CoP on the 200,000 ha PNF net productive participation estate in UNE NSW will result in:

A reduction of around 1M m³ of available merchantable timber volumes over each of the next two 15 year periods (i.e. >60,000m³/yr average) as a result of growth suppression caused by retained large trees and the minimum basal area limits.

A potential loss of more than 250 jobs (5 jobs per 1000m³ reduced log supply).

A consequent reduction in regional timber gross stumpage payments of some \$100M in today's values over a 30 year period,

Reduced returns and increased risk from applying silvicultural treatments to the private native forest estate, hence increasing the likelihood that 'high grading' activities without culling will persist or increase.

This is undesirable outcome for an industry increasingly reliant upon PNF log supplies. It implies a continuing or accelerated degradation of the PNF estate as higher quality commercial logs are selectively harvested, but little restorative silviculture is applied to ensure future forest productivity and commercial log supply.

It must also be recognised that even in the absence of the CoP, silvicultural treatment is economically unviable under the current set of circumstances impacting on the forests modeled in this study. Low stumpage prices and low commercial yields (due to a history of high-grading) necessitates substantial and costly silvicultural restoration. When combined with the relatively long time frames needed to generate a commercial growth response from this silviculture, circumstances conspire to generate a situation where, even under the current regulatory regime (the SEPP46 exemption which persists under the NVA), the financial incentives for improved forest management and commercial timber harvest do not exist.

Under the CoP, the ends seem less important than the means. A regulatory, prescriptive policy based on process constraints and outputs rather than actual outcomes may achieve little in the way of real environmental gains while imposing considerable costs. The "improve or maintain environmental values" criterion which is the ostensible rationale for the CoP, is likely to be better met by using objectively measured outcomes. Rewarding the landowners who maintain a balanced structural and floristic diversity, presence of large trees, and specific habitat values may result in less overall cost and community

friction or hardship to individuals. Pre-and post- harvest measures undertaken by the landowner would be of considerable education value, and form a basis for auditing, monitoring and prioritising adaptive management actions both for landowners and policy makers. Penalties for failing to meet minimal standards would only be relevant in a minority of cases.

Despite the finding that the CoP may be having a limited impact on improving environmental as measured by general habitat features, it is likely that tradeoffs between commercial timber production and habitat/biodiversity quality will exist under some circumstances. The problem is that imposing relatively broad prescriptive rules to address this situation may be ineffective and costly.

It is likely that much of the NSW private native forest estate is in the contradictory situation where it is increasingly relied upon as a source of log supply to industry, is being ‘managed’ in a manner which maximizes short-term financial returns to the landholder, but this mode of management (high-grading) reduces the future potential of the forest to supply commercial timber.

Proposed limitations under the CoP do not appear to resolve this conundrum. In fact, they may exacerbate the problem as relatively unskilled forest managers take a ‘safety first’ approach in order to ensure they remain within the CoP harvest limits and further limit the already minimal silvicultural ‘release’ that most of these forests require following a history of high grading.

Moreover, it appears that the CoP limitations may not be generating any significant improvement in the habitat quality of these forests. The possible exception to this finding is an improvement in the number of large trees in the forest stands, though this feature penalises future commercial timber growth. Previous studies in these forests (Jay 2006a, Thompson and Connell 2006) have demonstrated that, when habitat quality is measured using habitat scoring systems currently in use in Australia, there is little difference in scores across a wide range of forest management histories. The general conclusion appears to be that in terms of the general habitat features which these scoring systems measure, any forest structure, even one which has a history of high-grading, produces relatively high habitat scores compared to most alternative productive land uses.

Consequently, the commercial value of these forests to private landholders is declining, this decline seems unlikely to be reversed by the draft NSW CoP and the perceived increase in public goods (habitat quality) that the CoP was to generate appears doubtful.

In pursuit of improved habitat quality, the CoP imposes additional costs on landholders and industry, and may accelerate the degradation in the productive potential of these private forests. There is a likelihood that the CoP, in attempting to correct a perceived market failure (environmental degradation in PNF due to selective timber harvest) may generate an additional market failure (reduced commercial timber production) without significantly improving the original problem (which ironically, may not have existed, or at least, is far less of a problem than perceived).

This is an example of a failure to fully assess the benefits and costs of government intervention. However, it is acknowledged that assessing the benefits of environmental improvement through regulatory intervention is difficult and particularly so for biodiversity and habitat issues.

It is notable that some other Australian states (Victoria, Tasmania) have explicitly recognised the need for an outcomes base approach to forest management and policy, an approach which provides broad environmental objectives but which is less prescriptive about how those objectives can be achieved. This allows for greater flexibility in tailoring forest management and environmental protection measures to the landholders unique circumstances. It also allows improved targeting of local environmental issues (eg. local threatened species) without imposing the costs of a ‘catch-all’ type approach which may lead to perverse outcomes (eg. high-grading under the proposed NSW CoP).

Where specific environmental measures are required to protect key habitat features of species of local importance, and this would impose financial cost on the forest owner, stewardship payments should be considered in recognition of the public values they would be expected to manage in their forests under the proposed CoP.

Also, the present lack of incentives for active silvicultural treatment, a process required to secure future commercial timber supplies from PNF, points to the need for incentive mechanisms to address this problem. These incentives could assist with the costs of silvicultural restoration and should also include the development of markets for forest thinnings (eg. biofuels) which would reduce the need for direct and on-going publicly funded incentive payments, while contributing to a reduction in greenhouse gas production.

The examples in this report highlight the perverse outcomes arising from a policy built on possibly well-intentioned but inappropriate silvicultural rules, and the scope for market incentive or stewardship schemes to counter the imperative for high-grading. An amount

of around \$5 per tree per year would be sufficient to offset the opportunity cost of not harvesting large trees (

Figure 2). For example the total amount of stewardship paid for a stand with 12 large trees/ha over 30 years might be in the order of \$1800 per hectare in today's values.

Less than half of the potentially productive PNF land area is intended to be logged by current owners in NE NSW (Jay et al 2007, NNFS & BRS 1999), and this is less than a sixth of the total PNF area. If these ratios hold for the rest of the State, a CoP will serve little purpose on the majority of the estate. Since the undisturbed area is relatively large, and the environmental gains in logging areas are likely to be very small, the marginal benefits of a CoP are questionable. Landowners with existing healthy productive forest, or with well-maintained high quality habitat for fauna, or those wishing to undertake restorative silviculture, will be most heavily penalised. Those who have already exhausted their forest's potential growth capacity, cleared the forest entirely, or eliminated habitat values, will be least affected.

These recommendations require a significant paradigm shift in forestry policy thinking in NSW. The paradigm shift involves improving the level of trust between government agencies and private landholders and allowing greater flexibility with less punitive regulation in forest management. It requires explicit recognition that providing public goods from private land is not a costless exercise and incentives are required to generate the level of trust needed to achieve improved environmental outcomes and help forest owners understand the value of the public goods in their custody. It requires a policy which encourages landowners to think of private native forests positively and as a private asset to be nurtured and managed, not as a business liability which is exploited as the regulations allow with little regard for the future productivity of the forest.

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Abbreviations & definitions

CoP	the draft Code of Practice for PNF, most recent public version released then withdrawn in August 2006. The CoP can be found at http://www.dnr.nsw.gov.au/vegetation/pdf/pnf_code_practice.pdf
LSEP	Listed Species Ecological Prescriptions; attached to draft Code
PNF	private native forests or forestry as the context suggests
PNF estate	the gross area of native forest in private ownership.
UNE NSW	the upper northeast New South Wales Regional Forest Agreement area, running approximately from Coffs Harbour to the Queensland border, and inland to the New England Highway.
HBT	hollow-bearing tree ; has branches with hollows, but not necessarily a hollow trunk as is commonly assumed by laypersons.
NPV	Net Present Value, or sum of all future costs and revenues discounted to current day values using a real (inflation-adjusted) interest rate of 5%.
Stumpage	the standing value of the tree, i.e.the net profit to the landowner after deducting all costs associated with harvest and haulage to the market. Also known as log royalty in relation to Crown (public) forests.
NVA 2003	New South Wales Native Vegetation Act 2003
NVR 2005	Native Vegetation Regulation made under NVA 2003
TS	Threatened Species as listed in the Schedule to the Act
cc,cc1,cc2	cutting cycle, first cutting cycle, second cutting cycle etc. The period of time between one partial selective harvest and the next. A sustainable harvest can occur if the volume and types of products are much the same over an extended series of c.c.. In upper northeast NSW, sustainable c.c. are typically 15-20 years.
BOS	interim Best Operating Standards for private native forestry. A document used in NSW for assessing and determining conditional logging approval on Protected Land (eg.slopes>18°).
BA	Stand basal area (BA) is the sum of cross-sectional trunk area of all trees at 1.3m above ground (breast height). In mature, fully-stocked eucalypt forests, BA may typically fall in the range 30-60m ² /ha.
DBH	tree diameter at breast height over bark, 1.3m above ground.