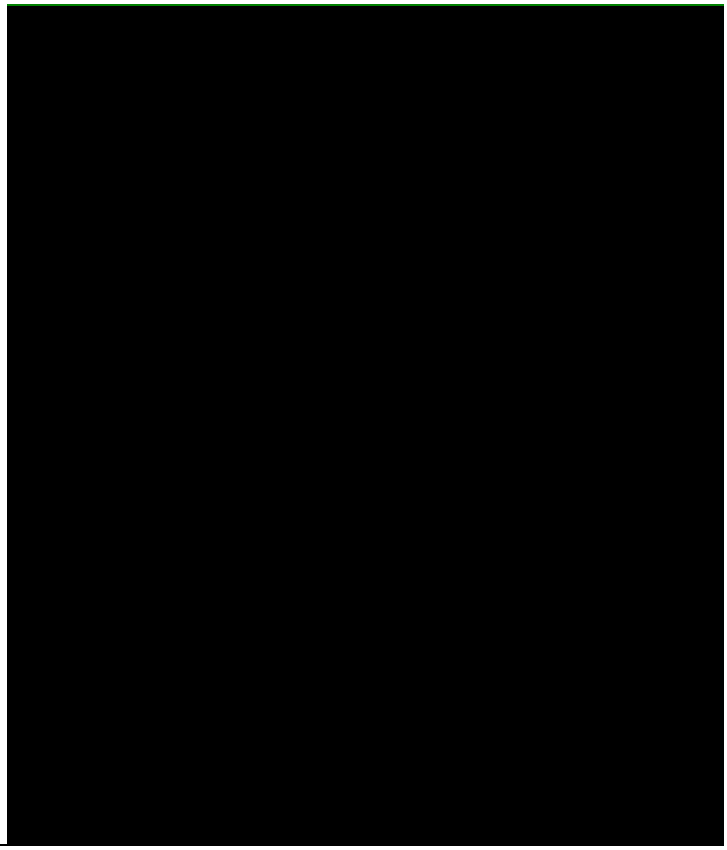
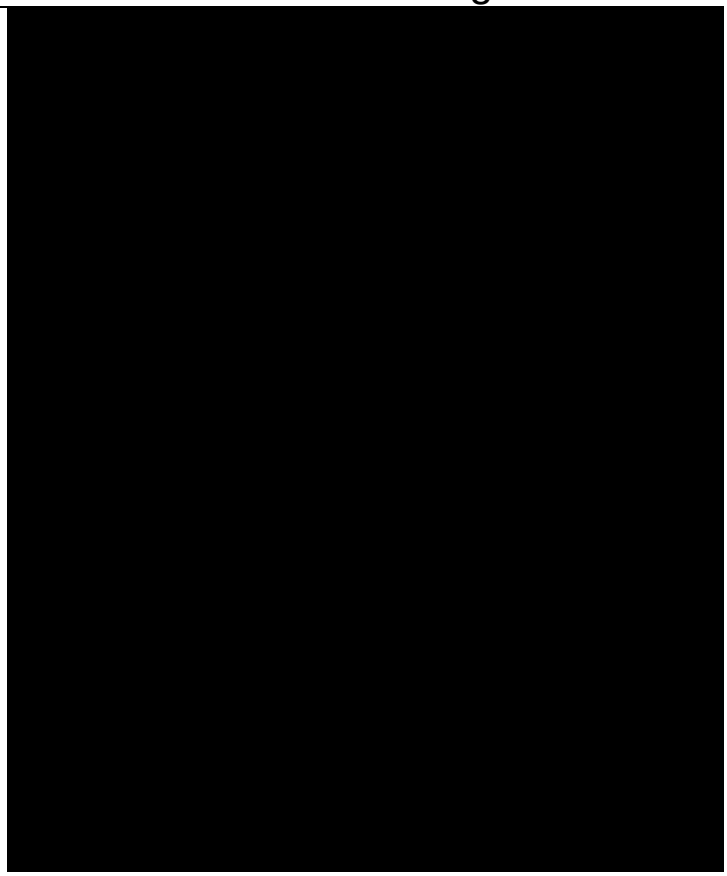


Management Options and Scenarios to Generate ESFM Targets for the Eden RFA (Project Area 5)

A report undertaken for the NSW CRA/RFA Steering Committee



MANAGEMENT OPTIONS AND SCENARIOS TO GENERATE ESFM TARGETS FOR THE EDEN RFA (PROJECT AREA 5)

ESFM GROUP

A report undertaken for the NSW CRA/RFA Steering Committee project number NE 28/ESFM

November 1997

Report Status

This report has been prepared as a working paper for the NSW CRA/RFA Steering Committee under the direction of the ESFM Group. It is recognised that it may contain errors that require correction but it is released to be consistent with the principle that information related to the comprehensive regional assessment process in New South Wales will be made publicly available.

For more information and for information on access to data contact the:

Resource and Conservation Division, Department of Urban Affairs and Planning

GPO Box 3927
SYDNEY NSW 2001

Phone: (02) 9228 3166
Fax: (02) 9228 4967

Forests Taskforce, Department of the Prime Minister and Cabinet

3-5 National Circuit
BARTON ACT 2600

Phone**:** 1800 650 983
Fax: (02) 6271 5511

This project has been jointly funded by the New South Wales and Commonwealth Governments. The work undertaken within this project has been managed by the joint NSW / Commonwealth CRA/RFA Steering Committee which includes representatives from the NSW and Commonwealth Governments and stakeholder groups.

The project has been overseen and the methodology has been developed through the ESFM Group which includes representatives from the NSW and Commonwealth Governments and stakeholder groups.

CONTENTS

Executive summary

1. ESFM IMPLICATIONS OF THE AGENCY SCENARIO FOR THE EDEN RFA 1
1.1 DIMENSIONS OF THE AGENCY SCENARIO 1
1.2 ESFM IMPLICATIONS OF THE AGENCY SCENARIO 1
1.3 CONSERVATION APPROACH 13
1.4 GENERAL RECOMMENDATIONS RELATING TO THE SCENARIO 13
1.5 CONCLUSION 15

2. ESFM IMPLICATIONS OF THE CONSERVATION SCENARIO 16
2.1 DIMENSIONS OF THE SCENARIO 16
2.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVESTING 16
2.3 ASSESSMENT OF CONSEQUENCES ON ESFM INDICATORS 17
2.4 CONCLUSION 50

3. ESFM IMPLICATIONS OF THE INDUSTRY-UNION SCENARIO 51
3.1 DIMENSIONS OF THE SCENARIO 51
3.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST51
3.3 ASSESSMENT OF CONSEQUENCES ON ESFM INDICATORS 52
3.4 CONCLUSION 64

4. ESFM IMPLICATIONS OF THE EXISTING TENURE SCENARIO 66
4.1 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST66
4.2 CONCLUSION 92

5. ESFM IMPLICATIONS OF THE SCENARIO TO MAXIMISE JANIS IN DEDICATED RESERVES 93
5.1 DIMENSIONS OF THE SCENARIO 93
5.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST93
5.3 ASSESSMENT AGAINST ESFM INDICATORS AND TARGETS 93
5.4 CONCLUSION 111

6. COMPUTER APPLICATIONS OF MANAGEMENT SCENARIOS 112
6.1 INTRODUCTION 112
6.2 THE MODELLING TOOL APPROACH 114
6.3 WHATIF?/LUPIS 115
6.4 SPECTRUM 117
6.5 DISCUSSION 121
6.6 REFERENCES 122

Figures

1 LUPIS flow diagram

2 SPECTRUM flow diagram

Tables

1.1 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group

1.2 Protective measures by species in conservation protocols' general prescriptions

1.3 Wood supply for A1/A2/C1 scenario

1.4 Estimated change in the extent of growth stages from 1997-2019 by catchment

1.5 Cultural Heritage places Requiring Special Management

1.6 Examples of trade-offs

2.1 Change in extent of growth stages from 1997 to 2019 by vegetation ecosystem group (B3/C2)

2.2 Change in extent of growth stages from 1997 to 2019 by vegetation ecosystem group (A1/A2/B0/C2)

2.3 Change in extent of growth stages from 1997 to 2019 by vegetation ecosystem group (A1/A2/C2)

2.4 Change in extent of growth stages from 1997 to 2019 by vegetation ecosystem group (A1/A2/C2 & old growth retained)

2.5 Proposed protective measures for biodiversity conservation off-reserve

2.6 Wood supply for B3/C2 scenario

2.7 Wood supply for A1/A2/B0/C2 scenario

2.8 Timber volume for SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning

2.9 Timber volume for SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth in the GMZ

2.10 Percent variation in growth stage gross area from 1997 to 2019 by catchment (B3/C2)

2.11 Percent variation in growth stage gross area from 1997 to 2019 by catchment

2.12 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/B0/C2)

2.13 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/B0/C2)

2.14 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/C2)

2.15 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/C2)

2.16 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/C2 with retention of old growth in GMZ)

2.17 Percent variation in growth stage gross area from 1997 to 2019 by catchment (A1/A2/C2)

2.18 Cultural Heritage places Requiring Special Management

3.1 Vegetation ecosystem groups* proposed for intensive management (C1)

3.2 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group

3.3 Proposed protective measures for biodiversity conservation off-reserve

3.4 Wood supply for B3/A2/C1 scenario

3.5 Percent variation in growth stage gross area from 1997 to 2019 by catchment

3.6 Cultural Heritage places Requiring Special Management

4.1 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group for B3 timber harvesting and C2 thinning

4.2 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group for B3/A2 timber harvesting and C2 thinning

4.3 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group for B3/B0/A1/C1 timber harvesting and C2 thinning (A1 harvesting of certain filter strips)

4.4 Proposed protective measures for biodiversity conservation off-reserve

4.5 Timber volume for B3 timber harvesting and C2 thinning

4.6 Wood supply for B3/A2/C2 scenario

4.7 Wood supply for B3/B0/C1 timber harvesting and C2 thinning under Scenario 4 (Existing tenure)

4.8 Proportion of catchment harvested from 1997-2019 by harvest system (B3/C2)

4.9 Percent variation in growth stage gross area from 1997 to 2019 by catchment (B3/C2)

4.10 Proportion of catchment harvested from 1997-2019 by harvest system

4.11 Percent variation in growth stage gross area from 1997 to 2019 by catchment

4.12 Proportion of catchment harvested from 1997-2019 by harvest system

4.13 Percent variation in growth stage gross area from 1997 to 2019 by catchment

4.14 Cultural Heritage places Requiring Special Management

5.1 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group for B3 timber harvesting and C2 thinning under Scenario 3 (maximise JANIS in dedicated reserves)

5.2 Change in extent of growth stages from 1997 and 2019 by vegetation ecosystem group (A2 timber harvesting with no logging of old growth and C2 thinning)

5.3 Proposed protective measures for biodiversity conservation off-reserve

5.4 Wood supply for B3/C2 scenario

5.5 Wood supply for A2/C2 scenario

5.6 Proportion of catchment harvested from 1997-2019 by harvest system

5.7 Percent variation in growth stage gross area from 1997 to 2019 by catchment

5.8 Proportion of catchment harvested from 1997-2019 by harvest system

5.9 Cultural Heritage places Requiring Special Management

6.1 Proportion of total area allocated to each land use under the Benchmark scenario. Landuses are presented and described in Appendix 1

6.2 Votes assigned to preference guidelines to implement forestry development scenarios

6.3 Area (hectares) assigned to landuses 6, 7, 10, 11 and 12 under the weightings described in Table 6.2. The benchmark is shown for comparison

Appendices

1 Details of Conservation approach to protecting old growth forests off reserve

2 Harvesting practices

1. EXECUTIVE SUMMARY

The ESFM Project Area 5: Management Options and Scenarios to Generate ESFM Targets for the EDEN RFA, was undertaken in two ways. Firstly the contingency plan was used to assess the various negotiation scenarios. The contingency plan was also developed based on modifier indices applied to FRAMES and quantitative and qualitative assessment using GIS overlays. Secondly two modelling tools, Whatif?/LUPIS and SPECTRUM were developed.

The Eden integration process examined reserve design within the framework of JANIS criteria. The process, using C-Plan and linking outputs to socio-economic indicators lead to options being generated for potential reserve strategies. ESFM considered the management problem from the direction of sustainability indicators, where, in principle, all tenures contribute to meeting targets over time for ESFM. Therefore at the coarsest level, land tenures will carry different responsibilities over time to meet ESFM targets, but in total they should meet all targets, thresholds or conditions.

1. Contingency plan to assess negotiation outcomes

The ecological sustainable forest management (ESFM) implications of different scenarios for the Eden RFA was determined by an indicative assessment being carried out either qualitatively or quantitatively in relation to harvesting intensities of 70%, 30% and 10% canopy removal (harvesting practices considered in the assessment are explained in Appendix 2), for the following indicators:

- extent of forest/vegetation type by growth stage
- extent of connectivity in the forest landscape in relation to threatened species habitat; conservation reserves; general retained habitat
- management measures in place to maintain species extent and abundance
- proportion of catchment likely to be harvested from 1997-2019 by harvest system as an immediate proxy determination of water quality
- change in the level of growth stages from 1997-2019 by catchment as an immediate proxy rating of water quantity.

Full assessment of the impacts of a wider range of combinations of harvesting and silvicultural practices or other indicators, was not undertaken for the Eden region because of time and data constraints. Key areas of ESFM definition remain outstanding such as quantitative targets for an adequate number of indicators to ensure all values are measured, and the incorporation of the recommendations by experts of appropriate forest practices.

The assessment also needed to estimate certain information before the ESFM implications could be determined. Firstly, the information used to determine changes in growth stages due to harvesting over a 23 year period, was determine by a perceived change in forest structure as a result of tree removal e.g a mature forest if harvested by B3 (extensive tree removal) would become young forest. Secondly, the timber yield estimates at a sub-compartment level, where changed to an estimate based on ecosystem type. This was done by proportioning the original timber yield based on dominant forest type and regional location. Thirdly, the timber yield that would result from different harvesting methods was estimated from the FRAMES data which used B3 harvesting (extensive tree removal). The estimate used proportional relationships of canopy removal and timber yield and balanced this with operational targeting for sawlogs.

Determination of the degree to which ESFM is met for each scenario depends largely upon stakeholder perception and choice of the level at which environmental, social, economic and cultural values should be protected, utilised and managed. There is no simple or single solution to resolving the complies issues presented by ESFM. Ultimately, the level and balance of protection, utilisation and management of forest values across the Eden RFA Region will reflect the views and requirements of different stakeholders. A fundamental platform of ESFM is the process of

adaptive management and continual improvement. Where deficiencies in any processes may be found, a system should be in place which addresses these and ultimately delivers ecologically sustainable forest management.

(It should be remembered that the ESFM implications were done in November 1997 and accordingly they do not take into account changes in the legislation or other regulatory controls that have occurred since then. Also, industry/union and the conservation movement have undertaken further development of their scenarios and ESFM implications but this information is not contained in this report. For example the conservation movement devised conservation protocols for their scenario and the industry/union have done work on achieving their wood volume while addressing the changes in the legislation or other regulatory controls.)

COMPARISON OF ESFM FOR EACH SCENARIO

	Agency Scenario	Industry-union proposal	Maximised JANIS	Conservation proposal	Existing Tenure
Sawlog (m^3/yr)	23000	25760	16150	14000 -19088	28026-28682
Pulpwood (tonnes/yr)	330000	373475	236000	204000-294000	398628-453287
Royalty/yr	$5.9 million	$6.9 million	$4.2 million	$3.1-5.1 million	$7.4-8.5 million
Overall oldgrowth	-4%	-5%	+1%	0 to 9% increase based on regime	-8%
Decrease in oldgrowth by ecosystem type	15 forest ecosystems	15 forest ecosystems	15 forest ecosystems	0 to 11 forest ecosystems based on regime	18-21 forest ecosystems based on regime
Regional Connectivity	Improved connectivity east-west	Improved connectivity east-west	Very enhanced	Very enhanced	Some improvement under two of the regimes
Water Catchment	Increased water flow in certain catchments	Reduced water flow and duration in certain catchments	Minimal change in water flow and duration	Minimal changes in water flow and duration	Likely changes in water flow and duration in all catchments
Socio-economic impact	Reduction in timber industry	Retain current level of timber industry, may encourage investment	Significant impact to current level of timber industry	Significant impact to current level of timber industry	Retain current level of timber industry, may encourage investment
Reserve additions	40000 ha	34000 ha	78900 ha	55000 ha	N/A

2. Modelling approach

The NSW ESFM Technical Committee sought advice on how ecologically sustainable forest management (ESFM) issues could be considered in the integration phase of the Eden CRA. They requested for modelling tools to be investigated such that ESFM issues in general and management scenarios for achieving ESFM could be considered during this phase.

The development of management scenarios has an iterative linkage with the option development phases of integration and finalisation of the RFA. Modelling tools were considered and developed based on these objectives for ESFM.

The tools were designed to help facilitate objectives of management such that the design of the reserve system and choice of achievable management objectives across tenures is an inter-connected process.

A number of modelling tools were considered. It was noted that SPECTRUM was also under consideration by FRAMES. Given the time constraints of the Eden CRA, a prototype system of SPECTRUM and Whatif?/LUPIS was considered as the only feasible way of running ESFM management options and scenarios. It was planned that the prototype system would be incrementally developed throughout the options development phases as new requirements were identified.

Whatif?/LUPIS and SPECTRUM, were developed to help explore management scenarios and consideration of ESFM.

- Whatif?/LUPIS through specification of guidelines (commitment, exclusion and preference), enables management intentions to be spatially presented and balanced.
- SPECTRUM provides the capacity to model silvicultural regimes and prescriptions and their consequent temporal effects on a range of values that can be linked to indicators. The confidence levels for these software tools are dependent upon the models, assumptions and underlying data used to model management scenarios.

1. ESFM IMPLICATIONS OF THE AGENCY SCENARIO FOR THE EDEN RFA

1.1 DIMENSIONS OF THE AGENCY SCENARIO

This response is provided by the Ecologically Sustainable Forest Management (ESFM) Technical Committee to a request by the NSW Negotiating Group to assess ESFM impacts in relation to the NSW scenario. The document constitutes only part of a full ESFM response which would be developed in relation to a formal option.

This scenario is designed to examine the consequences of adding an additional 40 000 ha of protected areas and providing a wood supply of 23 000m^3 of sawlog per annum during the RFA period. The wood supply is premised on a retention of 30% of the canopy in the net harvest area based on current conservation protocols. In addition it reflects the retention of riparian buffers, EPA filter strips, areas of high soil erosion hazard, protection of rainforest, buffering for rock outcrops, swamps, heaths and retention of PMPs. There are some species specific conservation recommendations, but these are designed to have no impact on wood supply. In addition the wood supply level is predicated on no further off-reserve protection of old growth outside of Priority Management zones. It also recognises a systematic thinning of regrowth forest of 50% canopy retention

The ESFM assessment undertakes an assessment of the consequences of this scenario for a set of key indicators.

1.2 ESFM IMPLICATIONS OF THE AGENCY SCENARIO

1.2.1 Forest Structure

The following table shows the change in the extent of growth stages for this scenario for vegetation types over a 20 year time period. It addresses indicator 1.1- 'extent of forest/vegetation type by growth stage'.

In the 23 year period there are a variety of changes in the various growth stages in response to estimated impacts of timber harvesting and growth stage succession in undisturbed areas. Old growth, for example, declines by 4% overall in the landscape over the 23 year period. Individual vegetation types can fluctuate more widely, however. For example, of 23 commercial forest types, the amount of old growth increases for eight, decreases by less than 10% for eight and decreases by between 10 and 25% for seven. The significance of these changes must be considered in light of the degree to which JANIS targets have been met by the reserve design and predicted level of old growth at the time of the changeover to regrowth harvesting following recruitment of younger forest into this growth stage. It can be expected that there will be an expansion in the area of old growth types in the period beyond twenty years as reserved areas evolve into old growth.

TABLE 1.1
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019
BY VEGETATION ECOSYSTEM GROUP

Vegetation ecosystem group	Vegetation type name	Change in size	Change in growth stage extent from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage area (ha)	5% 241	-92% -649	4% 228	13% 236	-47% -1416	48% 1359
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	-1% -73	-92% -942	-2% -205	5% 150	-23% -944	34% 2013
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage area (ha)	2% 42	-91% -415	0% 2	-10% -144	-7% -183	30% 701
southern blue gum	hinterland wet fern frst	percentage area (ha)	0% 30	-90% -493	-6% -1160	250% 3815	-67% -5915	156% 3723
yellow stringybark/ gum	hinterland wet shrub frst	percentage area (ha)	-11% -430	-72% -186	-16% -1543	217% 1999	-68% -5044	311% 5205
manna gum	flats wet herb frst	percentage area (ha)	-5% -13	-40% -6	1% 15	1% 4	-26% -109	57% 110
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage area (ha)	7% 70	-71% -70	1% 18	136% 338	-22% -370	60% 15
river peppermint	bega wet shrub frst	percentage area (ha)	0% -8	-66% -129	1% 37	84% 442	-24% -707	110% 364
snow gum	monaro dry grass frst monaro basalt grass wdland	percentage area (ha)	-1% -7	-29% -5	0% -12	109% 131	-23% -138	89% 31

monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	3%	-1%	9%
		area (ha)	26	-26	-8	12	-17	14
narrow leaved peppermint	subalpine dry shrub frst	percentage	1%	-46%	1%	-8%	-7%	35%
		area (ha)	77	-248	58	-105	-225	443
messmate	sandstone dry shrub frst coastal dry shrub frst (E.obliqua)	percentage	-25%	-70%	-36%	1154%	-71%	243%
		area (ha)	-474	-57	-2682	1893	-6185	7505
stringybark/ peppermint	tableland dry shrub frst	percentage	-19%	-39%	-26%	526%	-38%	69%
		area (ha)	-284	-56	-1458	1304	-1476	1969
applebox	waalimma dry grass frst	percentage	-11%	-80%	-38%	1013%	-73%	203%
		area (ha)	-8	-28	-134	81	-424	513
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage	-4%	-62%	-3%	104%	-43%	47%
		area (ha)	-390	-808	-711	3734	-3880	2058
woolybutt	coastal dry shrub frst (E.longifolia)	percentage	0%	-70%	0%	-7%	-60%	291%
		area (ha)	9	-354	-29	-209	-4164	4747
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage	-8%	-71%	-18%	511%	-47%	118%
		area (ha)	-212	-80	-1457	945	-1234	2039
gum/box/ stringybark	brogo dry shrub frst	percentage	3%	-71%	-2%	6%	-51%	288%
		area (ha)	105	-520	-86	102	-1408	1807
bangalay dunes	dune dry shrub frst	percentage	0%	-100%	0%	2800%	-57%	-33%
		area (ha)	0	-1	0	28	-25	-4
apple	coastal dry shrub frst (A.floribunda)	percentage	-18%	-95%	-25%	1703%	-83%	772%
		area (ha)	-529	-241	-1059	1856	-4072	4045
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage	6%	-100%	1%	800%	-73%	50%
		area (ha)	5	-4	1	80	-82	1

river oak	riverine frst	percentage area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage area (ha)	-1% -3	-96% -51	-1% -5	832% 491	-88% -543	123% 112
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage area (ha)	-26% -3473	-79% -1110	-22% -3388	255% 5822	-82% -10359	204% 4421
yertchuk	timbillica dry shrub frst	percentage area (ha)	-43% -678	-70% -149	-51% -2516	1013% 2290	-73% -7444	177% 8497
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage area (ha)	-20% -664	-76% -127	-35% -3469	753% 2689	-78% -11096	570% 12667
blue leaved stringybark	genoa dry shrub frst	percentage area (ha)	-2% -20	-94% -15	-3% -33	3320% 166	-53% -133	28% 35
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath swamp heath lowland swamp swamp forest sub alpine bog floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh estuarine wetland (Av.marin)	percentage area (ha)	1% 6	-73% -46	-3% -57	360% 648	-43% -686	41% 139
wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath	percentage area (ha)	0% 30	-63% -33	0% 7	8535% 7169	-96% -7082	-38% -92

	wadbilliga range wet frst							
wadbilliga	wadbilliga gorge dry frst	percentage	2%	-98%	1%	1640%	-89%	-100%
forests	wadbilliga river valley frst	area (ha)	51	-50	26	1673	-1679	-21

Non commercial forest types

1.2.2 Connectivity

The assessment is in relation to indicator 1.2, 'extent of connectivity in the forest landscape in relation to: (i) threatened species habitat; (ii) general retained habitat; (iii) conservation reserves'. Connectivity is required to ensure maintenance of ecosystem function at the regional, subregional and local levels. This will include maintenance of threatened species' habitat.

The reserve system is generally well-connected in a contiguous stretch along the tablelands and the additions proposed increase connectivity, particularly in the Devil's Hole area. In general, the reserve design also provides connectivity across main catchment boundaries but some outlying reserve areas will remain unconnected. Additional connectivity could be promoted by identifying opportunities for conservation agreements with landowners in the north coastal area of the Eden Management Area.

In State Forest, connectivity would be primarily provided through riparian areas, areas excluded through PMP and EPA restrictions and the river corridor system.

1.2.3 Protocols

The assessment is in relation to indicator 1.3, 'management measures in place to maintain species extent and abundance'. Table 1.2 lists the protective measures that would be implemented in this scenario for threatened species. In this scenario, the protection of threatened species would be through the identification and systematic protection of a series of habitat structures and features that provide for the major guilds of threatened species in the Eden area. This provides a landscape level foundation for the conservation of habitat of rare and threatened species.

TABLE 1.2
PROTECTIVE MEASURES BY SPECIES IN CONSERVATION PROTOCOLS' GENERAL PRESCRIPTIONS

Protective measures **(General prescriptions from Conservation Protocols)**	**Characteristics of measure**	**Species**
Hollow-bearing tree retention*	Minima of: 6 hollow-bearing trees per ha must be retained in good habitat across the landscape; 4 hollow-bearing trees per ha must be retained in moderate habitat across the landscape; 2 hollow-bearing trees per ha must be retained in low habitat across the landscape	Glossy Black Cockatoo, Yellow-tailed Black Cockatoo, Powerful Owl, Masked Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied glider, Greater Glider, Squirrel Glider, bRegent HoneyeBrush-tailed Phascogale, hollow-dependent bats
Recruitment tree retention*	A habitat clump shall be retained to surround one in three retained hollow-bearing trees.	As above
Significant food resources	Protection of Allocasurina spp At least 4 mature (.40cm dbh) winter-flowering eucalypt spp per two hectares Protect mature banksias & Xanthorrhoea spp Retain all V-notch trees Retain understorey vegetation	Glossy Black Cockatoo, Yellow-bellied glider, Greater Glider, Squirrel Glider, Regent Honeyeater, Swift Parrot, Grey-headed Flying fox
Wetlands	At least 10m buffer more than 0.1ha<0.5ha At least 40m buffer >0.5ha & SEPP 14 wetlands	frogs, Black Bittern, reptiles, rare plants
Heath	At least 20m buffer around heath >0.2ha<0.5ha At least 40m buffer around heath > 0.5ha	Passerines, herptiles, plants
Rocky Outcrops	At least 20m buffer around	Brush-tailed Rock Wallaby,

	>0.1ha<0.5ha At least 40m buffer around rocky outcrops > 0.5ha	endemic plants, herps
Caves, tunnels & disused mineshafts	All protected by at least 50m buffer	Cave-dependent bats
Rainforest	Protect all rainforest. 20m buffer around boundaries.	Olive Whistler, rare plants, herpetofauna
Riparian Buffers	Fauna stream buffers 1st=10m, 2nd=20m, >3rd=40m	Threatened frogs, habitat for forest-dependent fauna

*see EIS Determination for details

The following species-specific prescriptions are proposed:

- for the Koala, a 50 m exclusion zone would be established around individual animals encountered. In addition 150 ha of high quality habitat would be retained within a 2 km radius.
- for the owls, a landscape-level habitat management plan would be implemented. This would be designed to have no impact on total harvest, but would affect the timing and spatial pattern by requiring the retention of 25% of planning areas of about 10 000 ha each (across all tenures) in high quality foraging habitat. This habitat would be defined as regrowth, mature or old growth forest, greater than ten years of age with a weighting factor relating to time since logging and forest type.
- for the smoky mouse and southern brown bandicoot, intensified programs of feral animal control would be undertaken in areas where the limited number of sightings of these animals have occurred.
- there would be a need for intensified survey and habitat mapping for the Stuttering Barred Frog and the Giant Burrowing Frog. The conservation status of these species would be reviewed after five years.

Note: there are no exclusion based protocols for Old Growth forest, frogs, Quoll or Forest Owls in this scenario.

1.2.4 Wood Supply

In this scenario, the wood supply is specified based on general use of a 30% canopy retention harvesting system and systematic thinning from below of regrowth forests. Based on estimates from FRAMES this will provide an annual harvest of 23 000m^3 of sawlogs and 330 000 tonnes of pulpwood, as indicated in Table 1.3. The wood supply is based on the systematic harvest of multi-aged forest over a 23 year period within the policy constraints noted above.

TABLE 1.3
WOOD SUPPLY FOR A1/A2/C1 SCENARIO

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Sawlog	Total Pulp	Av. sawlog/ha	Av. pulp/ha	Total sawlog vol/yr	Total pulp vol/yr
Coastal	Low	4 123	23 143	205 845	6	50	1 006	8 950
Coastal	High	4 487	43 776	238 813	10	53	1 903	10 383
Hinterland	Low	9 468	60 500	749 523	6	79	2 630	32 588
Hinterland	High	18 991	168 251	1 787 300	9	94	7 315	77 709
Tableland	Low	1 321	20 830	159 128	16	120	906	6 919
Tableland	High	5 681	125 609	840 052	22	148	5 461	36 524
TOTAL							**19 222**	**173 072**
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Sawlog	Total Pulp	Av. sawlog/ha	Av. pulp/ha	Total sawlog vol/yr	Total pulp vol/yr
Coastal		19 681	66 219	2 086 112	7	211	2 879	90 701
Hinterland		12 155	10 420	966 800	2	155	453	42 035
Tableland		4 964	9 732	544 923	2	221	423	23 692
TOTAL							**3 755**	**156 428**
GRAND TOTAL							**22 977**	**329 500**

1.2.5 Catchment Level Disturbance

Changes in the distribution of growth stages occur both through the results of timber harvesting and the evolution of existing forest types through natural succession. In the Eden area catchments, there is a significant evolution of young forest into mature growth stages. This is largely due to regrowth from previously logged forests. There is a significant reduction in the amount of old growth in the Wallagaraugh Catchment, largely because this area is composed mostly of State Forest and is scheduled for significant timber harvesting in the next twenty years. In general, significant changes from old growth to regrowth can reduce water flow rates and flow duration, as foliar biomass is increased and transpiration rates increased. The shifts from regrowth to mature may have less impact on water flows, depending on the characteristics of the forest type.

Given that much of this forest is scheduled for thinning, water flows may potentially increase in some catchments. Table 1.4 shows the estimated change in the extent of growth stages from 1997-2019 by catchment (indicator 4.5).

TABLE 1.4
ESTIMATED CHANGE IN THE EXTENT OF GROWTH STAGES FROM 1997-2019 BY CATCHMENT

Catchment name	Percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	4%	-85%	5%	163%	-67%	97%	0%
Coastal Central	0%	-14%	-66%	-24%	248%	-48%	267%	0%
Coastal North	0%	2%	-65%	5%	54%	-65%	118%	0%
Coastal South	0%	-13%	-86%	-22%	12738%	-87%	793%	0%
Genoa	0%	-7%	-78%	-12%	725%	-43%	38%	0%
Murrumbidgee		1%	-54%	0%	30%	-3%	-7%	0%
Snowy		-1%	-64%	0%	-27%	-1%	28%	0%
Towamba	0%	-6%	-73%	-7%	113%	-46%	91%	0%
Unknown		0%		0%			0%	0%
Wallagaraugh	0%	-40%	-71%	-45%	937%	-69%	197%	0%

1.2.6 Socio-economic, Cultural and Heritage Issues

Socio-economic Issues

Outputs from FORUM will be required to assess the likely impacts on royalty value by product type against fair market rates. FRAMES will provide output for assessment of variation within five per cent of ecologically sustainable wood supply by product type over a five-year period .

Cultural Heritage Issues

ESFM aims to

- monitor and review condition of sites
  - identify mitigating actions if necessary; and
  - assess efficacy of protective measures
- ensure that protective mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous cultural values or other identified values
- ensure indigenous groups are employed to undertake monitoring.

Table 1.5 contains places (non-indigenous and National Estate) requiring special management. In addition to those listed in the table, other areas having indigenous cultural heritage values will need to be appropriately protected. Notable amongst these is Biamanga, an area currently in National Park and so not subject. from which logging should be excluded.

TABLE 1.5
CULTURAL HERITAGE PLACES REQUIRING SPECIAL MANAGEMENT

Heritage Feature (Place Name)	**National Estate /State Heritage Value**	**Location**	**Tenure**	**Threatening Processes**	**Current Protective Mechanisms**	**Management Implications for SFNSW**	**Resource Implications**
Old Growth Forest Patches - Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Siviculture	PMP 1.2	Nil logging, Nil silviculture Nil fire	Nil currently excluded from logging
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Siviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Forest management by prescription - light intensity logging, nil fire.	Nil additional impact on resource - area already identified and managed as PMP 1.1.8 Forest management by prescription and has conservation plan
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Clasification as PMP 1.1.6 & 1.1.2 Maintenance of viewing lines	Moderate impact on surrounding eucalypt forest
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - conservation of representative area of forest around site sought, needs to be clearly delineated, included in PMP and managed by prescription
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Substantial - some areas within area delineated currently PMP 1.1.8 Forest management by prescription, 1.2 excluded from harvesting, 1.3 excluded from harvesting, and 1.1.7 excluded from harvesting
Whipstick mines and village site	Historic	Gnupa SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977	Classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - needs to be clearly delineated, included in PMP and managed by prescription
Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Streamside reserve	Classification as PMP 1.1.2	Nil, currently protected by streamside buffer and excluded from harvesting.
Murrah State Forest (koala habitat)	Social Aesthetic	Indicative only Murrah SF	SFNSW	Fire Logging Silviculture	unknown		
Myrtle Mountain Lookout	Social Aesthetic	Tantawangalo SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2	Nil logging, Nil silviculture Nil fire Maintain access	Nil, currently PMP 1.1.2 and excluded from harvesting.

Wallaga Lake	Social Aesthetic	Bermagui SF	SFNSW, Crown land & NPWS	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Moderate impact on resource due to extensions of PMP 1.1.6 boundary outside current delineated area than currently exist
Davidson's Whaling Station	Social Historic Aesthetic	East Boyd SF / Ben Boyd NP	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 AHC Act 1975 NPW Act 19 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire	Nil - no change to current management
Cow bail trail / Chimneys trail / cuttings	Historic Aesthetic	Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 NPW Act 19 PMP 1.1.6	Classifiaction of entire area as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire	Moderate - 5m buffer for pine areas within State Forest, 20m buffer for native forest areas within State Forest - requires identification as PMP 1.1.6 harvesting by prescription
Edrom Lodge	Historic Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977 PMP 1.1.3	Additional classification as PMP 1.1.8 and PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintain historic values Maintain viewing lines	Nil, currently PMP 1.1.3 education harvesting by prescription.
Burrawang Picnic Ground	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil -. no change to current management
Ludwigs Creek	Aesthetic	Nadgee SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Maxwells forest walk	Aesthetic	Maxwells Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current forest preserve and excluded from harvesting
Newtons Crossing camping area	Aesthetic	Wallagaraugh Reserve, Timbillica SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Scrubby Creek picnic area	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6 PMP 1.1.2	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management

Nethercote Falls	Aesthetic	Nethercote Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3 AHC Act 1975	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - current flora reserve, excluded from harvesting
Nalbaugh Falls	Aesthetic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7 PMP 1.1.2	Additional classification as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest Management by prescription - light intensity logging, nil fire Maintenance of value Maintenance of viewing lines	Moderate - extent of buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Siviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Mostly private & crown land issue, if determined to be partly on State Forest may require PMP
Prison Farm, Bondi SF	Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Maintenance of value	Nil - on cleared land within pine plantation
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Razor-back Fire Trail	Potential Historic	Murrabrine SF	SFNSW & NPWS	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Sleeper cutter camps, Murrah SF	Potential Historic	Murrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Negligible - needs to be clearly delineated included in PMP and managed by prescription
Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Siviculture	PMP 1.1.6	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial if entire boundary as delineated applied - some of the area is currently PMP 1.1.6 harvesting by prescription
Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial on pine resource) if buffer suggested is considered, site currently has 50 -100m buffer.
Tantawangalo Road and Lookout	Aesthetic Potential Historic	Glen Bog SF	SFNSW & NPWS	Fire Logging Silviculture	PMP 1.1.6	Additional classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire Maintenance of viewing lines	Nil - moderate if it is proposed that current management prescriptions be changed - within current PMP 1.1.6 boundary harvesting by prescription

- The information in Table 5 should be considered indicative only - detailed assessments and documentation of places are yet to be finalised
- Current condition of places identified has not been able to be stated as detailed information on places has yet to be received.

All places identified as having historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

Conservation and management of cultural heritage values will be via existing national parks procedures, State Forest PMP classification and specific protocols for newly identified sites. The assessment proposes that cultural heritage, in terms of the aboriginal community, would become a co-management responsibility. This would take the following into account:

- a recognition of cultural heritage and traditional use values by State Forests and the NSW NPWS
- an agreement on access to those values and traditional uses by the Aboriginal communities
- recognition in management planning of these values, the protective measures or access required, and the mechanism to ensure Aboriginal participation in the management of those values
- an annual co-management board between the Aboriginal communities and the land management agencies to examine the management proposed for cultural heritage values, and to examine opportunities for expanded participation by the Aboriginal community in the economic activities in the conservation and production forest area.

Some natural and cultural heritage values are outside of the reserve system proposed in this scenario. Prescriptions for specific values are required for particular sites. Under current PMP classifications and regulatory arrangements, many of these values are protected. The impact on wood supply would need to be determined given any changes in classifications or arrangements.

1.3 CONSERVATION APPROACH

The negotiation group asked that an analysis be undertaken on issues raised by the conservation representatives in the negotiation process. The approach worked to identify JANIS targets not fully met by the NSW option and to protect those areas by policy. Details of the conservation approach to protecting old growth forests off reserve is contained in Appendix 1. In general, about 5,800 ha of forest were identified. In addition the analysis recommended additional connection corridors, and koala habitat protection where A1 selection logging would apply. A map identifying additional corridor areas to be managed by single tree selection harvesting is available.

The analysis recommended that all areas outside these special prescriptions would be managed by A2 selection logging or C2 regrowth thinning.

On the basis of this scenario, total sawlog volume per year was 16 189 m^3 and 188 650 tonnes of pulpwood for multiaged and regrowth forest. The full implications of this analysis on the indicators could not be undertaken in the time available.

1.4 GENERAL RECOMMENDATIONS RELATING TO THE SCENARIO

The scenario provided is based on a general application of current harvesting practice on a smaller landbase and an emphasis on enhancing conservation through an expanded protected areas system. At the highest level of analysis, this option should lead to an expansion in the protection of biodiversity via the 40,000 ha of additions to the CAR reserve system. There is a compensating reduction in wood supply, however of 3,000 m3 per year of sawlogs and a reduction of pulp supplies of approximately 100,000 tonnes per annum.

The application of ESFM is in many ways a choice of the levels of conservation, environmental, social, economic and cultural values to be managed for in the whole Eden Management Area. The ESFM indicators reviewed in this report provide some insight into potential impacts on the ecological and socio-economic values that might be associated with management objectives across tenures in Eden.

This scenario may be subject to improvements that would involve refining trade-offs between conservation and socio-economic values. These trade-offs may allow for example, expanded wood production and conservation outcomes across the

landscape. Examples of trade-offs are found in Table 1.6.

TABLE 1.6
EXAMPLES OF TRADE-OFFS

Value	Proposed Trade-off	Benefits	Assessment of Impact
Soil and Water Quality and Quantity	If less than 5% of a catchment is proposed to be harvested under current practice in a ten-year period, then a 30% canopy reduction using single tree selection and machinery exclusion is allowable in first order streams.	- reduced catchment level impacts by spreading harvest across catchments. - provides additional wood supply, particularly in sawlogs - estimates for filter strips can be provided	Extent and proportion of current harvested forest land with physical disturbance; target is to minimise physical disturbance; not to exceed target for each EPA hazard class for each harvest system
Variation in Harvest Systems by Ecosystem Types	Assign specific harvest systems to each ecosystem type. In some types this will involve intensification and in others, will involve reduced intensity	- better targets harvesting disturbance to the nature of the forest ecosystem - may be neutral to wood supply but may have benefits for species and log types	Extent of connectivity on threatened species and retained habitat. Extent and abundance of species and habitat. Regrowth stand condition and structure following harvesting.
Conservation Strategy for Old Growth Forests	Old growth forest will be extended by the evolution of younger forest added to reserve areas. Estimates of the evolution of old growth may allow modification of targets for off-reserve management	- Identifies likely dynamics of old growth resource and ensures that old growth levels are regulated at or above current levels. - provides access to some old growth resource off reserve for industry	Change in extent of old growthand other growth stages for forest types, and of rare and endangered old growth forest types. Comparison of regeneration to original forest type
Review of PMP categories	Some PMP's may not be recognised in CAR reserve design and their values would be less at risk with expanded reservation area.	- Could provide additional resource based on values that are now protected in reserves. Selective logging regimes are likely to be required to maintain values. Resource estimates	Extent of forest/vegetation type by growth stage. Extent of connectivity in relation to threatened species

		would need to be calculated	and retained habitat. Management measures in place to maintain species extent and abundance. Change in condition and number of recorded cultural and heritage places, artefacts, sites, buildings and other structures.
Accelerate the Availability of 1952 fire regrowth	Bring forward regrowth by three years	Allows higher rate of harvest in existing multi-age forests (approx. 1,000 cu m per annum)	Need to have ongoing assessment of the development of regrowth forest

1.5 CONCLUSION

The State Position is based on defining additions to the CAR reserve in a way to best augment the protection of biodiversity and the continued support for the industry. It is to a large degree based on a status quo timber management approach, but does significantly add to the National Parks land base. The main result of this is the pressure put on conservation efforts off reserve. The result is that the CAR reserve design and general habitat protection efforts in timber harvest planning would need to be judged sufficient for conserving rare and threatened species of flora and fauna.

If there is a desire to expand off-reserve conservation efforts through exclusions or added habitat protection via PMP areas, section 4 above indicates some ways in which this might be achieved. The reduction in wood supply to industry may have consequences in the local community, and government assistance may be required to ensure the resilience of the community and to identify new opportunities for rural development.

The option also recommends an increased partnership with the aboriginal communities in the Eden RFA area. These new approaches will need further development and negotiation to be fully worked out.

Finally, the need for ongoing fire management and fire protection must be recognized under this scenario. The wood supply commitments are not fully precautionary and should be protected by continued fire hazard management and improved capability in initial attack responsiveness and fire suppression resources.

2. ESFM IMPLICATIONS OF THE CONSERVATION SCENARIO

2.1 DIMENSIONS OF THE SCENARIO

The scenario is based on a minimum sawlog wood supply commitment of 20 000 m^3 per year with an extension of the planning horizon to 2021 and additions to the National Parks estate of approximately 55 000 ha.

The scenario requests different types of analysis in relation to the proposed CAR and wood supply of 20 000 m^3 per year:

- ESFM analysis of current integrated harvesting practice (B3) across the whole forest estate, plus the Conservation Protocols
- ESFM analysis of a combination of logging practices in the area available for logging. The land managed as special management zones for local small mill operators i.e Small Sawmill Management Zones (SSMZ), comprises areas with and without koala habitat.
  - In any SSMZ with koala habitat the multi-aged forest would be logged using A1 practice and the regrowth using C2 with no sawlogs being removed at the first thinning.
  - The SSMZ without koala habitat would be logged with A2 in the multi-aged forest and C2 in regrowth.
  - In the General Management Zone (GMZ) logging would occur by B0 (50% removal) in the multi-aged forest and C2 in regrowth.
- A variation on the ESFM analysis of a combination of logging practices in the area available for logging. Logging in the SSMZ would be the same as 2. above. However in the General Management Zone (GMZ) logging would occur by A2 (30% removal) in the multi-aged forest and C2 in regrowth.
- A proposal which allows logging with additional conservation protocols. In both the multi-aged and regrowth within the SSMZ and GMZ, the same logging practices would occur as outlined in 3 above but any old growth would be retained.

The scenario suggests that the Conservation Protocols form a minimum interim conservation standard for a two-year period. During this time, inventory/growth modelling will be undertaken to refine wood supply estimates and an ESFM implementation program will be put in place. It requires a change in the current base harvesting intensity (B3) from 70% to a variant of B0 (i.e 50% canopy reduction instead of 40%). It requires development of recovery plans for each regionally endangered species, permits access to high-value minerals sites for exploration and supports appropriate management for a number of Aboriginal sites. It requests recommendations relating to utilising lower grade (non-quota) sawlogs (about 5 000 m^3 per year) as part of the quota log volume.

2.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVESTING

2.2.1 B3 timber harvesting and C2 regrowth thinning

As a benchmark to the scenario, the **B3** or 70% canopy reduction harvest system was assessed across the proposed remaining State Forest estate in conjunction with Conservation Protocols.

Regrowth thinning from below (C2) will be applied systematically in regrowth forests.

This scenario provided approximately 19 000 m^3 of wood supply.

2.2.2 SSMZ A1 and A2 with C2 and B0 being 50% canopy reduction timber harvesting and C2 regrowth thinning

Production forest

Harvesting using no more than 50% canopy reduction in the general management zone, plus the Conservation Protocols.

Small Sawmill Management Zones

Selective logging practices in areas managed as Small Sawmill Management Zones for local small mill operators, either using A1 practice in areas of koala habitat or A2 practice in areas not managed for koala.

Regrowth thinning from below (C2) will be applied across the forest estate. However no sawlogs will be removed from the first thinning in the koala area of the SSMZ.

This option would produce about 17 000 m^3 per year.

2.2.3 SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning

Harvesting regimes would be similar to those outlined in scenario 2 with sawlog production of about 15 000m^3.

2.2.4 SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth

This option would produce around 14 000m^3.

2.3 ASSESSMENT OF CONSEQUENCES ON ESFM INDICATORS

2.3.1 Forest Structure

ESFM aims to:

- minimise loss of old growth
- targets for the extent of each growth stage in each forest type to be maintained should be set after examination of data compatible with an ecologically sustainable sawlog industry
- increase area of old growth of rare or endangered forest types
- all areas harvested to be regenerated and managed to maintain the original forest type (including use of the State Forests ecological field guide).

B3 timber harvesting and C2 thinning

This scenario (Table 2.1) decreases the overall extent of Old Growth by less than 1% over the twenty three-year period. Of 29 forest types, the extent of Old Growth increases or stays the same in 18, decreases by less than 10% in 6 and decreases by more than 10% for 5 forest types. Both disturbed native forest and recently disturbed forest increases significantly by 177 and 134% respectively.

TABLE 2.1
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 TO 2019
BY VEGETATION ECOSYSTEM GROUP (B3/C2)

Vegetation ecosystem group	Vegetation type name	Change in size	Extent of change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf							
	myanba euc/fig frst							
	rocky top dry shrub frst							
	a silve/p brogo shrub rf							
	bunga head rf							

	coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered	mtn wet layered frst	percentage	8%	-92%	6%	17%	-41%	31%
brown barrel	*(E.nitens)* mtn wet layered frst *(E.fastigata)*	area (ha)	357	-649	336	315	-1233	874
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage	1%	-92%	1%	6%	-16%	21%
		area (ha)	81	-944	145	166	-670	1222
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage	5%	-91%	1%	-10%	-6%	24%
		area (ha)	114	-416	32	-140	-149	561
southern blue gum	hinterland wet fern frst	percentage	2%	-90%	-6%	254%	-66%	138%
		area (ha)	215	-495	-1057	3885	-5840	3292
yellow stringybark/ gum	hinterland wet shrub frst	percentage	-6%	-77%	-13%	236%	-68%	276%
		area (ha)	-239	-199	-1257	2180	-5105	4620
manna gum	flats wet herb frst	percentage	-3%	-40%	4%	0%	-25%	40%
		area (ha)	-7	-6	44	-1	-106	77
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage	7%	-72%	1%	134%	-22%	80%
		area (ha)	70	-71	21	333	-374	20
river peppermint	bega wet shrub frst	percentage	2%	-66%	1%	92%	-25%	89%
		area (ha)	50	-129	43	485	-742	293
snow gum	monaro dry grass frst monaro basalt grass wdland	percentage	-1%	-29%	-1%	109%	-23%	86%
		area (ha)	-7	-5	-13	131	-138	30
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	3%	-1%	9%
		area (ha)	25	-26	-8	12	-17	14
narrow leaved peppermint	subalpine dry shrub frst	percentage	2%	-46%	1%	-7%	-3%	13%
		area (ha)	173	-248	94	-94	-83	159
messmate	sandstone dry shrub frst coastal dry shrub frst (E.obliqua)	percentage	-12%	-70%	-34%	1220%	-71%	229%
		area (ha)	-229	-57	-2556	2001	-6232	7074

stringybark/ peppermint	tableland dry shrub frst	percentage	-15%	-39%	-25%	570%	-36%	56%
		area (ha)	-219	-56	-1376	1414	-1365	1602
applebox	waalimma dry grass frst	percentage	13%	-80%	-19%	1550%	-73%	155%
		area (ha)	10	-28	-67	124	-429	391
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage	2%	-62%	-2%	108%	-42%	21%
		area (ha)	273	-805	-463	3868	-3791	920
woolybutt	coastal dry shrub frst (E.longifolia)	percentage	8%	-72%	2%	-3%	-60%	262%
		area (ha)	175	-368	162	-88	-4160	4280
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage	-5%	-84%	-18%	514%	-48%	115%
		area (ha)	-142	-95	-1428	951	-1267	1982
gum/box/ stringybark	brogo dry shrub frst	percentage	4%	-72%	-2%	5%	-49%	273%
		area (ha)	144	-527	-72	73	-1330	1712
bangalay dunes	dune dry shrub frst	percentage	0%	-100%	0%	2800%	-57%	-33%
		area (ha)	0	-1	0	28	-25	-4
apple	coastal dry shrub frst (A.floribunda)	percentage	-15%	-95%	-24%	1741%	-83%	738%
		area (ha)	-430	-243	-1029	1898	-4065	3868
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage	6%	-100%	1%	800%	-73%	50%
		area (ha)	5	-4	1	80	-82	1
river oak	riverine frst	percentage						
		area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage	1%	-96%	1%	839%	-87%	92%
		area (ha)	4	-51	5	495	-537	84
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi)	percentage	-4%	-75%	-4%	536%	-80%	207%
		area (ha)	-402	-582	-481	7020	-9194	3639

	lowland dry shrub frst eden dry shrub frst bega dry shrub frst							
yertchuk	timbillica dry shrub frst	percentage area (ha)	-13% -202	-70% -149	-48% -2364	1080% 2441	-73% -7423	161% 7698
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage area (ha)	-11% -380	-77% -130	-33% -3326	855% 3052	-78% -11084	534% 11867
blue leaved stringybark	genoa dry shrub frst	percentage area (ha)	-2% -20	-94% -15	-3% -33	3320% 166	-53% -133	28% 35
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath swamp heath lowland swamp swamp forest sub alpine bog floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh estuarine wetland (Av.marin)	percentage area (ha)	1% 9	-73% -46	1% 21	363% 653	-43% -678	13% 42
wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath wadbilliga range wet frst	percentage area (ha)	0% 30	-64% -33	0% 7	8534% 7169	-96% -7079	-40% -96
wadbilliga forests	wadbilliga gorge dry frst wadbilliga river valley frst	percentage area (ha)	2% 42	-98% -50	1% 22	1641% 1674	-90% -1690	12% 3

Generally non commercial forest types

SSMZ A1 and A2 with C2 and B0 being 50% canopy reduction timber harvesting and C2 regrowth thinning

Under this scenario (Table 2.2), only two forest types (messmate and ash stringybark) have a reduction in Old Growth. Both reduce by 3% or less. Overall, there is a 4% increase in Old Growth and most of the production forest is converted disturbed mature forest (48 000ha).

TABLE 2.2
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 TO 2019
BY VEGETATION ECOSYSTEM GROUP (A1/A2/B0/C2)

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage area (ha)	11% 517	-74% -517	17% 893	47% 875	-31% -914	-30% -855
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	10% 624	-61% -625	12% 1190	34% 995	-9% -378	-30% -1806
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage area (ha)	13% 290	-63% -289	11% 440	11% 152	0% 8	-26% -599
southern blue gum	hinterland wet fern frst	percentage area (ha)	4% 339	-74% -405	-1% -110	313% 4785	-44% -3924	-29% -686
yellow stringybark/ gum	hinterland wet shrub frst	percentage area (ha)	1% 35	-25% -65	-2% -176	241% 2222	-23% -1694	-19% -322
manna gum	flats wet herb frst	percentage area (ha)	1% 4	-40% -6	8% 89	15% 68	-23% -96	-30% -58
red gum	brogo wet vine frst	percentage	7%	-72%	1%	135%	-22%	8%

	bega dry grass frst candelo dry grass frst	area (ha)	70	-71	29	336	-367	2
river peppermint	bega wet shrub frst	percentage	3%	-56%	2%	114%	-20%	-12%
		area (ha)	77	-108	77	599	-609	-38
snow gum	monaro dry grass frst	percentage	0%	-18%	0%	109%	-21%	-17%
	monaro basalt grass wdland	area (ha)	2	-3	0	131	-125	-6
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	3%	-1%	-1%
		area (ha)	25	-26	0	12	-10	-1
narrow leaved peppermint	subalpine dry shrub frst	percentage	3%	-42%	4%	-2%	3%	-25%
		area (ha)	225	-225	253	-29	96	-319
messmate	sandstone dry shrub frst	percentage	-3%	2%	-6%	1394%	-16%	-14%
	coastal dry shrub frst (E.obliqua)	area (ha)	-53	2	-424	2286	-1390	-422
stringybark/ peppermint	tableland dry shrub frst	percentage	3%	-32%	-2%	630%	-16%	-29%
		area (ha)	46	-46	-115	1562	-622	-825
applebox	waalimma dry grass frst	percentage	37%	-80%	2%	1338%	-7%	-28%
		area (ha)	28	-28	8	107	-43	-72
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage	5%	-46%	3%	132%	-38%	-42%
		area (ha)	510	-592	571	4737	-3380	-1844
woolybutt	coastal dry shrub frst (E.longifolia)	percentage	9%	-49%	8%	32%	-23%	6%
		area (ha)	216	-250	597	950	-1617	105
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage	0%	-7%	-9%	937%	-19%	-30%
		area (ha)	-12	-8	-692	1734	-495	-525
gum/box/ stringybark	brogo dry shrub frst	percentage	7%	-41%	6%	40%	-32%	20%
		area (ha)	233	-299	197	633	-889	126

bangalay dunes	dune dry shrub frst	percentage	0%	0%	0%	2800%	-57%	-42%
		area (ha)	0	0	0	28	-25	-5
apple	coastal dry shrub frst (A.floribunda)	percentage	0%	-2%	0%	1460%	-31%	-7%
		area (ha)	-3	-4	-14	1591	-1533	-39
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage	6%	-100%	1%	800%	-71%	-50%
		area (ha)	5	-4	2	80	-80	-1
river oak	riverine frst	percentage						
		area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage	7%	-49%	6%	880%	-83%	-47%
		area (ha)	25	-26	34	519	-509	-43
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage	3%	-45%	3%	566%	-62%	-36%
		area (ha)	318	-347	435	7410	-7180	-635
yertchuk	timbillica dry shrub frst	percentage	1%	-8%	1%	1006%	-19%	-9%
		area (ha)	17	-17	46	2274	-1908	-412
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage	-2%	-32%	-8%	1059%	-21%	6%
		area (ha)	-71	-53	-780	3779	-3017	141
blue leaved stringybark	genoa dry shrub frst	percentage	0%	-19%	0%	3320%	-45%	-47%
		area (ha)	3	-3	5	166	-114	-58
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath swamp heath lowland swamp swamp forest sub alpine bog	percentage	3%	-49%	4%	362%	-35%	-47%
		area (ha)	31	-31	70	651	-562	-158

	floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh estuarine wetland (Av.marin)							
wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath wadbilliga range wet frst	percentage area (ha)	0% 33	-64% -33	0% 13	8552% 7184	-96% -7080	-49% -119
wadbilliga forests	wadbilliga gorge dry frst wadbilliga river valley frst	percentage area (ha)	2% 51	-98% -50	1% 21	1646% 1679	-90% -1690	-48% -10

Generally non commercial forest types

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning

Table 2.3 indicates the change in extent of growth stages from 1997 to 2019 by vegetation ecosystem group, with SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning.

TABLE 2.3
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 TO 2019 BY VEGETATION ECOSYSTEM GROUP (A1/A2/C2)

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage area (ha)	11% 517	-74% -517	17% 893	47% 875	-31% -914	-30% -855
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	10% 624	-61% -625	12% 1190	34% 995	-9% -378	-30% -1806
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage area (ha)	13% 290	-63% -289	11% 440	11% 152	0% 8	-26% -599
southern blue gum	hinterland wet fern frst	percentage area (ha)	4% 339	-74% -405	-1% -110	313% 4785	-44% -3924	-29% -686
yellow stringybark/ gum	hinterland wet shrub frst	percentage area (ha)	1% 35	-25% -65	-2% -176	241% 2222	-23% -1694	-19% -322
manna gum	flats wet herb frst	percentage area (ha)	1% 4	-40% -6	8% 89	15% 68	-23% -96	-30% -58
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage area (ha)	7% 70	-72% -71	1% 29	135% 336	-22% -367	8% 2
river peppermint	bega wet shrub frst	percentage area	3% 77	-56% -108	2% 77	114% 599	-20% -609	-12% -38

		(ha)						
snow gum	monaro dry grass frst	percentage	0%	-18%	0%	109%	-21%	-17%
	monaro basalt grass wdland	area (ha)	2	-3	0	131	-125	-6
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	3%	-1%	-1%
		area (ha)	25	-26	0	12	-10	-1
narrow leaved peppermint	subalpine dry shrub frst	percentage	3%	-42%	4%	-2%	3%	-25%
		area (ha)	225	-225	253	-29	96	-319
messmate	sandstone dry shrub frst	percentage	-3%	2%	-6%	1394%	-16%	-14%
	coastal dry shrub frst (E.obliqua)	area (ha)	-53	2	-424	2286	-1390	-422
stringybark/ peppermint	tableland dry shrub frst	percentage	3%	-32%	-2%	630%	-16%	-29%
		area (ha)	46	-46	-115	1562	-622	-825
applebox	waalimma dry grass frst	percentage	37%	-80%	2%	1338%	-7%	-28%
		area (ha)	28	-28	8	107	-43	-72
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage	5%	-46%	3%	132%	-38%	-42%
		area (ha)	510	-592	571	4737	-3380	-1844
woolybutt	coastal dry shrub frst (E.longifolia)	percentage	9%	-49%	8%	32%	-23%	6%
		area (ha)	216	-250	597	950	-1617	105
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage	0%	-7%	-9%	937%	-19%	-30%
		area (ha)	-12	-8	-692	1734	-495	-525
gum/box/ stringybark	brogo dry shrub frst	percentage	7%	-41%	6%	40%	-32%	20%
		area (ha)	233	-299	197	633	-889	126
bangalay dunes	dune dry shrub frst	percentage	0%	0%	0%	2800%	-57%	-42%
		area (ha)	0	0	0	28	-25	-5
apple	coastal dry shrub frst (A.floribunda)	percentage	0%	-2%	0%	1460%	-31%	-7%
		area	-3	-4	-14	1591	-1533	-39

		(ha)						
riparian	sthn riparian scrub	percentage	6%	-100%	1%	800%	-71%	-50%
scrub	nthn riparian scrub	area (ha)	5	-4	2	80	-80	-1
river oak	riverine frst	percentage						
		area (ha)						
white ash	mtn dry shrub frst	percentage	7%	-49%	6%	880%	-83%	-47%
	(E.fraxinoides)	area (ha)	25	-26	34	519	-509	-43
silvertop	foothills dry shrub frst	percentage	3%	-45%	3%	566%	-62%	-36%
ash	mtn dry shrub frst (E.sieberi)	area (ha)	318	-347	435	7410	-7180	-635
	lowland dry shrub frst							
	eden dry shrub frst							
	bega dry shrub frst							
yertchuk	timbillica dry shrub frst	percentage	1%	-8%	1%	1006%	-19%	-9%
		area (ha)	17	-17	46	2274	-1908	-412
ash/	coastal dry shrub frst	percentage	-2%	-32%	-8%	1059%	-21%	6%
stringybark	(E.agglomerata)	area (ha)	-71	-53	-780	3779	-3017	141
blue leaved	genoa dry shrub frst	percentage	0%	-19%	0%	3320%	-45%	-47%
stringybark		area (ha)	3	-3	5	166	-114	-58
scrub/	rock shrub (K.ambig)	percentage	3%	-49%	4%	362%	-35%	-47%
heath/	mtn rock scrub	area (ha)	31	-31	70	651	-562	-158
wetlands	montane heath							
etc	mtn nadgee heath							
	coastal lowland heath							
	swamp heath							
	lowland swamp							
	swamp forest							
	sub alpine bog							
	floodplain wetlands							
	coastal scrub							
	estuarine wetland (M.erci)							
	saltmarsh							
	estuarine wetland (Av.marin)							

wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath wadbilliga range wet frst	percentage area (ha)	0% 33	-64% -33	0% 13	8552% 7184	-96% -7080	-49% -119
wadbilliga forests	wadbilliga gorge dry frst wadbilliga river valley frst	percentage area (ha)	2% 51	-98% -50	1% 21	1646% 1679	-90% -1690	-48% -10

Generally non commercial forest types

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth

Under this scenario (Table 2.4), there is a net increase in Old Growth for all forest types. Overall, Old Growth increases by 9% and most of the remaining forest is disturbed mature forest (43 000ha) or young forest.

TABLE 2.4
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 TO 2019 BY VEGETATION ECOSYSTEM GROUP (A1/A2/C2 & OLD GROWTH RETAINED)

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage area (ha)	15% 691	-74% -517	17% 893	38% 701	-31% -914	-30% -855
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	20% 1214	-61% -625	12% 1190	14% 405	-9% -378	-30% -1806

brown	mtn wet fern frst	percentage	21%	-63%	11%	-2%	0%	-26%
barrel/ gum	basalt wet herb frst	area (ha)	471	-289	440	-29	8	-599
southern	hinterland wet fern frst	percentage	6%	-74%	-1%	297%	-44%	-29%
blue gum		area (ha)	586	-405	-110	4538	-3924	-686
yellow	hinterland wet shrub frst	percentage	10%	-25%	-2%	202%	-23%	-19%
stringybark/ gum		area (ha)	393	-65	-176	1864	-1694	-322
manna gum	flats wet herb frst	percentage	6%	-40%	8%	13%	-23%	-30%
		area (ha)	17	-6	89	55	-96	-58
red gum	brogo wet vine frst	percentage	7%	-72%	1%	135%	-22%	8%
	bega dry grass frst	area (ha)	70	-71	29	336	-367	2
	candelo dry grass frst							
river	bega wet shrub frst	percentage	5%	-56%	2%	101%	-20%	-12%
peppermint		area (ha)	144	-108	77	532	-609	-38
snow gum	monaro dry grass frst	percentage	1%	-18%	0%	101%	-21%	-17%
	monaro basalt grass wdland	area (ha)	12	-3	0	121	-125	-6
monaro	numeralla dry shrub	percentage	1%	-30%	0%	3%	-1%	-1%
grasslands/ woodlands	wdland monaro grassland	area (ha)	25	-26	0	12	-10	-1
narrow	subalpine dry shrub frst	percentage	4%	-42%	4%	-6%	3%	-25%
leaved peppermint		area (ha)	281	-225	253	-85	96	-319
messmate	sandstone dry shrub frst	percentage	9%	2%	-6%	1251%	-16%	-14%
	coastal dry shrub frst (E.obliqua)	area (ha)	183	2	-424	2051	-1390	-422
stringybark/	tableland dry shrub frst	percentage	21%	-32%	-2%	520%	-16%	-29%
peppermint		area (ha)	318	-46	-115	1289	-622	-825
applebox	waalimma dry grass frst	percentage	59%	-80%	2%	1125%	-7%	-28%
		area (ha)	45	-28	8	90	-43	-72
gum/	wog wog dry grass frst	percentage	8%	-46%	3%	122%	-38%	-42%
stringybark	nalbaugh dry grass frst	area (ha)	887	-592	571	4360	-3380	-1844

	wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)							
woolybutt	coastal dry shrub frst (E.longifolia)	percentage area (ha)	16% 365	-49% -250	8% 597	27% 801	-23% -1617	6% 105
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage area (ha)	12% 346	-7% -8	-9% -692	744% 1376	-19% -495	-30% -525
gum/box/ stringybark	brogo dry shrub frst	percentage area (ha)	15% 474	-41% -299	6% 197	25% 392	-32% -889	20% 126
bangalay dunes	dune dry shrub frst	percentage area (ha)	0% 0	0% 0	0% 0	2800% 28	-57% -25	-42% -5
apple	coastal dry shrub frst (A.floribunda)	percentage area (ha)	16% 472	-2% -4	0% -14	1024% 1116	-31% -1533	-7% -39
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage area (ha)	6% 5	-100% -4	1% 2	800% 80	-71% -80	-50% -1
river oak	riverine frst	percentage area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage area (ha)	13% 48	-49% -26	6% 34	841% 496	-83% -509	-47% -43
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage area (ha)	10% 1128	-45% -347	3% 435	504% 6600	-62% -7180	-36% -635
yertchuk	timbillica dry shrub frst	percentage area (ha)	12% 195	-8% -17	1% 46	928% 2097	-19% -1908	-9% -412
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage area (ha)	11% 375	-32% -53	-8% -780	933% 3332	-21% -3017	6% 141

blue leaved stringybark	genoa dry shrub frst	percentage	3%	-19%	0%	2820%	-45%	-47%
		area (ha)	28	-3	5	141	-114	-58
scrub/ heath/ wetlands etc	rock shrub (K.ambig)	percentage	4%	-49%	4%	353%	-35%	-47%
	mtn rock scrub	area (ha)	47	-31	70	635	-562	-158
	montane heath							
	mtn nadgee heath							
	coastal lowland heath							
	swamp heath							
	lowland swamp							
	swamp forest							
	sub alpine bog							
	floodplain wetlands							
	coastal scrub							
	estuarine wetland (M.erci)							
	saltmarsh							
	estuarine wetland (Av.marin)							
wadbilliga forests	wadbilliga dry shrub frst	percentage	0%	-64%	0%	8549%	-96%	-49%
	wadbilliga range ash frst	area (ha)	36	-33	13	7181	-7080	-119
	wadbilliga mallee heath							
	wadbilliga range wet frst							
wadbilliga forests	wadbilliga gorge dry frst	percentage	2%	-98%	1%	1644%	-90%	-48%
	wadbilliga river valley frst	area (ha)	53	-50	21	1677	-1690	-10

Generally non commercial forest types

2.3.2 Connectivity

ESFM aims to ensure functional connectivity through implementation of:

- conservation protocols; and
- maintenance of ecosystem function.

The main reserve area is largely similar to the 23 000 m^3 scenario. There is a strong north-south corridor along the tablelands and some coastal-tablelands connectivity through the Devils Hole and Stanton Rock. The use of a low intensity harvesting area in the North Jingera area (Nullica) would strengthen the main North-South connectivity in the hinterland forests. The option establishes a number of reserves in areas of former leasehold land that are isolated from other reserves but which are connected by extant vegetation on privately managed lands. These areas would become 'island ecosystems' if the surrounding land were cleared. There are also some national park areas proposed that are surrounded by State Forests. While connected to other Park areas by forested land, this land will not be continuous old growth forest and may not be effective for all species.

On the coast there are still some breaks in the continuity of forests and there may be a need to

work towards establishing conservation agreements with private landowners in the north coastal area of the Eden RFA.

Connectivity is similar for all the regimes under this scenario.

2.3.3 Management Measures for Conservation of Flora and Fauna

ESFM aims to assess the implementation of habitat conservation measures (Table 2.5).

TABLE 2.5
PROPOSED PROTECTIVE MEASURES FOR BIODIVERSITY CONSERVATION OFF-RESERVE

Protected measures (General Prescriptions from Conservation Protocols)	Characteristics of Measure	Species Addressed
Hollow-bearing tree retention*	Minima of: 6 hollow-bearing trees per ha must be retained in good habitat across the landscape; 4 hollow-bearing trees per ha must be retained in moderate habitat across the landscape; 2 hollow-bearing trees per ha must be retained in low habitat across the landscape.	Glossy black Cockatoo, Yellow-tailed black Cockatoo, Powerful Owl, Masked Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied glider, Greater Glider, Squirrel Glider, Regent Honeyeater, Brush-tailed phascogale, hollow dependent bats
Recruitment tree retention*	A habitat clump will be retained to surround one in three retained hollow-bearing trees.	as above
Significant food resources	Protection of Allocasurina spp. At least 4 mature (40 cm dbh) winter-flowering Eucalypts per 2 ha in identified forest ecosystems, protection of mature banksia and Xanthorrhea spp., Retain all V-notch trees, Retain representative understory vegetation	Glossy black cockatoo, Yellow-bellied glider, Squirrel Glider, Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox, Brushtailed Phascogale
Wetlands	At least 10m buffer on areas between 0.1 and 0.5 ha, at least 40m buffer on areas greater than 0.5 ha or SEPP 14 wetlands	frogs, Black Bittern, herpetofauna, rare plants
Rocky Outcrops	At least 20m buffer around rocks and associated heathland between 0.2 and 0.5 ha, at least 40m buffer around heathlands > 0.5 ha	Passerines, herpetofauna, plants
Caves,tunnels and disused mineshafts	All protected by at least 50m buffer	Cave-dependent bats
Rainforest	Protect all rainforest. 20m buffer on warm temperate	Olive Whistler, rare plants, herpetofauna

	rainforest	
Riparian buffer	Fauna stream buffers (i) 1st order streams, 10m (ii) 2nd order streams, 20m (iii) 3rd order, 40m	threatened frogs, habitat for forest-dependent fauna
Koala	protect high use area , approximately 50 ha per individual	
Large forest owls	retain 300 ha of high quality habitat in a 1.2 km radius area around record. 50 m buffer on permanent roosts and nests	
Stuttering barred frog and giant burrowing frog	Extended riparian buffer zone	
Quoll	50 m buffer around latrine sites and dens	
Southern Brown Bandicoot	Moratorium on harvesting of compartments where the animal is sighted	
Old Growth	Protect via PMP on State Forest all Old Growth Types to achieve 80% of target. Estimated to be 1500 ha.	
Rare Plants	Buffers on individual or populations	

*see EIS Determination for details

Application of these protocols would be similar for all the regimes modelled.

2.3.4 Wood Supply

ESFM aims to ensure that the allowable timber cut is not exceeded until an ecologically sustainable yield is determined and that targets are set within range after examination of data compatible with an ecologically sustainable sawlog industry.

B3 timber harvesting and C2 thinning

As a benchmark, this scenario generates 19 088 m^3 of sawlogs over a twenty three-year period and 294 061 tonnes of pulpwood. The wood supply is realised using current practice for mature and Old Growth forests and thinning of regrowth. Should an old growth protocol be introduced which retains all old growth within the net harvest area, then the reduction in sawlog resource would approximate a further 1 900 m^3 per annum.

Table 2.6 contains full details of the wood supply for this scenario.

TABLE 2.6
WOOD SUPPLY FOR B3/C2 SCENARIO

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	2865	18294	125390	6.38	43.76	795	5452
Coastal	High	4007	38115	189486	9.51	47.29	1657	8239
Hinterland	Low	8220	51025	633375	6.21	77.06	2218	27538
Hinterland	High	17076	145243	1578673	8.51	92.45	6315	68638
Tableland	Low	1083	16688	130227	15.42	120.29	726	5662
Tableland	High	4377	89913	616767	20.54	140.91	3909	26816
TOTAL							**15621**	**142344**
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		19087	65958	2068650	3.46	108.38	2868	89941
Hinterland		11720	10508	926988	0.90	79.10	457	40304
Tableland		4460	3270	493836	0.73	110.74	142	21471
TOTAL							**3467**	**151716**
GRAND TOTAL							**19088**	**294061**

A1/A2/B0 timber harvesting and C2 thinning

This scenario generates 17 000 m^3 of sawlogs and 240 000 tonnes of pulpwood annually.

The scenario includes regrowth thinning to 50% canopy reduction and some limited regeneration harvesting in regrowth. The wood supply estimate is based on a B0 (50% canopy reduction) in the general management area, A1 (single tree selection with 10% canopy removal) in Koala habitat zones and corridor systems, and A2 (single tree selection with 30% canopy removal) in the Small Sawmiller Management Zone (SSMZ).

There is some uncertainty about the economic viability of the widespread use of single tree selection harvesting systems. This would require further analysis.

TABLE 2.7
WOOD SUPPLY FOR A1/A2/B0/C2 SCENARIO

A1 logging in SSMZ (koala management zone) of Multiple-aged forest

Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	1961	9694	13007	4.94	6.63	421	566
Coastal	High	374	2257	2880	6.03	7.70	98	125
Hinterland	Low	144	379	1339	2.63	9.29	16	58
Hinterland	High	1230	6431	14483	5.23	11.77	280	630
Tableland	Low							
Tableland	High							
TOTAL							816	1379
A2 logging in SSMZ (not koala management zone) of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	87	197	2127	2.25	24.33	9	92
Coastal	High	1107	2665	29440	2.41	26.60	116	1280
Hinterland	Low	1672	5844	49379	3.50	29.53	254	2147
Hinterland	High	3239	15375	110720	4.75	34.19	668	4814
Tableland	Low							
Tableland	High							
TOTAL							1047	8333
B0 (variation to 50%) logging in GMZ of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	817	3117	21073	3.82	25.80	136	916
Coastal	High	2526	28035	71892	11.10	28.46	1219	3126
Hinterland	Low	6590	40745	378967	6.18	57.51	1772	16477
Hinterland	High	12458	103709	867137	8.33	69.61	4509	37702

Tableland	Low	1099	15123	40316	13.76	36.69	658	1753
Tableland	High	4377	80913	440542	18.49	100.65	3518	19154
TOTAL							11811	79127
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	T1	18469	5347	1744513	0.29	94.46	232	75848
Hinterland	T1	11184	4332	907889	0.39	81.18	188	39473
Tableland	T1	4435	156	483179	0.04	108.96	7	21008
Coastal	T2	4953	40662	284240	8.21	57.39	1768	12358
Hinterland	T2	551	1627	8922	2.95	16.18	71	388
Tableland	T2	89	1342	6589	15.00	73.65	58	286
Coastal	rh	1272	19949	39897	15.68	31.36	867	1735
Hinterland	rh	525	4549	9098	8.66	17.33	198	396
Tableland	rh	24	1772	3545	75.00	150.00	77	154
TOTAL							3467	151647
GRAND TOTAL							17140	240486

The ESFM analysis on all options used sawlog availabitity modifers for A1 and A2 practices of 66% and 75% of B3 sawlog volumes respectively. Conservation groups have asked for a sensitivity analysis on sawlog volumes, using a modifer of 80% of B3 sawlog availability. If 80% is considered then an additional 200 m^3 per annum of sawlogs may be avialable.

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning

This scenario produces about 15 000m^3 and 210 000 tonnes of pulpwood annually as shown in Table 2.8.

TABLE 2.8
TIMBER VOLUME FOR SSMZ A1 AND A2 WITH C2 AND A2 BEING 30% CANOPY REDUCTION TIMBER HARVESTING AND C2 REGROWTH THINNING

A1 logging in SSMZ (koala management zone) of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwoo

								d
Coastal	Low	1961	9694	13007	4.94	6.63	421	566
Coastal	High	374	2257	2880	6.03	7.70	98	125
Hinterland	Low	144	379	1339	2.63	9.29	16	58
Hinterland	High	1230	6431	14483	5.23	11.77	280	630
Tableland	Low							
Tableland	High							
TOTAL							816	1379
A2 logging in SSMZ (not koala management zone) of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	87	197	2127	2.25	24.33	9	92
Coastal	High	1107	2665	29440	2.41	26.60	116	1280
Hinterland	Low	1672	5844	49379	3.50	29.53	254	2147
Hinterland	High	3239	15375	110720	4.75	34.19	668	4814
Tableland	Low							
Tableland	High							
TOTAL							1047	8333
A2 logging in GMZ of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	817	2597	12644	3.18	15.48	113	550
Coastal	High	2526	23362	43135	9.25	17.07	1016	1875
Hinterland	Low	6590	33955	227380	5.15	34.50	1476	9886
Hinterland	High	12458	86424	520282	6.94	41.76	3758	22621
Tableland	Low	1099	12602	56443	11.47	51.36	548	2454
Tableland	High	4377	67427	264325	15.41	60.39	2932	11492
TOTAL							9842	48879

Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	T1	18469	5347	1744513	0.29	94.46	232	75848
Hinterland	T1	11184	4332	907889	0.39	81.18	188	39473
Tableland	T1	4435	156	483179	0.04	108.96	7	21008
Coastal	T2	4953	40662	284240	8.21	57.39	1768	12358
Hinterland	T2	551	1627	8922	2.95	16.18	71	388
Tableland	T2	89	1342	6589	15.00	73.65	58	286
Coastal	rh	1272	19949	39897	15.68	31.36	867	1735
Hinterland	rh	525	4549	9098	8.66	17.33	198	396
Tableland	rh	24	1772	3545	75.00	150.00	77	154
TOTAL							3467	151647
GRAND TOTAL							15172	210237

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth in the GMZ

This scenario results in 14 000m^3 of sawlog and 204 000 tonnes of pulpwood (Table 7.9).

TABLE 2.9
TIMBER VOLUME FOR SSMZ A1 AND A2 WITH C2 AND A2 BEING 30% CANOPY REDUCTION TIMBER HARVESTING AND C2 REGROWTH THINNING AND RETENTION OF OLD GROWTH IN THE GMZ

A1 logging in SSMZ (koala management zone) of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	1961	9694	13007	4.94	6.63	421	566
Coastal	High	374	2257	2880	6.03	7.70	98	125

Hinterland	Low	144	379	1339	2.63	9.29	16	58
Hinterland	High	1230	6431	14483	5.23	11.77	280	630
Tableland	Low							
Tableland	High							
TOTAL							816	1379
A2 logging in SSMZ (not koala management zone) of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	87	197	2127	2.25	24.33	9	92
Coastal	High	1107	2665	29440	2.41	26.60	116	1280
Hinterland	Low	1672	5844	49379	3.50	29.53	254	2147
Hinterland	High	3239	15375	110720	4.75	34.19	668	4814
Tableland	Low							
Tableland	High							
TOTAL							1047	8333
A2 logging with retained old growth in GMZ of Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	395	1256	6115	3.18	15.48	55	266
Coastal	High	2168	20049	37017	9.25	17.07	872	1609
Hinterland	Low	4793	24696	165379	5.15	34.50	1074	7190
Hinterland	High	11729	81370	489853	6.94	41.76	3538	21298
Tableland	Low	564	6468	28967	11.47	51.36	281	1259
Tableland	High	4285	66010	258771	15.41	60.39	2870	11251
TOTAL							8689	42874
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	

			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	T1	18469	5347	1744513	0.29	94.46	232	75848
Hinterland	T1	11184	4332	907889	0.39	81.18	188	39473
Tableland	T1	4435	156	483179	0.04	108.96	7	21008
Coastal	T2	4953	40662	284240	8.21	57.39	1768	12358
Hinterland	T2	551	1627	8922	2.95	16.18	71	388
Tableland	T2	89	1342	6589	15.00	73.65	58	286
Coastal	rh	1272	19949	39897	15.68	31.36	867	1735
Hinterland	rh	525	4549	9098	8.66	17.33	198	396
Tableland	rh	24	1772	3545	75.00	150.00	77	154
TOTAL							3467	151647
GRAND TOTAL							14019	204233

2.3.5 Soil and Water

ESFM aims to

- minimise road density
- minimise the density of drainage line crossings
- define range for allowed percentage cut in regrowth areas per 5 years by catchment
- balance growth stage across landscape
- maintain dry weather water flows at a level expected from the catchment if it were undisturbed by logging and regeneration

Given the reduced tenure available for timber harvesting, the reduced intensity of silvicultural practice and reduced timber supply, this scenario will likely have lower short term impacts on water yield. There will still be a potential for increased water yield in sub-catchments subject to large scale regrowth thinning. There may also be some changes in hydrology in the Wallagaraugh Catchment, even with the 50% harvest, as a greater proportion of regrowth is established. Over longer time periods, the evolution of Old Growth Forest in the reserve system will likely lead to greater water yield for most catchments.

As noted for the previous scenario, increased foliar biomass and transpiration rates due to significant changes from Old Growth to regrowth can reduce water flow rates and flow duration while shifts from regrowth to mature may have less impact on water flows, depending on the characteristics of the forest type.

For this scenario, the application of current integrated harvesting (B3) and regrowth thinning from below (C2) as a benchmark has the following impact on (i) the proportion of the surface area of the catchment which is harvested over the twenty three-year period in relation to harvest practice and (ii) extent of change in growth stage, for the Eden catchments.

Proportion of the catchment harvested by harvest practice (Indicator 4.1)

1. B3 timber harvesting and C2 regrowth thinning

Four catchments (Bega, Coastal North, Murrumbidgee and Snowy) are the only catchments which will be subject to harvesting in less than 5% of the area. Similar results apply to the other regimes. Tables 2.10, 2.12, 2.14 and 2.16 provide details.

TABLE 2.10
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (B3/C2)

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)						3179		2574	5753
		proportion						2%		1%	3%
Coastal Central	59807	area (ha)						7752		679	8431
		proportion						13%		1%	14%
Coastal North	88578	area (ha)						2839		307	3146
		proportion						3%		0%	4%
Coastal South	63857	area (ha)						3931		13528	17460
		proportion						6%		21%	27%
Genoa	52442	area (ha)						2624		2140	4764
		proportion						5%		4%	9%
Murrumbidgee	44889	area (ha)						0		0	0
		proportion						0%		0%	0%
Snowy	132888	area (ha)						2456		1611	4067
		proportion						2%		1%	3%
Towamba	102819	area (ha)						6536		2307	8843
		proportion						6%		2%	9%
Wallagaraugh	59045	area (ha)						11757		8924	20681
		proportion						20%		15%	35%
TOTAL	814251	area (ha)						41074		32071	73145
		proportion						5%		4%	9%

Extent of change in growth stage by catchment (Indicator 4.5)

The largest impacts in terms of changes in growth stages are found in the Coastal South and Wallagaragh catchments. In these two areas, 12-15% of Old Growth will be harvested and between 74 and 86% of the Old Growth Disturbed. The Coastal Central catchment will also experience some changes given that there will be an 86% reduction in the extent of Old Growth disturbed forest and a 22% reduction in the extent of mature forest (Table 2.11).

TABLE 2.11
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT

Catchment name	Percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	4%	-85%	6%	164%	-66%	84%	0%
Coastal Central	0%	-2%	-85%	-21%	282%	-49%	226%	0%
Coastal North	0%	3%	-66%	5%	53%	-63%	99%	0%
Coastal South	0%	-12%	-86%	-22%	12828%	-87%	790%	0%
Genoa	0%	-7%	-78%	-10%	767%	-41%	27%	0%

Murrumbidgee	#DIV/0!	1%	-54%	0%	30%	-3%	-7%	0%
Snowy	#DIV/0!	3%	-64%	1%	-27%	1%	21%	0%
Towamba	0%	1%	-74%	-5%	119%	-44%	53%	0%
Unknown	#DIV/0!	#DIV/0!	#DIV/0!	1%	#DIV/0!	#DIV/0!	6%	0%
Wallagaraugh	0%	-15%	-71%	-42%	1105%	-69%	175%	0%

A1/A2/B0 timber harvesting and C2 thinning

1. Proportion of the catchment harvested by harvest practice (Indicator 4.1)

The area statement is similar to the first scenario (Table 2.12).

TABLE 2.12
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/B0/C2)

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)	2180	0	999					2574	5743
		proportion	1%		< 1%					1%	3%
Coastal Central	59807	area (ha)	1932	3216	2604					679	8431
		proportion	3%	5%	4%					1%	14%
Coastal North	88578	area (ha)	1313	0	1526					307	3146
		proportion	1%		2%					< 1%	4%
Coastal South	63857	area (ha)	0	0	3931					13528	17460
		proportion			6%					21%	27%
Genoa	52442	area (ha)	0	0	2624					2140	4764
		proportion			5%					4%	9%
Murrumbidgee	44889	area (ha)	0	0	0					0	0
		proportion								0%	0%
Snowy	132888	area (ha)	0	0	2456					1611	4067
		proportion			2%					1%	3%
Towamba	102819	area (ha)	1313	1642	3582					2307	8843
		proportion	1%	2%	3%					2%	9%
Wallagaraugh	59045	area (ha)	0	53	11705					8924	20681
		proportion		< 1%	20%					15%	35%
TOTAL	814251	area (ha)	6737	4910	29427					32071	73145
		proportion	1%	1%	4%					4%	9%

2. Extent of change in growth stage by catchment (Indicator 4.5)

Any impact on water flows resulting from harvesting in this scenario are likely to occur only in the Coastal South and Wallagaragh catchments. This will largely result from the areas converted to mature disturbed forest (Table 2.13).

TABLE 2.13
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/B0/C2)

Catchment name	Percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	5%	-68%	7%	183%	-86%	140%	0%
Coastal Central	0%	0%	-45%	-14%	726%	-66%	114%	0%
Coastal North	0%	3%	-45%	8%	83%	-83%	55%	0%
Coastal South	0%	0%	-2%	0%	11558%	-92%	677%	0%
Genoa	0%	4%	-40%	1%	793%	-49%	-5%	0%
Murrumbidgee	0%	1%	-54%	0%	34%	-80%	335%	0%
Snowy	0%	6%	-42%	9%	-3%	-28%	21%	0%
Towamba	0%	6%	-52%	1%	146%	-76%	65%	0%
Unknown	0%	0%	0%	1%	0%	0%	-100%	0%
Wallagaraugh	0%	1%	-14%	0%	1010%	-60%	82%	0%

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning.

The area affected by harvesting is similar to the two preceding scenarios (Table 2.14).

TABLE 2.14
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/C2)

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)	2180	999						2574	5743
		proportion	1%	< 1%						1%	3%
Coastal Central	59807	area (ha)	1932	5818						679	8429
		proportion	3%	10%						1%	14%
Coastal North	88578	area (ha)	1313	1526						307	3146
		proportion	1%	2%						< 1%	4%
Coastal South	63857	area (ha)	0	3931						13528	17460
		proportion		6%						21%	27%
Genoa	52442	area (ha)	0	2624						2140	4764
		proportion		5%						4%	9%
Murrumbidgee	44889	area (ha)	0	0						0	0
		proportion								0%	0%
Snowy	132888	area (ha)	0	2456						1611	4067

		proportion		2%						1%	3%
Towamba	102819	area (ha)	1313	5224						2307	8844
		proportion	1%	5%						2%	9%
Wallagaraugh	59045	area (ha)	0	11758						8924	20682
		proportion		20%						15%	35%
TOTAL	814251	area (ha)	6737	34337						32071	73144
		proportion	1%	4%						4%	9%

1. Extent of change in growth stage by catchment (Indicator 4.5)

Similar effects to those resulting from the second scenario are anticipated under this scenario (Table 2.15).

TABLE 2.15
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/C2)

Catchment name	Percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	5%	-68%	7%	183%	-60%	-13%	0%
Coastal Central	0%	0%	-45%	-14%	726%	-23%	-7%	0%
Coastal North	0%	3%	-45%	8%	83%	-57%	-38%	0%
Coastal South	0%	0%	-2%	0%	11558%	-35%	-7%	0%
Genoa	0%	4%	-40%	1%	793%	-21%	-39%	0%
Murrumbidgee	0%	1%	-54%	0%	34%	-3%	-10%	0%
Snowy	0%	6%	-42%	9%	-3%	3%	-15%	0%
Towamba	0%	6%	-52%	1%	146%	-30%	-43%	0%
Unknown	0%	0%	0%	1%	0%	0%	6%	0%
Wallagaraugh	0%	1%	-14%	0%	1010%	-15%	-14%	0%

SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth

The area affected by harvesting is similar to the previous scenario (Table 2.16).

TABLE 2.16
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/C2 WITH RETENTION OF OLD GROWTH IN GMZ)

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)	2180	567						2574	5321

		proportion	1%	< 1%						1%	3%
Coastal Central	59807	area (ha)	1932	5184						679	7795
		proportion	3%	9%						1%	13%
Coastal North	88578	area (ha)	1313	1182						307	2801
		proportion	1%	1%						< 1%	3%
Coastal South	63857	area (ha)	0	2708						13528	16236
		proportion		4%						21%	25%
Genoa	52442	area (ha)	0	1996						2140	4136
		proportion		4%						4%	8%
Murrumbidgee	44889	area (ha)	0	0						0	0
		proportion								0%	0%
Snowy	132888	area (ha)	0	2263						1611	3874
		proportion		2%						1%	3%
Towamba	102819	area (ha)	1313	4245						2307	7864
		proportion	1%	4%						2%	8%
Wallagaraugh	59045	area (ha)	0	10998						8924	19922
		proportion		19%						15%	34%
TOTAL	814251	area (ha)	6737	29142						32071	67949
		proportion	1%	4%						4%	8%

2. Extent of change in growth stage by catchment (Indicator 4.5)

Similar effects to those anticipated for scenarios 2 and 3 are anticipated under this scenario (Table 2.17).

TABLE 2.17
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (A1/A2/C2)

Catchment name	Percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	6%	-68%	7%	177%	-60%	-13%	0%
Coastal Central	0%	8%	-45%	-14%	646%	-23%	-7%	0%
Coastal North	0%	5%	-45%	8%	75%	-57%	-38%	0%
Coastal South	0%	12%	-2%	0%	10048%	-35%	-7%	0%
Genoa	0%	15%	-40%	1%	662%	-21%	-39%	0%
Murrumbidgee	0%	1%	-54%	0%	34%	-3%	-10%	0%
Snowy	0%	10%	-42%	9%	-7%	3%	-15%	0%
Towamba	0%	12%	-52%	1%	126%	-30%	-43%	0%
Unknown	0%	0%	0%	1%	0%	0%	6%	0%
Wallagaraugh	0%	17%	-14%	0%	857%	-15%	-14%	0%

2.3.6 Socio-economic considerations

ESFM aims to

- review royalty rates by product type against fair market rates in other comparable jurisdictions
- ensure harvest does not exceed ecologically sustainable wood supply commitments by product type over 5 year period of RFA, within 5%.
- ensure harvest, by product type, does not vary by more than 25% of ecologically sustainable wood supply commitments in any given year
- ensure that the volume outcome is driven by option choice ensure minimum levels of preferred species.

This option will significantly impact on the total royalty rates paid, the size of the forest industry and the labour force employed in the forest sector. The rapidity of this transition will make development of alternative employment and business opportunities difficult. In the longer term it may be possible to mitigate some of the employment and income losses by establishing conservation oriented businesses in tourism, recreation, and cultural heritage experiences. This would still likely require government support in terms of infrastructure, worker retraining and marketing and promotion. Details of estimated royalties follow.

ROYALTY

1. B3 timber harvesting and C2 thinning

Sawlogs: 19088 m^3@$38.52=$735270

Pulp (multiaged): 142344 t@$20.05= $2853997

Pulp (regrowth): 151716 t@$10.03= $1521711

TOTAL $5 110 978

2 A1/A2/B0 timber harvesting and C2 thinning

Sawlogs: 17140 m^3@$38.52=$660233

Pulp (multiaged): 88839 t@$20.05= $1781222

Pulp (regrowth): 151647 t@$10.03= $1521019

TOTAL $3 962 474

3 SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning

Sawlogs: 15172 m^3@$38.52=$584425

Pulp (multiaged): 58590 t@$20.05= $1174730

Pulp (regrowth): 151647 t@$10.03= $1521019

TOTAL $3 280 174

4 SSMZ A1 and A2 with C2 and A2 being 30% canopy reduction timber harvesting and C2 regrowth thinning and retention of old growth

Sawlogs: 14019 m^3@$38.52=$540012

Pulp (multiaged): 52586 t@$20.05= $1054349

Pulp (regrowth): 151647 t@$10.03= $1521019

TOTAL $3 115 380

2.3.7 Cultural and Heritage Considerations

ESFM aims to:

- monitor and review condition of sites
  - identify mitigating actions if necessary; and
  - assess efficacy of protective measures
- ensure that protective mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous cultural values or other identified values
- ensure indigenous groups are employed to undertake monitoring.

Table 2.18 contains places (non-indigenous and National Estate) requiring special management. In addition to those listed in the table, other areas having indigenous cultural heritage values will need to be appropriately protected. Notable amongst these is Biamanga, an area currently in National Park and so not subject to timber harvest.

TABLE 2.18
CULTURAL HERITAGE PLACES REQUIRING SPECIAL MANAGEMENT

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management Implications for SFNSW	Resource Implications
Old Growth Forest Patches - Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Siviculture	PMP 1.2	Nil logging, Nil silviculture Nil fire	Nil currently excluded from logging
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Siviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Forest management by prescription - light intensity logging, nil fire.	Nil additional impact on resource - area already identified and managed as PMP 1.1.8 Forest management by prescription and has conservation plan
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Clasification as PMP 1.1.6 & 1.1.2 Maintenance of viewing lines	Moderate impact on surrounding eucalypt forest
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - conservation of representative area of forest around site sought, needs to be clearly delineated, included in PMP and managed by prescription
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Substantial - some areas within area delineated currently PMP 1.1.8 Forest management by prescription, 1.2 excluded from harvesting, 1.3 excluded from harvesting, and 1.1.7 excluded from harvesting

Whipstick mines and village site	Historic	Gnupa SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977	Classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - needs to be clearly delineated, included in PMP and managed by prescription
Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Streamside reserve	Classification as PMP 1.1.2	Nil, currently protected by streamside buffer and excluded from harvesting.
Murrah State Forest (koala habitat)	Social Aesthetic	Indicative only Murrah SF	SFNSW	Fire Logging Silviculture	unknown		
Myrtle Mountain Lookout	Social Aesthetic	Tantawangalo SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2	Nil logging, Nil silviculture Nil fire Maintain access	Nil, currently PMP 1.1.2 and excluded from harvesting.
Wallaga Lake	Social Aesthetic	Bermagui SF	SFNSW, Crown land & NPWS	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Moderate impact on resource due to extensions of PMP 1.1.6 boundary outside current delineated area than currently exist
Davidson's Whaling Station	Social Historic Aesthetic	East Boyd SF / Ben Boyd NP	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 AHC Act 1975 NPW Act 19 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire	Nil - no change to current management
Cow bail trail / Chimneys trail / cuttings	Historic Aesthetic	Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 NPW Act 19 PMP 1.1.6	Classifiaction of entire area as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire	Moderate - 5m buffer for pine areas within State Forest, 20m buffer for native forest areas within State Forest - requires identification as PMP 1.1.6 harvesting by prescription
Edrom Lodge	Historic Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977 PMP 1.1.3	Additional classification as PMP 1.1.8 and PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintain historic values Maintain viewing lines	Nil, currently PMP 1.1.3 education harvesting by prescription.
Burrawang Picnic Ground	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil -. no change to current management
Ludwigs Creek	Aesthetic	Nadgee SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting

Maxwells forest walk	Aesthetic	Maxwells Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current forest preserve and excluded from harvesting
Newtons Crossing camping area	Aesthetic	Wallagaraugh Reserve, Timbillica SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Scrubby Creek picnic area	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6 PMP 1.1.2	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Nethercote Falls	Aesthetic	Nethercote Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3 AHC Act 1975	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - current flora reserve, excluded from harvesting
Nalbaugh Falls	Aesthetic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7 PMP 1.1.2	Additional classification as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest Management by prescription - light intensity logging, nil fire Maintenance of value Maintenance of viewing lines	Moderate - extent of buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Siviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Mostly private & crown land issue, if determined to be partly on State Forest may require PMP
Prison Farm, Bondi SF	Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Maintenance of value	Nil - on cleared land within pine plantation
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Razor-back Fire Trail	Potential Historic	Murrabrine SF	SFNSW & NPWS	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Sleeper cutter camps, Murrah SF	Potential Historic	Murrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Negligible - needs to be clearly delineated included in PMP and managed by prescription

Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Siviculture	PMP 1.1.6	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial if entire boundary as delineated applied - some of the area is currently PMP 1.1.6 harvesting by prescription
Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial on pine resource) if buffer suggested is considered, site currently has 50 -100m buffer.
Tantawangalo Road and Lookout	Aesthetic Potential Historic	Glen Bog SF	SFNSW & NPWS	Fire Logging Silviculture	PMP 1.1.6	Additional classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire Maintenance of viewing lines	Nil - moderate if it is proposed that current management prescriptions be changed - within current PMP 1.1.6 boundary harvesting by prescription

- The information in Table 11 should be considered indicative only - detailed assessments and documentation of places are yet to be finalised
- Current condition of places identified has not been able to be stated as detailed information on places has yet to be received.

All places identified as having historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

Conservation and management of cultural heritage values will be via existing national parks procedures, State Forest PMP classification and specific protocols for newly identified sites. The assessment proposes that cultural heritage, in terms of the aboriginal community, would become a co-management responsibility. This would take the following into account:

- a recognition of cultural heritage and traditional use values by State Forests and the NSW NPWS
- an agreement on access to those values and traditional uses by the Aboriginal communities
- recognition in management planning of these values, the protective measures or access required, and the mechanism to ensure Aboriginal participation in the management of those values
- an annual co-management board between the Aboriginal communities and the land management agencies to examine the management proposed for cultural heritage values, and to examine opportunities for expanded participation by the Aboriginal community in the economic activities in the conservation and production forest area.

2.4 CONCLUSION

This scenario attempts to maximise conservation values in dedicated reserves. There is a resultant significant impact on wood supply to industry to a point where viability is questioned. In general the scenario places many of the JANIS targets into conservation reserves, strengthens the level of biodiversity conservation in National Parks and improves connectivity in the protected area system.

3. ESFM IMPLICATIONS OF THE INDUSTRY-UNION SCENARIO

3.1 DIMENSIONS OF THE SCENARIO

The scenario is based on a sawlog wood supply commitment of 26 000 m^3 and additions to the National Parks estate of approximately 34 000 ha. The wood supply target exceeds that estimated by FRAMES by 1 200 m^3, implying an intensification of timber management on State Forests. The scenario is based on increased access to filter strips and an intensification of timber harvesting beyond the 70% canopy removal in selected forest ecosystem types.

The scenario also requests recommendations relating to mechanisms to accomodate Aboriginal rights and values, recognition of conservation values on private lands, recognition of conservation values on leasehold land, mechanisms to efficiently regulate mining access to forest lands and mechanisms to regulate grazing activities.

Similar to other scenarios analysed, the ESFM response is based on an objective consideration of the consequences of the proposal on a set of ESFM indicators.

3.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST

3.2.1 Production forest

The scenario uses the **B3** or 70% canopy reduction harvest system for the majority of operations.

Areas subject to special logging prescriptions

Two alternative types of practice are suggested in the form of special logging prescriptions for some areas.

A2 Use of a 30% canopy reduction, single tree selection system in filter strips adjacent to first-order streams' mapped and unmapped drainage features in compartments with slope of less than 18 degrees. All trees to be felled out of the drainage feature and machinery is excluded in the drainage feature.

C1 Intensification of timber harvest to a 90% canopy reduction on selected forest ecosystems identified in Table 3.1.

TABLE 3.1
VEGETATION ECOSYSTEM GROUPS* PROPOSED FOR INTENSIVE MANAGEMENT (C1)

Ecosystem Type	Geographic Location	Vegetation ecosystem group	Area of Multi-aged forest on State Forest (ha)
9	Tableland	Shining Gum	0
10	Tableland	Brown Barrel	1475
26	Tableland	Tableland Stringybark	282
41	Tableland	Mountain (white ash)	25
45	Tableland	Mountain (silvertop)	114
44	Hinterland	Foothills (silvertop)	0
50	Hinterland	Genoa (stringybark)	20
47	Coastal	Eden (silvertop/apple)	77
49	Coastal	Dry (stringybark/silvertop)	1726
TOTAL			**3719**

* selected on the basis of ecosystem types having lower arboreal mammal density

3.3 ASSESSMENT OF CONSEQUENCES ON ESFM INDICATORS

3.3.1 Forest Structure

ESFM aims to

- minimise loss of old growth
- targets for the extent of each growth stage in each forest type to be maintained should be set after examination of data compatible with ecologically sustainable sawlog industry
- increase area of old growth of rare or endangered forest types
- all areas harvested to be regenerated and managed to maintain the original forest type (including use of the State Forests ecological field guide).

In this scenario (Table 3.2 and 3.3), there are many changes in the amount of growth stage by individual forest types but overall the shifts in growth stages are less significant. The overall decline in old growth, for example, is 5%. Of 26 forest ecosystem types with old growth, 10 remain the same or increase, 6 decline by less than ten percent, 8 decline by between 10 and 25% and 2 (silvertop ash and yertchuk types) decline by more than 25%. There are large increases in the proportion of disturbed mature types, particularly for commercial forest types, as these result from the systematic thinning of regrowth over the next two decades.

TABLE 3.2
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP

Vegetation ecosystem group	Vegetation type name	Change in size	Extent of change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage area (ha)	5% 233	-93% -652	4% 216	14% 256	-44% -1315	44% 1262
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	-7% -411	-91% -929	-13% -1319	-3% -82	-31% -1256	67% 3997
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage area (ha)	2% 36	-91% -415	0% -6	-9% -124	-6% -150	28% 661
southern blue gum	hinterland wet fern frst	percentage area (ha)	0% -8	-90% -494	-8% -1403	240% 3672	-69% -6076	181% 4309
yellow stringybark/ gum	hinterland wet shrub frst	percentage area (ha)	-12% -463	-69% -177	-17% -1625	212% 1956	-69% -5185	329% 5494
manna gum	flats wet herb frst	percentage area (ha)	-7% -19	-40% -6	-4% -52	-10% -45	-29% -121	127% 243
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage area (ha)	7% 70	-72% -71	1% 17	135% 335	-22% -377	100% 25
river peppermint	bega wet shrub frst	percentage area	1% 25	-66% -129	-1% -38	66% 347	-24% -719	156% 514

		(ha)						
snow gum	monaro dry grass frst monaro basalt grass wdland	percentage area (ha)	-1% -7	-29% -5	-1% -13	110% 132	-23% -138	86% 30
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage area (ha)	1% 25	-30% -26	0% 0	5% 18	-1% -17	-1% -1
narrow leaved peppermint	subalpine dry shrub frst	percentage area (ha)	1% 80	-46% -248	3% 201	3% 36	0% 8	-6% -77
messmate	sandstone dry shrub frst coastal dry shrub frst (E.obliqua)	percentage area (ha)	-25% -484	-71% -58	-38% -2806	1124% 1844	-72% -6304	253% 7808
stringybark/ peppermint	tableland dry shrub frst	percentage area (ha)	-20% -301	-39% -56	-32% -1794	459% 1139	-44% -1678	94% 2689
applebox	waalimma dry grass frst	percentage area (ha)	-11% -8	-80% -28	-47% -169	1000% 80	-73% -426	218% 551
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage area (ha)	-5% -589	-61% -787	-12% -2530	86% 3072	-52% -4677	125% 5512
woolybutt	coastal dry shrub frst (E.longifolia)	percentage area (ha)	-4% -98	-53% -270	4% 316	-5% -154	-60% -4154	267% 4360
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage area (ha)	-14% -382	-84% -95	-25% -2067	441% 815	-52% -1366	180% 3096
gum/box/ stringybark	brogo dry shrub frst	percentage area (ha)	0% -2	-69% -503	2% 80	3% 43	-50% -1360	278% 1743
bangalay dunes	dune dry shrub frst	percentage area (ha)	0% 0	-100% -1	0% 0	2900% 29	-57% -25	-33% -4
apple	coastal dry shrub frst (A.floribunda)	percentage area	-18% -534	-93% -237	-25% -1058	1704% 1857	-83% -4073	772% 4043

		(ha)						
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage area (ha)	6% 5	-100% -4	1% 1	800% 80	-73% -82	50% 1
river oak	riverine frst	percentage area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage area (ha)	-2% -7	-96% -51	-1% -6	834% 492	-89% -545	130% 118
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage area (ha)	-11% -1205	-59% -456	-7% -922	519% 6792	-81% -9359	293% 5149
yertchuk	timbillica dry shrub frst	percentage area (ha)	-41% -643	-70% -149	-51% -2515	1014% 2291	-73% -7444	177% 8460
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage area (ha)	-20% -675	-76% -128	-35% -3537	749% 2674	-78% -11100	574% 12764
blue leaved stringybark	genoa dry shrub frst	percentage area (ha)	-5% -43	-94% -15	-3% -36	3340% 167	-49% -124	40% 50
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath swamp heath lowland swamp swamp forest sub alpine bog floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh estuarine wetland (Av.marin)	percentage area (ha)	0% 4	-73% -46	-5% -80	361% 650	-44% -702	51% 173

wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath wadbilliga range wet frst	percentage area (ha)	0% 30	-63% -33	0% 7	8535% 7169	-96% -7082	-38% -92
wadbilliga forests	wadbilliga gorge dry frst wadbilliga river valley frst	percentage area (ha)	2% 51	-98% -50	1% 26	1640% 1673	-89% -1679	-100% -21

Non commercial forest types

3.3.2 Connectivity

ESFM aims to ensure functional connectivity through implementation of:

- conservation protocols; and

maintenance of ecosystem function.

The main reserve area is largely similar to the 23 000 m^3 scenario. There is a strong north-south corridor along the tablelands and some coastal-tablelands connectivity through the Devils Hole and Stanton Rock. The option establishes a number of reserves in areas of former leasehold land which are isolated from other reserves but are connected by extant vegetation on privately managed lands. These areas would become 'island ecosystems' if the surrounding land were cleared. There are also some national park areas proposed that are surrounded by State Forests. While connected to other Park areas by forested land, this land will not be continuous old growth forest and may not be effective for all species.

On the coast there are still some breaks in the continuity of forests and there may be a need to work towards establishing conservation agreements with private landowners in the north coastal area of the Eden RFA. Within the State Forests tenure, the harvest of some first-order streams may reduce connectivity across small subcatchments. There is also less habitat retained in dry ridgetops, which may further contribute to lower connectivity across small sub-catchments.

3.3.3 3. Management Measures for Conservation of Flora and Fauna

ESFM aims to assess the implementation of habitat conservation measures (Table 3.3).

TABLE 3.3
PROPOSED PROTECTIVE MEASURES FOR BIODIVERSITY CONSERVATION OFF-RESERVE

Protected measures (General Prescriptions from Conservation Protocols)	Characteristics of Measure	Species addressed by current practice
Hollow-bearing tree retention*	Minima of: 6 hollow-bearing trees per ha must be retained in good habitat across the landscape; 4 hollow-bearing trees per ha must be retained in moderate habitat across the landscape; 2 hollow-bearing trees per ha must be retained in low habitat across the landscape;	Glossy black Cockatoo, Yellow-tailed black Cockatoo, Powerful Owl, Masked Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied glider, Greater Glider, Squirrel Glider, Regent Honeyeater, Brush-tailed phascogale, hollow dependent bats

	Areas nominated for intensified management will have 6 habitat trees per 2 ha (these are mainly dry ridgetop ecosystems, see Table2)	
Recruitment tree retention*	A habitat clump shall be retained to surround one in three retained hollow-bearing trees. Areas nominated for intensified management would not have recruitment trees; replacement trees, where required, would be identified at the next harvest cycle.	as above
Significant food resources	Protection of Allocasurina spp. At least 4 mature (40 cm dbh) winter-flowering Eucalypts per 2 ha in identified forest ecosystems, protection of mature banksia and Xanthorrhea spp., Retain all V-notch trees, Retain representative understory vegetation	Glossy black cockatoo, Yellow-bellied glider, Squirrel Glider, Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox, Brushtailed Phascogale
Wetlands	At least 10m buffer on areas between 0.1 and 0.5 ha, at least 40m buffer on areas greater than 0.5 ha or SEPP 14 wetlands	frogs, Black Bittern, herpetofauna, rare plants
Rocky Outcrops	At least 20m buffer around rocks and associated heathland between 0.2 and 0.5 ha, at least 40m buffer around heathlands > 0.5 ha	Passerines, herpetofauna, plants
Caves,tunnels and disused mineshafts	All protected by at least 50m buffer	Cave-dependent bats
Rainforest	Protect all rainforest. 20m buffer on warm temperate rainforest	Olive Whistler, rare plants, herpetofauna
Riparian buffer	Fauna stream buffers (i) 1st order streams greater than 18 degrees, no logging (ii) 1st order streams less than 18 degrees, single tree selection with machinery exclusion	threatened frogs, habitat for forest-dependent fauna

	(iii) 2nd order streams, 20m (iv) 3rd order, 40m	

*see EIS Determination for details

A number of **species-specific measures** are also proposed as follows:

- For the Koala, a 50 m exclusion zone would be established around individual animals encountered. In addition 150 ha of high quality habitat would be retained within a 2 km radius.
- For the owls, a landscape-level habitat management plan would be implemented. This would be designed to have no impact on total harvest, but would affect the timing and spatial pattern by requiring the retention of 25% of planning areas of about 10 000 ha each (across all tenures) in high quality foraging habitat. This habitat would be defined as regrowth, mature or old growth forest, greater than ten years of age with a weighting factor relating to time since logging and forest type.
- For the smoky mouse and southern brown bandicoot, intensified programs of feral animal control would be undertaken in areas where the limited number of sightings of these animals have occurred.
- There would be a need for intensified survey and habitat mapping for the Stuttering Barred Frog and the Giant Burrowing Frog. The conservation status of these species would be reviewed after five years.

3.3.4 Wood Supply

ESFM aims to ensure that the allowable timber cut is not exceeded until an ecologically sustainable yield is determined and that targets are set within range after examination of data compatible with an ecologically sustainable sawlog industry.

This scenario generates 25 760 m^3 of sawlogs over a twenty three-year period and 373 475 tonnes of pulpwood. Table 3.4 contains full details of the wood supply.

This is achieved by harvesting using B3 and C1 practices from mature and old growth forests on State Forests, and through C2 systematic thinning of regrowth forests.

The scenario also includes A2 harvesting to provide 1 000 m^3 of sawlogs from filter strips. These sawlogs will be selection harvested in the upper first-order streams in areas of less than 18 degrees slope. It is estimated that there is approximately 2 000 ha in this category. To meet the 1 000 m^3 requirement, these areas would need to yield an average of 10 m^3 of sawlogs per ha. In addition, they will yield 2 000 tonnes of pulpwood. This would necessitate a preferential harvest of sawlogs in these areas.

Implementation of partial logging in certain first-order streams would have, at this stage, an unknown impact on water values. Harvest planning should consider felling patterns to minimise impacts.

TABLE 3.4
WOOD SUPPLY FOR B3/A2/C1 SCENARIO

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	3703	17959	172316	4.85	47	781	7492
Coastal	High	4703	44764	251887	9.52	54	1946	10952
Hinterland	Low	10230	65499	830541	6.40	81	2848	36110
Hinterland	High	25642	209785	2548612	8.18	99	9121	110809
Tableland	Low	973	14078	116176	14.47	119	612	5051
Tableland	High	5763	127878	861283	22.19	149	5560	37447
TOTAL							**20868**	**207862**
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwd
Coastal		19468	66219	2064823	3.40	106.1	2879	89775
Hinterland		12826	11434	1036073	0.89	80.78	497	45047
Tableland		4999	9732	5478321	1.95	109.59	423	23818
TOTAL							**3799**	**158640**
GRAND TOTAL							**25760**	**366501**

Note: The above table does not reflect the added volume made available through the use of C1 harvesting system in selected forest types and the use of the A3 system in selected filter strips. These techniques are estimated to augment sawlog and pulplog supply as noted in the text above.

3.3.5 Soil and Water

ESFM aims to:

- minimise road density
- minimise the density of drainage line crossings
- define range for allowed percentage cut in regrowth areas per 5 years by catchment
- balance growth stage across landscape
- maintain dry weather water flows at a level expected from the catchment if it were undisturbed by logging and regeneration
- long term levels from ANZECC guidelines.

The changes in growth stage extent shown in Table 3.5 differ from those for the State Government scenario mainly in relation to the reserve design. Overall the pattern of impacts is similar, but slightly greater in terms of order of magnitude of impacts.

- Some conclusions can be reached concerning changes in growth stage extent under this scenario:
- there is a significant evolution of young forest into mature growth stages largely due to development of thinned regrowth from previously logged forests
- there is a significant reduction in the amount of old growth in the Wallagaraugh Catchment, largely because this area is composed mostly of State Forest and is scheduled for significant timber harvesting in the next twenty years
- potential increases in water flow due to the proposed extensive thinning.

As noted for the previous scenario, increased foliar biomass and transpiration rates due to significant changes from old growth to regrowth can reduce water flow rates and flow duration while shifts from regrowth to mature may have less impact on water flows, depending on the characteristics of the forest type.

TABLE 3.5
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT

Catchment name	Percent variation in growth stage gross area from 1997 to 2019 by catchment							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	3%	-85%	6%	163%	-67%	94%	0%
Coastal Central	0%	-16%	-55%	-25%	252%	-50%	277%	0%
Coastal North	0%	1%	-62%	7%	54%	-66%	107%	0%
Coastal South	0%	-13%	-86%	-22%	12774%	-87%	793%	0%
Genoa	0%	-9%	-78%	-16%	606%	-47%	63%	0%
Murrumbidgee		1%	-54%	0%	30%	-3%	-7%	0%
Snowy		0%	-64%	3%	-22%	6%	13%	0%
Towamba	0%	-10%	-72%	-18%	92%	-54%	180%	0%
Unknown				0%			-50%	0%
Wallagaraugh	0%	-41%	-71%	-51%	924%	-70%	210%	0%

3.3.6 Socio-economic considerations

ESFM aims to:

- review royalty rates by product type against fair market rates in other comparable jurisdictions
- ensure harvest does not exceed ecologically sustainable wood supply commitments by product type over 5 year period of RFA, within 5%.
- ensure harvest, by product type, does not vary by more than 25% of ecologically sustainable wood supply commitments in any given year
- ensure that the volume outcome is driven by option choice
- ensure minimum levels of preferred species.

For the purposes of assessing socio-economic values, annual royalty returns of $987 123 for sawlogs and $5 898 601 for pulpwood were calculated using mean annual sawlog and pulpwood production, and royalty rates of $38.32 per m^3 for sawlog and $20.05 per tonne from multi-aged forest and $10.03 for pulpwood thinnings.

3.3.7 Cultural and Heritage Considerations

ESFM aims to:

- monitor and review condition of sites
  - identify mitigating actions if necessary; and

  - assess efficacy of protective measures
- ensure that protective mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous cultural values or other identified values
- ensure indigenous groups are employed to undertake monitoring.

Table 3.6 contains places (non-indigenous and National Estate) requiring special management. In addition to those listed in the table, other areas having indigenous cultural heritage values will need to be appropriately protected. Notable amongst these is Biamanga, an area currently in National Park and so not subject to timber harvesting.

TABLE 3.6
CULTURAL HERITAGE PLACES REQUIRING SPECIAL MANAGEMENT

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management Implications for SFNSW	Resource Implications
Old Growth Forest Patches - Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Siviculture	PMP 1.2	Nil logging, Nil silviculture Nil fire	Nil currently excluded from logging
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Siviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Forest management by prescription - light intensity logging, nil fire.	Nil additional impact on resource - area already identified and managed as PMP 1.1.8 Forest management by prescription and has conservation plan
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Clasification as PMP 1.1.6 & 1.1.2 Maintenance of viewing lines	Moderate impact on surrounding eucalypt forest
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - conservation of representative area of forest around site sought, needs to be clearly delineated, included in PMP and managed by prescription
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Substantial - some areas within area delineated currently PMP 1.1.8 Forest management by prescription, 1.2 excluded from harvesting, 1.3 excluded from harvesting, and 1.1.7 excluded from harvesting
Whipstick mines and village site	Historic	Gnupa SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977	Classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - needs to be clearly delineated, included in PMP and managed by prescription

Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Streamside reserve	Classification as PMP 1.1.2	Nil, currently protected by streamside buffer and excluded from harvesting.
Murrah State Forest (koala habitat)	Social Aesthetic	Indicative only Murrah SF	SFNSW	Fire Logging Silviculture	unknown		
Myrtle Mountain Lookout	Social Aesthetic	Tantawangalo SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2	Nil logging, Nil silviculture Nil fire Maintain access	Nil, currently PMP 1.1.2 and excluded from harvesting.
Wallaga Lake	Social Aesthetic	Bermagui SF	SFNSW, Crown land & NPWS	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Moderate impact on resource due to extensions of PMP 1.1.6 boundary outside current delineated area than currently exist
Davidson's Whaling Station	Social Historic Aesthetic	East Boyd SF / Ben Boyd NP	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 AHC Act 1975 NPW Act 19 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire	Nil - no change to current management
Cow bail trail / Chimneys trail / cuttings	Historic Aesthetic	Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 NPW Act 19 PMP 1.1.6	Classifiaction of entire area as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire	Moderate - 5m buffer for pine areas within State Forest, 20m buffer for native forest areas within State Forest - requires identification as PMP 1.1.6 harvesting by prescription
Edrom Lodge	Historic Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977 PMP 1.1.3	Additional classification as PMP 1.1.8 and PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintain historic values Maintain viewing lines	Nil, currently PMP 1.1.3 education harvesting by prescription.
Burrawang Picnic Ground	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil -. no change to current management
Ludwigs Creek	Aesthetic	Nadgee SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Maxwells forest walk	Aesthetic	Maxwells Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current forest preserve and excluded from harvesting

Newtons Crossing camping area	Aesthetic	Wallagaraugh Reserve, Timbillica SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Scrubby Creek picnic area	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6 PMP 1.1.2	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Nethercote Falls	Aesthetic	Nethercote Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3 AHC Act 1975	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - current flora reserve, excluded from harvesting
Nalbaugh Falls	Aesthetic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7 PMP 1.1.2	Additional classification as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest Management by prescription - light intensity logging, nil fire Maintenance of value Maintenance of viewing lines	Moderate - extent of buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Siviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Mostly private & crown land issue, if determined to be partly on State Forest may require PMP
Prison Farm, Bondi SF	Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Maintenance of value	Nil - on cleared land within pine plantation
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Razor-back Fire Trail	Potential Historic	Murrabrine SF	SFNSW & NPWS	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Sleeper cutter camps, Murrah SF	Potential Historic	Murrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Negligible - needs to be clearly delineated included in PMP and managed by prescription
Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Siviculture	PMP 1.1.6	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial if entire boundary as delineated applied - some of the area is currently PMP 1.1.6 harvesting by prescription

Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial on pine resource) if buffer suggested is considered, site currently has 50 -100m buffer.
Tantawangalo Road and Lookout	Aesthetic Potential Historic	Glen Bog SF	SFNSW & NPWS	Fire Logging Silviculture	PMP 1.1.6	Additional classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire Maintenance of viewing lines	Nil - moderate if it is proposed that current management prescriptions be changed - within current PMP 1.1.6 boundary harvesting by prescription

- The information in Table 6 should be considered indicative only - detailed assessments and documentation of places are yet to be finalised
- Current condition of places identified has not been able to be stated as detailed information on places has yet to be received.

All places identified as having historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

Conservation and management of cultural heritage values will be via existing national parks procedures, State Forest PMP classification and specific protocols for newly identified sites. The assessment proposes that cultural heritage, in terms of the aboriginal community, would become a co-management responsibility. This would take the following into account:

- a recognition of cultural heritage and traditional use values by State Forests and the NSW NPWS
- an agreement on access to those values and traditional uses by the Aboriginal communities
- recognition in management planning of these values, the protective measures or access required, and the mechanism to ensure Aboriginal participation in the management of those values
- an annual co-management board between the Aboriginal communities and the land management agencies to examine the management proposed for cultural heritage values, and to examine opportunities for expanded participation by the Aboriginal community in the economic activities in the conservation and production forest area.

3.4 CONCLUSION

This scenario was generated by the forest industry and unions. It is based on an attempt to design park additions that maximise fulfillment of the JANIS criteria while ensuring a minimal impact on wood supply to industry. In general the scenario addresses many JANIS targets, strengthens the level of biodiversity conservation in the National Parks and contributes towards connectivity in the protected areas system.

The scenario places a higher responsibility on the State Forests tenure to provide wood supply. A higher intensity logging regime in some major forest types (approximately 10% of the net loggable area of multi-aged forests) reduces the retained canopy and density of habitat trees in those types. While most of these ecosystems are the dry ridgetop types that are considered to have somewhat lower arboreal mammal density, there is likely to be some impact on off-reserve conservation.

The scenario also includes harvesting in upper reaches of the drainage system in the form of sawlog harvesting in upper first-order streams in compartments with relatively flatter terrain. The management of these operations will need to be done carefully to avoid impacts on water quality. Of greatest importance will be the need to avoid soil disturbance in these filter strip areas.

The scenario generates socio-economic benefits. By largely maintaining both solid wood and pulp supplies, it is likely to retain current employment levels and may encourage increased industry investment. It also has some recognition of expanded opportunities for aboriginal community involvement in cultural heritage conservation.

Overall the scenario seeks to maximize conservation and wood supply outcomes by a compartmentalization of values. The conservation reserve is expanded and the State Forests tenure is

harvested more intensively. The success of the scenario will be based on demonstrating delivery of the range of outcomes across tenures while maintaining public support for the timber harvesting operations.

The scenario is predicated on no significant loss of timber to wildfire. The wood supply calculated is fully committed from State Forest. To ensure that production from both native forests and pine plantations is realized to industry, forest management needs to recognise the importance of fire protection. For native forests, this is especially so in relation to regeneration from the 1952 fires.

4. ESFM IMPLICATIONS OF THE EXISTING TENURE SCENARIO

Dimensions of the Scenario

The scenario is based on existing tenure and wood of 29 000 m^3 per year and no additions to the National Parks estate. It specifies that JANIS targets should be met in dedicated reserves but provides for flexibility in tailoring harvesting practices to different parts of the landscape. This scenario emphasises the tailoring of harvesting regimes for the protection of conservation values while providing a viable timber supply.

Different combinations of current integrated harvesting(B3), single tree selection (A1), selection logging practice (A2), selection logging at 50% canopy reduction (B0) and intensified harvesting (C1) are explored on identified forest ecosystems as appropriate in association with the Conservation Protocols and thinning from below (C2). These combinations of harvesting regimes attempt to maximise production from existing tenures and to meet JANIS targets through prescription logging. Modified B0 selection logging (50% canopy retention) would be designed on a coupe basis to protect JANIS values. Harvesting regimes may include patch cutting, group selection and variable intensity selection logging. These would be applied in a manner where the net harvestable area of a coupe has a mean canopy retention of fifty per cent once harvesting is completed. The design of the harvesting regime would be around conservation values and silvicultural limitations.

4.1 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST

The scenario is in three parts:

- current integrated harvesting (B3) or 70% canopy reduction across the whole forest estate with the Conservation Protocols
- B3 or 70% canopy reduction for the majority of operations in the general management zone, selection logging practice (A2) or 30% canopy reduction in areas of connectivity and intensified harvesting to 90% canopy reduction (C1) on selected forest ecosystems (not modelled) with the Conservation Protocols
- modified selection logging to 50% canopy retention (B0) on forests identified for JANIS under the scenario (mandatory or negotiated) to maximise the protection of JANIS values while producing sawlogs. In areas not identified to meet JANIS targets, a regime of 40% B3 and 60% C1 and selection logging of filter strips (1st order streams) would be applied to meet 28 700 m^3 of sawlogs. Conservation protocols would be limited to the areas on which B3 and B0 practices would be applied.

4.1.1 Forest Structure

ESFM aims to:

- minimise loss of old growth
- targets for the extent of each growth stage in each forest type to be maintained should be set after examination of data compatible with an ecologically sustainable sawlog industry

- increase area of old growth of rare or endangered forest types
- all areas harvested to be regenerated and managed to maintain the original forest type (including use of the State Forests ecological field guide).

As indicated by Table 4.1 to 4.3, applying B3 and C2 to the current landbase results in an 8% (8717ha) decrease in candidate Old Growth and a 16% (26 492ha) decrease in mature forest. Sixty nine per cent of disturbed Old Growth is also affected. These growth stages are generally converted to either disturbed mature forest (152% increase) or recently disturbed forest (202% increase).

Of 29 forest types, the extent of Old Growth increases or stays the same in 9, decreases by less than 10% in 7 and decreases by more than 10% in 9. Messmate, stringybark/peppermint, woolybutt, yertchuk and ash/stringybark forest ecosystems have a predicted decline in Old Growth of between 21-43% under this scenario.

TABLE 4.1
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP FOR B3 TIMBER HARVESTING AND C2 THINNING

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage	5%	-92%	3%	13%	-49%	52%
		area (ha)	213	-649	174	233	-1450	1479
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage	-10%	-91%	-16%	-8%	-34%	80%
		area (ha)	-615	-929	-1560	-232	-1414	4749
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage	-1%	-84%	-2%	-11%	-8%	36%
		area (ha)	-17	-386	-76	-160	-214	855
southern blue gum	hinterland wet fern frst	percentage	-2%	-89%	-10%	220%	-67%	210%
		area (ha)	-156	-491	-1747	3368	-5971	4998
yellow stringybark/ gum	hinterland wet shrub frst	percentage	-14%	-67%	-20%	204%	-69%	354%
		area (ha)	-557	-174	-1912	1880	-5152	5915

manna gum	flats wet herb frst	percentage	-13%	-40%	-6%	-11%	-35%	159%
		area (ha)	-34	-6	-71	-48	-146	306
red gum	brogo wet vine frst	percentage	7%	-71%	-3%	120%	-20%	548%
	bega dry grass frst	area (ha)	65	-70	-88	298	-341	137
	candelo dry grass frst							
river peppermint	bega wet shrub frst	percentage	-5%	-57%	-7%	53%	-24%	295%
		area (ha)	-142	-110	-288	277	-709	972
snow gum	monaro dry grass frst	percentage	-1%	-29%	-1%	8%	-3%	89%
	monaro basalt grass wdland	area (ha)	-7	-5	-13	10	-16	31
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	2%	-1%	9%
		area (ha)	25	-26	-8	7	-13	14
narrow leaved peppermint	subalpine dry shrub frst	percentage	1%	-45%	1%	-11%	-6%	35%
		area (ha)	67	-238	58	-146	-183	443
messmate	sandstone dry shrub frst	percentage	-25%	-70%	-38%	1117%	-72%	254%
	coastal dry shrub frst (E.obliqua)	area (ha)	-490	-57	-2824	1832	-6317	7857
stringybark/ peppermint	tableland dry shrub frst	percentage	-24%	-39%	-34%	406%	-45%	105%
		area (ha)	-353	-56	-1896	1006	-1713	3011
applebox	waalimma dry grass frst	percentage	-11%	-80%	-47%	1000%	-73%	218%
		area (ha)	-8	-28	-169	80	-426	551
gum/ stringybark	wog wog dry grass frst	percentage	-14%	-59%	-17%	67%	-53%	184%
	nalbaugh dry grass frst	area (ha)	-1581	-767	-3500	2396	-4701	8155
	wallagaraugh dry grass frst							
	hinterland dry grass frst							
	escarpment dry grass frst							
	mtn dry shrub frst (E.cypellocarpa)							
woolybutt	coastal dry shrub frst	percentage	-21%	-42%	-15%	-13%	-64%	403%
	(E.longifolia)	area (ha)	-489	-216	-1111	-394	-4371	6580
yellow stringybark	coastal dry shrub frst	percentage	-18%	-71%	-29%	378%	-53%	208%
	(E.muellerana)	area	-491	-80	-2328	699	-1390	3592

		(ha)						
gum/box/ stringybark	brogo dry shrub frst	percentage	-11%	-54%	-9%	-3%	-49%	397%
		area (ha)	-368	-392	-329	-54	-1345	2489
bangalay dunes	dune dry shrub frst	percentage	0%	-100%	0%	2300%	-52%	0%
		area (ha)	0	-1	0	23	-23	0
apple	coastal dry shrub frst (A.floribunda)	percentage	-19%	-93%	-25%	1699%	-83%	775%
		area (ha)	-547	-237	-1061	1852	-4068	4061
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage	6%	-100%	1%	800%	-73%	50%
		area (ha)	5	-4	1	80	-82	1
river oak	riverine frst	percentage						
		area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage	-2%	-96%	-1%	831%	-88%	132%
		area (ha)	-9	-51	-6	490	-543	120
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage	-15%	-53%	-10%	501%	-81%	351%
		area (ha)	-1688	-413	-1313	6557	-9306	6161
yertchuk	timbillica dry shrub frst	percentage	-43%	-70%	-51%	1013%	-73%	177%
		area (ha)	-678	-149	-2516	2290	-7444	8497
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage	-23%	-73%	-36%	749%	-78%	586%
		area (ha)	-795	-123	-3632	2674	-11154	13029
blue leaved stringybark	genoa dry shrub frst	percentage	-5%	-94%	-3%	3320%	-53%	48%
		area (ha)	-43	-15	-36	166	-133	60
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath	percentage	0%	-73%	-5%	278%	-35%	57%
		area (ha)	2	-46	-87	500	-562	193

	swamp heath							
	lowland swamp							
	swamp forest							
	sub alpine bog							
	floodplain wetlands							
	coastal scrub							
	estuarine wetland (M.erci)							
	saltmarsh							
	estuarine wetland (Av.marin)							
wadbilliga	wadbilliga dry shrub frst	percentage	0%	-64%	0%	8513%	-96%	-33%
forests	wadbilliga range ash frst	area (ha)	28	-33	-1	7151	-7068	-80
	wadbilliga mallee heath							
	wadbilliga range wet frst							
wadbilliga	wadbilliga gorge dry frst	percentage	-4%	-96%	-5%	1620%	-89%	1810%
forests	wadbilliga river valley frst	area (ha)	-107	-49	-197	1652	-1678	380

Non commercial forest types

TABLE 4.2
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP FOR B3/A2 TIMBER HARVESTING AND C2 THINNING

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf							
	myanba euc/fig frst							
	rocky top dry shrub frst							
	a silve/p brogo shrub rf							
	bunga head rf							
	coastal warm temperate rf							
	hinterland warm temperate rf							
	cool temperate rf							
layered	mtn wet layered frst	percentage	5%	-92%	3%	13%	-49%	52%
brown	*(E.nitens)*	area (ha)	213	-649	174	233	-1450	1479
barrel	mtn wet layered frst *(E.fastigata)*							

messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	-10% -615	-91% -929	-16% -1560	-1% -36	-34% -1414	77% 4553
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage area (ha)	-1% -17	-84% -386	-2% -76	-11% -150	-8% -214	36% 845
southern blue gum	hinterland wet fern frst	percentage area (ha)	-2% -156	-89% -491	-10% -1747	229% 3498	-67% -5971	204% 4868
yellow stringybark/ gum	hinterland wet shrub frst	percentage area (ha)	-14% -557	-67% -174	-20% -1912	220% 2032	-69% -5152	345% 5764
manna gum	flats wet herb frst	percentage area (ha)	-13% -34	-40% -6	-6% -71	-2% -7	-35% -146	138% 265
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage area (ha)	7% 65	-71% -70	-3% -88	120% 298	-20% -341	548% 137
river peppermint	bega wet shrub frst	percentage area (ha)	-5% -142	-57% -110	-7% -288	89% 471	-24% -709	236% 778
snow gum	monaro dry grass frst monaro basalt grass wdland	percentage area (ha)	-1% -7	-29% -5	-1% -13	8% 10	-3% -16	89% 31
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage area (ha)	1% 25	-30% -26	0% -8	2% 7	-1% -13	9% 14
narrow leaved peppermint	subalpine dry shrub frst	percentage area (ha)	1% 67	-45% -238	1% 58	-11% -146	-6% -183	35% 443
messmate	sandstone dry shrub frst coastal dry shrub frst (E.obliqua)	percentage area (ha)	-25% -490	-70% -57	-38% -2824	1121% 1839	-72% -6317	254% 7850
stringybark/ peppermint	tableland dry shrub frst	percentage area (ha)	-24% -353	-39% -56	-34% -1896	406% 1006	-45% -1713	105% 3011
applebox	waalimma dry grass frst	percentage area (ha)	-11% -8	-80% -28	-47% -169	1000% 80	-73% -426	218% 551

gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage area (ha)	-14% -1581	-59% -767	-17% -3500	110% 3922	-53% -4701	150% 6628
woolybutt	coastal dry shrub frst (E.longifolia)	percentage area (ha)	-21% -489	-42% -216	-15% -1111	-11% -332	-64% -4371	400% 6518
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage area (ha)	-18% -491	-71% -80	-29% -2328	559% 1035	-53% -1390	189% 3256
gum/box/ stringybark	brogo dry shrub frst	percentage area (ha)	-11% -368	-54% -392	-9% -329	-3% -54	-49% -1345	397% 2489
bangalay dunes	dune dry shrub frst	percentage area (ha)	0% 0	-100% -1	0% 0	2300% 23	-52% -23	0% 0
apple	coastal dry shrub frst (A.floribunda)	percentage area (ha)	-19% -547	-93% -237	-25% -1061	1699% 1852	-83% -4068	775% 4061
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage area (ha)	6% 5	-100% -4	1% 1	800% 80	-73% -82	50% 1
river oak	riverine frst	percentage area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage area (ha)	-2% -9	-96% -51	-1% -6	831% 490	-88% -543	132% 120
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage area (ha)	-15% -1688	-53% -413	-10% -1313	502% 6574	-81% -9306	350% 6145
yertchuk	timbillica dry shrub frst	percentage area (ha)	-43% -678	-70% -149	-51% -2516	1013% 2290	-73% -7444	177% 8497

ash/	coastal dry shrub frst	percentage	-23%	-73%	-36%	749%	-78%	586%
stringybark	(E.agglomerata)	area (ha)	-795	-123	-3632	2674	-11154	13029
blue leaved	genoa dry shrub frst	percentage	-5%	-94%	-3%	3320%	-53%	48%
stringybark		area (ha)	-43	-15	-36	166	-133	60
scrub/	rock shrub (K.ambig)	percentage	0%	-73%	-5%	278%	-35%	57%
heath/	mtn rock scrub	area (ha)	2	-46	-87	500	-562	193
wetlands	montane heath							
etc	mtn nadgee heath							
	coastal lowland heath							
	swamp heath							
	lowland swamp							
	swamp forest							
	sub alpine bog							
	floodplain wetlands							
	coastal scrub							
	estuarine wetland (M.erci)							
	saltmarsh							
	estuarine wetland (Av.marin)							
wadbilliga	wadbilliga dry shrub frst	percentage	0%	-64%	0%	8513%	-96%	-33%
forests	wadbilliga range ash frst	area (ha)	28	-33	-1	7151	-7068	-80
	wadbilliga mallee heath							
	wadbilliga range wet frst							
wadbilliga	wadbilliga gorge dry frst	percentage	-4%	-96%	-5%	1620%	-89%	1810%
forests	wadbilliga river valley frst	area (ha)	-107	-49	-197	1652	-1678	380

Non commercial forest types

TABLE 4.3
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP FOR B3/B0/A1/C1 TIMBER HARVESTING AND C2 THINNING (A1 HARVESTING OF CERTAIN FILTER STRIPS)

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed

rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered	mtn wet layered frst	percentage	5%	-92%	3%	30%	-49%	41%
brown barrel	*(E.nitens)* mtn wet layered frst *(E.fastigata)*	area (ha)	213	-649	174	560	-1450	1151
messmate/	tantawangalo wet shrub	percentage	-10%	-91%	-16%	80%	-34%	37%
gum	frst mtn wet herb frst	area (ha)	-615	-929	-1560	2313	-1414	2204
brown	mtn wet fern frst	percentage	-1%	-84%	-2%	11%	-8%	23%
barrel/ gum	basalt wet herb frst	area (ha)	-17	-386	-76	155	-214	540
southern	hinterland wet fern frst	percentage	-2%	-89%	-10%	308%	-67%	154%
blue gum		area (ha)	-156	-491	-1747	4707	-5971	3659
yellow	hinterland wet shrub frst	percentage	-14%	-67%	-20%	322%	-69%	289%
stringybark/ gum		area (ha)	-557	-174	-1912	2971	-5152	4825
manna gum	flats wet herb frst	percentage	-13%	-40%	-6%	31%	-35%	65%
		area (ha)	-34	-6	-71	134	-146	124
red gum	brogo wet vine frst	percentage	7%	-71%	-3%	165%	-20%	92%
	bega dry grass frst candelo dry grass frst	area (ha)	65	-70	-88	412	-341	23
river	bega wet shrub frst	percentage	-5%	-57%	-7%	168%	-24%	111%
peppermint		area (ha)	-142	-110	-288	885	-709	365
snow gum	monaro dry grass frst	percentage	-1%	-29%	-1%	17%	-3%	60%
	monaro basalt grass wdland	area (ha)	-7	-5	-13	20	-16	21
monaro	numeralla dry shrub	percentage	1%	-30%	0%	4%	-1%	4%
grasslands/ woodlands	wdland monaro grassland	area (ha)	25	-26	-8	16	-13	6

narrow leaved peppermint	subalpine dry shrub frst	percentage	1%	-45%	1%	10%	-6%	12%
		area (ha)	67	-238	58	141	-183	156
messmate	sandstone dry shrub frst	percentage	-25%	-70%	-38%	1769%	-72%	220%
	coastal dry shrub frst (E.obliqua)	area (ha)	-490	-57	-2824	2901	-6317	6788
stringybark/ peppermint	tableland dry shrub frst	percentage	-24%	-39%	-34%	752%	-45%	75%
		area (ha)	-353	-56	-1896	1865	-1713	2153
applebox	waalimma dry grass frst	percentage	-11%	-80%	-47%	2838%	-73%	160%
		area (ha)	-8	-28	-169	227	-426	405
gum/ stringybark	wog wog dry grass frst	percentage	-14%	-59%	-17%	216%	-53%	64%
	nalbaugh dry grass frst	area (ha)	-1581	-767	-3500	7721	-4701	2830
	wallagaraugh dry grass frst							
	hinterland dry grass frst							
	escarpment dry grass frst							
	mtn dry shrub frst (E.cypellocarpa)							
woolybutt	coastal dry shrub frst	percentage	-21%	-42%	-15%	43%	-64%	300%
	(E.longifolia)	area (ha)	-489	-216	-1111	1292	-4371	4894
yellow stringybark	coastal dry shrub frst	percentage	-18%	-71%	-29%	1161%	-53%	124%
	(E.muellerana)	area (ha)	-491	-80	-2328	2148	-1390	2143
gum/box/ stringybark	brogo dry shrub frst	percentage	-11%	-54%	-9%	37%	-49%	294%
		area (ha)	-368	-392	-329	592	-1345	1843
bangalay dunes	dune dry shrub frst	percentage	0%	-100%	0%	2300%	-52%	0%
		area (ha)	0	-1	0	23	-23	0
apple	coastal dry shrub frst	percentage	-19%	-93%	-25%	1928%	-83%	727%
	(A.floribunda)	area (ha)	-547	-237	-1061	2101	-4068	3811
riparian scrub	sthn riparian scrub	percentage	6%	-100%	1%	800%	-73%	50%
	nthn riparian scrub	area (ha)	5	-4	1	80	-82	1
river oak	riverine frst	percentage						
		area (ha)						

white ash	mtn dry shrub frst	percentage	-2%	-96%	-1%	895%	-88%	90%
	(E.fraxinoides)	area (ha)	-9	-51	-6	528	-543	82
silvertop ash	foothills dry shrub frst	percentage	-15%	-53%	-10%	637%	-81%	250%
	mtn dry shrub frst (E.sieberi)	area (ha)	-1688	-413	-1313	8332	-9306	4386
	lowland dry shrub frst							
	eden dry shrub frst							
	bega dry shrub frst							
yertchuk	timbillica dry shrub frst	percentage	-43%	-70%	-51%	1330%	-73%	163%
		area (ha)	-678	-149	-2516	3006	-7444	7782
ash/ stringybark	coastal dry shrub frst	percentage	-23%	-73%	-36%	1047%	-78%	538%
	(E.agglomerata)	area (ha)	-795	-123	-3632	3738	-11154	11965
blue leaved stringybark	genoa dry shrub frst	percentage	-5%	-94%	-3%	3820%	-53%	28%
		area (ha)	-43	-15	-36	191	-133	35
scrub/ heath/ wetlands etc	rock shrub (K.ambig)	percentage	0%	-73%	-5%	345%	-35%	21%
	mtn rock scrub	area (ha)	2	-46	-87	621	-562	72
	montane heath							
	mtn nadgee heath							
	coastal lowland heath							
	swamp heath							
	lowland swamp							
	swamp forest							
	sub alpine bog							
	floodplain wetlands							
	coastal scrub							
	estuarine wetland (M.erci)							
	saltmarsh							
	estuarine wetland (Av.marin)							
wadbilliga forests	wadbilliga dry shrub frst	percentage	0%	-64%	0%	8525%	-96%	-37%
	wadbilliga range ash frst	area (ha)	28	-33	-1	7161	-7068	-90
	wadbilliga mallee heath							
	wadbilliga range wet frst							
wadbilliga	wadbilliga gorge dry frst	percentage	-4%	-96%	-5%	1978%	-89%	67%

forests	wadbilliga river valley frst	area (ha)	-107	-49	-197	2018	-1678	14

Non commercial forest types

4.1.2 Connectivity

ESFM aims to ensure functional connectivity through implementation of:

- conservation protocols; and
- maintenance of ecosystem function.

For the scenario reflecting current integrated harvesting (B3) and thinning practice (C2), connectivity occurs in the tableland reserve system. There are significant breaks in the coastal reserve system. Connectivity between the two reserve systems does not occur under the current reserve design.

Selection logging (A2) harvesting is maintained along the tablelands through the north-south corridor and through the Devils Hole and Stanton Rock area between the coastal forest and tablelands.

The following comments applies to the combination of harvesting regimes at 70% (B3), 50% (B0), 90% (C1), 10% (A1) and regrowth thinning (C2). Modified selection logging or canopy retention of 50% applies to negotiated and mandatory planning units identified under the maximised JANIS outcome. Under such a regime, connectivity between the reserve system would result. The efficacy of connectivity depends on the harvesting regime applied in the connecting planning unit. Harvesting could be designed to maximise the opportunity for connectivity.

Areas subject to intensification and harvesting in first-order streams will have a reduction in connectivity at the local scale.

4.1.3 Management Measures for Conservation of Flora and Fauna

ESFM aims to assess the implementation of habitat conservation measures.

The protective meaures outlined in Table 4.4 and the prescriptions described immediately following the table apply to all three scenario harvesting regimes.

TABLE 4.4
PROPOSED PROTECTIVE MEASURES FOR BIODIVERSITY CONSERVATION OFF-RESERVE

Protected measures (General Prescriptions from Conservation Protocols)	**Characteristics of Measure**	**Species Addressed**
Hollow-bearing tree retention	Minima of: 6 hollow-bearing trees per ha must be retained in good habitat across the landscape; 4 hollow-bearing trees per ha must be retained in moderate habitat across the landscape; 2 hollow-bearing trees per ha must be retained in low habitat across the landscape.	Glossy black Cockatoo, Yellow-tailed black Cockatoo, Powerful Owl, Masked Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied glider, Greater Glider, Squirrel Glider, Regent Honeyeater, Brush-tailed phascogale, hollow dependent bats
Recruitment tree retention	A habitat clump shall be retained to surround one in three retained hollow-bearing trees.	as above
Significant food resources	Protection of Allocasurina spp. At least 4 mature (40 cm dbh) winter-flowering Eucalypts per 2 ha, protection of mature banksia and Xanthorrhea spp., Retain all V-notch trees, Retain representative understory vegetation	Glossy black cockatoo, Yellow-bellied glider, Squirrel Glider, Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox, Brushtailed Phascogale
Wetlands	At least 10m buffer on areas between 0.1 and 0.5 ha, at least 40m buffer on areas greater than 0.5 ha or SEPP 14 wetlands	frogs, Black Bittern, herpetofauna, rare plants
Rocky Outcrops	At least 20m buffer around rocks and associated heathland between 0.2 and 0.5 ha, at least 40m buffer around heathlands > 0.5 ha	Passerines, herpetofauna, plants
Caves,tunnels and disused mineshafts	All protected by at least 50m buffer	Cave-dependent bats
Rainforest	Protect all rainforest. 20m buffer on warm temperate rainforest	Olive Whistler, rare plants, herpetofauna
Riparian buffer	Fauna stream buffers (i) 1st order streams, 10m (iii) 2nd order streams, 20m (iv) 3rd order, 40m	threatened frogs, habitat for forest-dependent fauna

The following prescriptions would also be required for adequate species conservation management:

- for the Koala, a 50 m exclusion zone would be established around individual animals encountered. In addition 150 ha of high quality habitat would be retained within a 2 km radius.
- for the owls, a landscape-level habitat management plan would be implemented. This would be designed to have no impact on total harvest, but would affect the timing and spatial pattern by requiring the retention of 25% of planning areas of about 10 000 ha each (across all tenures) in high quality foraging habitat. This habitat would be defined as regrowth, mature or old growth forest, greater than ten years of age with a weighting factor relating to time since logging and forest type.
- for the smoky mouse and southern brown bandicoot, intensified programs of feral animal control would be undertaken in areas where the limited number of sightings of these animals have occurred.
- there would be a need for intensified survey and habitat mapping for the Stuttering Barred Frog and the Giant Burrowing Frog. The conservation status of these species would be reviewed after five years.

4.1.4 Wood Supply

ESFM aims to ensure that the allowable timber cut is not exceeded until an ecologically sustainable yield is determined and that targets are set within range after examination of data compatible with an ecologically sustainable sawlog industry.

B3 timber harvesting and C2 thinning

As a benchmark, Table 4.5 shows the wood supply resulting from applying existing current integrated harvesting (B3) to mature and Old Growth forests on State Forests and regrowth thinning from below (C2) to regrowth forests on State Forests tenure. This scenario generates 28 309 m^3 of sawlogs over a twenty three-year period and 401 655 tonnes of pulpwood.

The scenario stipulates that JANIS targets should be met in existing reserves. While this is largely the case, additional impact will occur in relation to the targets not met in the dedicated reserves. Prescriptions for Old Growth could be considered for application to production forests but the impact of these has not been analysed. The anticipated impact of the conservation protocols including Old Growth is a reduction of about 2 000m^3 per annum.

Species-specific prescriptions will impact on the timing and location of harvesting rather than through exclusions.

TABLE 4.5
TIMBER VOLUME FOR B3 TIMBER HARVESTING AND C2 THINNING

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	5546	2634	274851	4.84	49.56	1167	11950
Coastal	High	5185	46614	269643	8.99	52.00	2027	11724
Hinterland	Low	11539	77275	916241	6.70	79.41	3360	39837
Hinterland	High	29516	25323	2920383	8.72	98.94	11188	126973
Tableland	Low	1444	21399	174014	14.82	120.50	930	7566
Tableland	High	6201	133364	914892	21.51	147.54	5798	39778
TOTAL							**24470**	**237827**

Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		20142	66219	2132210	3.29	105.86	2879	92705
Hinterland		13180	12355	1073128	0.94	81.42	537	46658
Tableland		5129	9732	562695	1.90	109.71	423	24465
TOTAL							**3839**	**163828**
GRAND TOTAL							**28309**	**4.1655**

B3/A2/C1 timber harvesting and C2 thinning

Table 4.6 shows the wood supply resulting from the second part of the scenario using a combination of current integrated harvesting practice (B3), selection harvesting (A2) in connectivity areas and C1 on selected forest ecosystems (not modelled) in association with Conservation Protocols. The wood volume provided by this is 28 026m^3 of sawlog and 398 628 tonnes of pulpwood. The yield of pulpwood would increase through applying intensified harvesting regimes on selected forest ecosystems. The conservation strategy for fauna would be based more on managing the timing and location of harvesting rather than specific exclusions. Therefore it is anticipated that there would be no net impact on wood supply. Again, if an Old Growth protocol is applied, the impact on wood supply would be significant but unquantified.

TABLE 4.6
WOOD SUPPLY FOR B3/A2/C2 SCENARIO

B3 in Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	5546	2634	274851	4.84	49.56	1167	11950
Coastal	High	5185	46614	269643	8.99	52.00	2027	11724
Hinterland	Low	1118	74428	887085	6.69	79.41	3236	38569
Hinterland	High	26890	234105	2671037	8.71	98.94	10178	116132
Tableland	Low	1444	21399	174014	14.82	120.50	930	7566
Tableland	High	6201	133364	914892	21.51	147.54	5798	39778
TOTAL							**23337**	**225718**

A2 in Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	0						
Coastal	High	0						
Hinterland	Low	420	2136	21867	5.08	52.05	93	951
Hinterland	High	2627	17414	187010	6.63	71.19	757	8131
Tableland	Low							
Tableland	High							
TOTAL							**850**	**9082**
C2 in Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		20142	66219	2132210	3.29	105.86	2879	92705
Hinterland		13180	12355	1073128	0.94	81.42	537	46658
Tableland		5129	9732	562695	1.90	109.71	423	24465
TOTAL							**3839**	**163828**
GRAND TOTAL							**28026**	**398628**

B3/B0/C1 timber harvesting and C2 thinning

Table 4.7 shows the wood supply resulting from the third part of the scenario using a combination of current integrated harvesting practice (B3), modified selection harvesting (B0) to areas identified for reservation uner the scenario designed to maximise JANIS in dedicated reserves and intensified harvesting on selected forest ecosystems with Conservation Protocols applying to areas subjected to current and modified integrated harvesting (B3 and B0). An additional 1 000m^3 of sawlog and 2 000 ha of pulpwood are obtained through single tree selection of the 1st order filter strips. The wood volume provided under this suite of harvesting regimes is 28 682m^3 of sawlog and 453 287 tonnes of pulpwood for the 23 year period up to 2020.

TABLE 4.7
WOOD SUPPLY FOR B3/B0/C1 TIMBER HARVESTING AND C2 THINNING UNDER SCENARIO 4 (EXISTING TENURE)

B3 in 40% of Multiple-aged forest					
Location	Sawlog Produc	Net Area	Total Volume	Average Volume/ha	Total Volume/yr

	t-ivity							
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	976	5261	40277	5.39	41.27	229	1751
Coastal	High	1481	14636	65193	9.88	44.03	636	2834
Hinterland	Low	2669	16985	211791	6.36	79.36	738	9208
Hinterland	High	5379	46404	502168	8.63	93.36	2018	21833
Tableland	Low	260	3697	31387	14.21	120.64	161	1365
Tableland	High	1663	34710	233082	20.88	140.18	1509	10134
TOTAL							**5291**	**47126**

C1 in 60% of Multiple-aged forest

Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	1464	7892	108749	5.39	74.29	343	4728
Coastal	High	2221	21954	176020	9.88	79.25	955	7653
Hinterland	Low	4003	25478	571835	6.36	142.85	1108	24862
Hinterland	High	8068	69906	1355854	8.63	168.06	3026	58950
Tableland	Low	390	5545	84745	14.21	217.16	241	3685
Tableland	High	2494	52065	629323	20.88	252.33	2264	27362
TOTAL							**7937**	**127240**

B0 variation (50%) in JANIS areas

Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	3231	13387	168461	4.14	52.15	582	7324
Coastal	High	1483	9021	95996	6.08	64.72	392	4174
Hinterland	Low	5114	33553	374759	6.56	73.29	1459	16294
Hinterland	High	16815	133483	1565586	7.94	93.10	5804	68069
Tableland	Low	895	127763	97374	14.26	108.81	555	4234
Tablelan	High	2044	41930	298968	20.51	146.26	1823	12999

d								
TOTAL							**10615**	**113093**

C2 regrowth thinning

Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		20142	66219	2132210	3.29	105.86	2879	92705
Hinterland		13180	12355	1073128	0.94	81.42	537	46658
Tableland		5129	9732	562695	1.90	109.71	423	24465
TOTAL							**3839**	**163828**
GRAND TOTAL							**28682**	**453287**

4.1.5 Soil and Water

ESFM aims to:

- minimise road density
- minimise the density of drainage line crossings
- define range for allowed percentage cut in regrowth areas per 5 years by catchment
- balance growth stage across landscape
- maintain dry weather water flows at a level expected from the catchment if it were undisturbed by logging and regeneration
- long term levels from ANZECC guidelines.

B3 timber harvesting and C2 regrowth thinning

The application of current integrated harvesting (B3) and regrowth thinning from below (C2) as a benchmark to existing tenure has the following impact on (i) the proportion of the surface area of the catchment which is harvested over the twenty three-year period in relation to harvest practice and (ii) extent of change in growth stage, for the Eden catchments.

1. Proportion of the catchment harvested by harvest practice (Indicator 4.1)

As shown in Table 4.8, the Bega, Coastal North, Murrumbidgee and Snowy catchments are the only catchments with less than 8% of the catchment affected by harvesting. Wallagaragh catchment wil be affected by harvesting which could cause significant changes to waterflow. The remaining catchments are affected by harvesting at levels of 15% or more. Conceivably, waterflows may be affected in the remaining catchments.

TABLE 4.8
PROPORTION OF CATCHMENT HARVESTED FROM 1997-2019 BY HARVEST SYSTEM (B3/C2)

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)						5513		2713	8226
		proportion						3%		1%	4%
Coastal Central	59807	area (ha)						9578		797	10376
		proportion						16%		1%	17%
Coastal North	88578	area (ha)						6913		564	7476

		proportion						8%		1%	8%
Coastal South	63857	area (ha)						4267		13560	17827
		proportion						7%		21%	28%
Genoa	52442	area (ha)						5292		2575	7867
		proportion						10%		5%	15%
Murrumbidgee	44889	area (ha)						0		0	0
		proportion						0%		0%	0%
Snowy	132888	area (ha)						2732		1747	4479
		proportion						2%		1%	3%
Towamba	102819	area (ha)						15411		3419	18830
		proportion						15%		3%	18%
Wallagaraugh	59045	area (ha)						14959		9275	24234
		proportion						25%		16%	41%
TOTAL	814251	area (ha)						64665		34650	99315
		proportion						8%		4%	12%

2. Extent of change in growth stage by catchment (Indicator 4.5)

Based on changes in growth stages, an anticipated reduction in waterflow could be expected for the Coastal South, Genoa and Wallagaragh catchments once regeneration becomes established in harvesting areas. In the Coastal South and Wallagaragh catchments, this could be offset through timing of thinning regimes. This is shown in Table 4.9

TABLE 4.9
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT (B3/C2)

Catchment name	percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	2%	-85%	3%	159%	-67%	125%	0%
Coastal Central	0%	-17%	-50%	-26%	208%	-48%	291%	0%
Coastal North	0%	-7%	-48%	-8%	38%	-65%	335%	0%
Coastal South	0%	-16%	-86%	-23%	12697%	-87%	815%	0%
Genoa	0%	-11%	-77%	-18%	538%	-53%	84%	0%
Murrumbidgee	0%	1%	-28%	0%	-2%	2%	-7%	0%
Snowy	0%	-1%	-64%	0%	-29%	0%	28%	0%
Towamba	0%	-15%	-72%	-22%	80%	-55%	216%	0%
Unknown	0%	#DIV/0!	#DIV/0!	1%	#DIV/0!	#DIV/0!	6%	0%
Wallagaraugh	0%	-43%	-71%	-51%	920%	-70%	212%	0%

B3/A2/C1 timber harvesting and C2 regrowth thinning

The impact on catchments using this scenario would be similar to that described for the previous harvesting regime.

1. Proportion of the catchment harvested by harvest practice (Indicator 4.1), shown in Table 4.10.

TABLE 4.10
PROPORTION OF CATCHMENT HARVESTED FROM 1997-2019 BY HARVEST SYSTEM

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)		756				4757		2713	8226
		proportion		< 1%				2%		1%	4%
Coastal Central	59807	area (ha)		309				9270		797	10376
		proportion		1%				15%		1%	17%
Coastal North	88578	area (ha)		0				6913		564	7476
		proportion						8%		1%	8%
Coastal South	63857	area (ha)		0				4267		13560	17827
		proportion						7%		21%	28%
Genoa	52442	area (ha)		0				5292		2575	7867
		proportion						10%		5%	15%
Murrumbidgee	44889	area (ha)		0				0		0	0
		proportion						0%		0%	0%

Snowy	132888	area (ha)		0				2732		1747	4479
		proportion						2%		1%	3%
Towamba	102819	area (ha)		1986				13425		3419	18830
		proportion		2%				13%		3%	18%
Wallagaraugh	59045	area (ha)		0				14959		9275	24234
		proportion						25%		16%	41%
TOTAL	814251	area (ha)		3051				61614		34650	99315
		proportion		< 1%				8%		4%	12%

2. Extent of change in growth stage by catchment (Indicator 4.5), as shown in Table 4.11.

TABLE 4.11
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT

Catchment name	percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	2%	-85%	3%	169%	-67%	108%	0%
Coastal Central	0%	-17%	-50%	-26%	245%	-48%	283%	0%
Coastal North	0%	-7%	-48%	-8%	38%	-65%	335%	0%
Coastal South	0%	-16%	-86%	-23%	12697%	-87%	815%	0%
Genoa	0%	-11%	-77%	-18%	538%	-53%	84%	0%
Murrumbidgee	0%	1%	-28%	0%	-2%	2%	-7%	0%
Snowy	0%	-1%	-64%	0%	-29%	0%	28%	0%
Towamba	0%	-15%	-72%	-22%	113%	-55%	191%	0%
Unknown	0%	#DIV/0!	#DIV/0!	1%	#DIV/0!	#DIV/0!	6%	0%
Wallagaraugh	0%	-43%	-71%	-51%	920%	-70%	212%	0%

B3/B0/A2/C1 timber harvesting and C2 regrowth thinning

The percentage of the catchment subjected to harvesting under this scenario is the same as the previous two scenarios.

1. Proportion of the catchment harvested by harvest practice (Indicator 4.1), as shown in Table 4.12.

TABLE 4.12
PROPORTION OF CATCHMENT HARVESTED FROM 1997-2019 BY HARVEST SYSTEM

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)			4270			497	746	2713	8226
		proportion			2%			< 1%	< 1%	1%	4%
Coastal Central	59807	area (ha)			3760			2327	3491	797	10376
		proportion			6%			4%	6%	1%	17%
Coastal North	88578	area (ha)			4886			811	1216	564	7476
		proportion			6%			1%	1%	1%	8%
Coastal South	63857	area (ha)			1695			1029	1544	13560	17827
		proportion			3%			2%	2%	21%	28%
Genoa	52442	area (ha)			3632			664	996	2575	7867
		proportion			7%			1%	2%	5%	15%
Murrumbidgee	44889	area (ha)			0			0	0	0	0
		proportion			0%			0%	0%	0%	0%
Snowy	132888	area (ha)			1232			600	900	1747	4479
		proportion			1%			< 1%	1%	1%	3%
Towamba	102819	area (ha)			10893			1807	2711	3419	18830
		proportion			11%			2%	3%	3%	18%
Wallagaraugh	59045	area (ha)			3866			4437	6656	9275	24234
		proportion			7%			8%	11%	16%	41%
TOTAL	814251	area (ha)			34234			12173	18259	34650	99315
		proportion			4%			1%	2%	4%	12%

2. Extent of change in growth stage by catchment (Indicator 4.5)

Through the use of modified selection harvesting (B0), the impact on waterflow in catchments is expected to be less than experienced under the previous two scenarios, as shown in Table 4.13

TABLE 4.13
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT

Catchment name	percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	2%	-85%	3%	176%	-67%	96%	0%
Coastal Central	0%	-17%	-50%	-26%	573%	-48%	208%	0%
Coastal North	0%	-7%	-48%	-8%	123%	-65%	150%	0%
Coastal South	0%	-16%	-86%	-23%	13546%	-87%	785%	0%
Genoa	0%	-11%	-77%	-18%	983%	-53%	49%	0%
Murrumbidgee	0%	1%	-28%	0%	-2%	2%	-7%	0%

Snowy	0%	-1%	-64%	0%	-14%	0%	18%	0%
Towamba	0%	-15%	-72%	-22%	242%	-55%	96%	0%
Unknown	0%	#DIV/0!	#DIV/0!	1%	#DIV/0!	#DIV/0!	6%	0%
Wallagaraugh	0%	-43%	-71%	-51%	1518%	-70%	184%	0%

4.1.6 Socio-economic considerations

ESFM aims to:

- review royalty rates by product type against fair market rates in other comparable jurisdictions
- ensure harvest does not exceed ecologically sustainable wood supply commitments by product type over 5 year period of RFA, within 5%.
- ensure harvest, by product type, does not vary by more than 25% of ecologically sustainable wood supply commitments in any given year
- ensure that the volume outcome is driven by option choice
- ensure minimum levels of preferred species.

ROYALTY

1. B3 timber harvesting and C2 regrowth thinning

Sawlogs: 28309 m^3@$38.52=$1090463

Pulp (multiaged): 237827 t@$20.05= $4768431

Pulp (regrowth):163828 t@$10.03= $1643195

TOTAL $7 502 089

2. B3/A2/C1 timber harvesting and C2 regrowth thinning

Sawlogs: 28026 m^3@$38.52=

$1079562

Pulp (multiaged): 234800 t@$20.05= $4707740

Pulp (regrowth): 163828 t@$10.03= $1643195

TOTAL $7 430 497

3. B3/B0/A2/C1 timber harvesting and C2 regrowth thinning

Sawlogs: 27682 m^3@$38.52=$1066311

Pulp (multiaged):287459 t@$20.05= $5763533

Pulp (regrowth):163828 t@$10.03= $1643195

TOTAL $8 473 039

The third scenario adds an extra $1m in expected royalty above the benchmark (first scenario.) The extra royalty would be offset by the increased management costs associated with the design of harvesting regimes (B0, 50% canopy retention) to conserve JANIS values through prescription while achieving a good supply of sawlogs. This third scenario could have flow-on effects to the forest industry and those employed in the forests sector.

4.1.7 Cultural and Heritage Considerations

ESFM aims to:

- monitor and review condition of sites
  - identify mitigating actions if necessary; and
  - assess efficacy of protective measures
- ensure that protective mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous cultural values or other identified values
- ensure indigenous groups are employed to undertake monitoring.

Table 4.14 contains places (non-indigenous and National Estate) requiring special management. In addition to those listed in the table, other areas having indigenous cultural heritage values will need to be appropriately protected. Notable amongst these is Biamanga, an area currently in National Park and so not subject. from which logging should be excluded.

TABLE 4.14
CULTURAL HERITAGE PLACES REQUIRING SPECIAL MANAGEMENT

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management Implications for SFNSW	Resource Implications
Old Growth Forest Patches - Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Siviculture	PMP 1.2	Nil logging, Nil silviculture Nil fire	Nil currently excluded from logging
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Siviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Forest management by prescription - light intensity logging, nil fire.	Nil additional impact on resource - area already identified and managed as PMP 1.1.8 Forest management by prescription and has conservation plan
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Clasification as PMP 1.1.6 & 1.1.2 Maintenance of viewing lines	Moderate impact on surrounding eucalypt forest
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - conservation of representative area of forest around site sought, needs to be clearly delineated, included in PMP and managed by prescription
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Substantial - some areas within area delineated currently PMP 1.1.8 Forest management by prescription, 1.2 excluded from harvesting, 1.3 excluded from harvesting, and 1.1.7 excluded from harvesting
Whipstick mines and village site	Historic	Gnupa SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977	Classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - needs to be clearly delineated, included in PMP and managed by prescription
Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Streamside reserve	Classification as PMP 1.1.2	Nil, currently protected by streamside buffer and excluded from harvesting.
Murrah State Forest (koala habitat)	Social Aesthetic	Indicative only Murrah SF	SFNSW	Fire Logging Silviculture	unknown		
Myrtle Mountain Lookout	Social Aesthetic	Tantawangalo SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2	Nil logging, Nil silviculture Nil fire Maintain access	Nil, currently PMP 1.1.2 and excluded from harvesting.

Wallaga Lake	Social Aesthetic	Bermagui SF	SFNSW, Crown land & NPWS	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Moderate impact on resource due to extensions of PMP 1.1.6 boundary outside current delineated area than currently exist
Davidson's Whaling Station	Social Historic Aesthetic	East Boyd SF / Ben Boyd NP	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 AHC Act 1975 NPW Act 19 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire	Nil - no change to current management
Cow bail trail / Chimneys trail / cuttings	Historic Aesthetic	Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 NPW Act 19 PMP 1.1.6	Classifiaction of entire area as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire	Moderate - 5m buffer for pine areas within State Forest, 20m buffer for native forest areas within State Forest - requires identification as PMP 1.1.6 harvesting by prescription
Edrom Lodge	Historic Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977 PMP 1.1.3	Additional classification as PMP 1.1.8 and PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintain historic values Maintain viewing lines	Nil, currently PMP 1.1.3 education harvesting by prescription.
Burrawang Picnic Ground	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil -. no change to current management
Ludwigs Creek	Aesthetic	Nadgee SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Maxwells forest walk	Aesthetic	Maxwells Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current forest preserve and excluded from harvesting
Newtons Crossing camping area	Aesthetic	Wallagaraugh Reserve, Timbillica SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Scrubby Creek picnic area	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6 PMP 1.1.2	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management

Nethercote Falls	Aesthetic	Nethercote Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3 AHC Act 1975	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - current flora reserve, excluded from harvesting
Nalbaugh Falls	Aesthetic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7 PMP 1.1.2	Additional classification as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest Management by prescription - light intensity logging, nil fire Maintenance of value Maintenance of viewing lines	Moderate - extent of buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Siviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Mostly private & crown land issue, if determined to be partly on State Forest may require PMP
Prison Farm, Bondi SF	Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Maintenance of value	Nil - on cleared land within pine plantation
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Razor-back Fire Trail	Potential Historic	Murrabrine SF	SFNSW & NPWS	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Sleeper cutter camps, Murrah SF	Potential Historic	Murrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Negligible - needs to be clearly delineated included in PMP and managed by prescription
Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Siviculture	PMP 1.1.6	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial if entire boundary as delineated applied - some of the area is currently PMP 1.1.6 harvesting by prescription
Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial on pine resource) if buffer suggested is considered, site currently has 50 -100m buffer.
Tantawangalo Road and Lookout	Aesthetic Potential Historic	Glen Bog SF	SFNSW & NPWS	Fire Logging Silviculture	PMP 1.1.6	Additional classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire Maintenance of viewing lines	Nil - moderate if it is proposed that current management prescriptions be changed - within current PMP 1.1.6 boundary harvesting by prescription

- The information in Table 15 should be considered indicative only - detailed assessments and documentation of places are yet to be finalised
- Current condition of places identified has not been able to be stated as detailed information on places has yet to be received.

All places identified as having historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

Conservation and management of cultural heritage values will be via existing national parks procedures, State Forest PMP classification and specific protocols for newly identified sites. The assessment proposes that cultural heritage, in terms of the aboriginal community, would become a co-management responsibility. This would take the following into account:

- a recognition of cultural heritage and traditional use values by State Forests and the NSW NPWS
- an agreement on access to those values and traditional uses by the Aboriginal communities
- recognition in management planning of these values, the protective measures or access required, and the mechanism to ensure Aboriginal participation in the management of those values
- an annual co-management board between the Aboriginal communities and the land management agencies to examine the management proposed for cultural heritage values, and to examine opportunities for expanded participation by the Aboriginal community in the economic activities in the conservation and production forest area.

4.2 CONCLUSION

This scenario attempts to provide flexibility in the choice of timber harvesting practices while maximising JANIS targets in off-reserve management regimes. The application of a B0 regime would need to be further investigated for its adequacy in conserving JANIS targets while supplying high levels of sawlogs. Using a B0 regime would place many JANIS targets into forest that would be subject to specific prescriptions resulting in a strenghthening of the level of biodiversity conservation. Connectivity would also be improved. The socio-economic impacts expected to be limited.

5. ESFM IMPLICATIONS OF THE SCENARIO TO MAXIMISE JANIS IN DEDICATED RESERVES

5.1 DIMENSIONS OF THE SCENARIO

The scenario attempts to maximise JANIS in dedicated reserves. It is based on a sawlog wood supply commitment of 16 132 m^3 per year and additions to the National Parks estate of approximately 78 883 ha. No direction was given on the need to meet JANIS through prescriptions outside of dedicated reserves.

The scenario requests two types of analysis:

- analysis of current integrated harvesting practice (B3) across the whole forest estate with general Conservation Protocols
- analysis of selective logging practice (A2) retaining 70% of the canopy in the net harvest area with the Conservation Protocols including no logging of old growth.

The ESFM response is based on an objective consideration of the consequences of the proposal on a set of ESFM indicators.

5.2 PROPOSED HARVESTING PRACTICES ON AREAS AVAILABLE FOR TIMBER HARVEST

- Current integrated harvesting (B3) or 70% canopy reduction harvest system across the forest estate with Conservation Protocols plus regrowth thinning from below (C2) applied across the forest estate
- Selection logging (A2) or 30% canopy reduction harvest system across the forest estate with Conservation Protocols, including no logging of old growth plus regrowth thinning from below (C2) applied across the forest estate.

5.3 ASSESSMENT AGAINST ESFM INDICATORS AND TARGETS

5.3.1 Forest Structure

ESFM aims to:

- minimise loss of old growth
- ensure that targets for the extent of each growth stage in each forest type to be maintained are set after examination of data compatible with an ecologically sustainable sawlog industry
- increase area of old growth of rare or endangered forest types
- ensure that all areas harvested are regenerated and managed to maintain the original forest type (including use of the State Forests ecological field guide).

B3 timber harvesting and C2 thinning

As would be expected, the scenario to maximise JANIS provides more stability in terms of forest structure. However, there are still some significant changes to be noted.

Under the current harvesting and thinning regimes (Table 5.1), the extent of Old Growth, for example, is estimated to increase by 1% overall during the twenty three-year period. Of 29 forest types, the extent of Old Growth increases in 20, decreases by

less than 10% for 8 and decreases by more than 10% only for one type (ash/stringybark types). The amount of disturbed mature forest increases significantly due to the systematic thinning of regrowth forests and there is a counter-incline in the amount of young regrowth. The amount of recently disturbed forest increases by about 90% but much of this forest will likely be moving into the category of 'young forest' during the twenty three-year period.

Under selection logging and with no logging of Old Growth, candidate Old Growth will increase by 5% (5 043ha). The outcome is similar to that resulting from the present harvesting regime. Differences include a reduction in recently disturbed forest to 47% because most of the selectively logged forest moves into the disturbed mature forest category. There is a net increase in Old Growth in all 20 vegetation ecosystem types over the 23-year period.

TABLE 5.1
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP FOR B3 TIMBER HARVESTING AND C2 THINNING UNDER SCENARIO 3 (MAXIMISE JANIS IN DEDICATED RESERVES)

Vegetation ecosystem group	Vegetation type name	Change in size	Extent of change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage	8%	-93%	7%	14%	-38%	27%
		area (ha)	346	-652	389	268	-1130	779
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage	6%	-92%	3%	5%	-16%	13%
		area (ha)	333	-946	292	159	-638	799
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage	5%	-91%	4%	-7%	1%	8%
		area (ha)	123	-416	183	-93	24	181
southern blue gum	hinterland wet fern frst	percentage	3%	-91%	-4%	281%	-65%	99%
		area (ha)	278	-498	-681	4296	-5754	2358
yellow stringybark/ gum	hinterland wet shrub frst	percentage	-5%	-76%	-9%	412%	-71%	163%
		area (ha)	-187	-197	-882	3802	-5264	2728

manna gum	flats wet herb frst	percentage	2%	-40%	7%	3%	-23%	-1%
		area (ha)	5	-6	86	14	-97	-1
red gum	brogo wet vine frst	percentage	7%	-72%	1%	137%	-22%	44%
	bega dry grass frst	area (ha)	70	-71	21	341	-373	11
	candelo dry grass frst							
river peppermint	bega wet shrub frst	percentage	4%	-66%	3%	113%	-24%	3%
		area (ha)	104	-129	121	596	-701	9
snow gum	monaro dry grass frst	percentage	0%	-29%	0%	110%	-23%	51%
	monaro basalt grass wdland	area (ha)	2	-5	-12	132	-135	18
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	1%	-30%	0%	5%	-1%	-1%
		area (ha)	25	-26	0	19	-17	-1
narrow leaved peppermint	subalpine dry shrub frst	percentage	3%	-46%	4%	3%	8%	-38%
		area (ha)	201	-248	242	38	251	-482
messmate	sandstone dry shrub frst	percentage	-6%	-82%	-27%	2501%	-74%	150%
	coastal dry shrub frst (E.obliqua)	area (ha)	-123	-67	-2042	4101	-6501	4632
stringybark/ peppermint	tableland dry shrub frst	percentage	-8%	-42%	-21%	644%	-36%	40%
		area (ha)	-122	-60	-1176	1598	-1384	1143
applebox	waalimma dry grass frst	percentage	41%	-94%	-8%	6863%	-59%	-68%
		area (ha)	31	-33	-30	549	-343	-173
gum/ stringybark	wog wog dry grass frst	percentage	5%	-65%	0%	108%	-41%	0%
	nalbaugh dry grass frst	area (ha)	568	-847	102	3852	-3673	0
	wallagaraugh dry grass frst							
	hinterland dry grass frst							
	escarpment dry grass frst							
	mtn dry shrub frst (E.cypellocarpa)							
woolybutt	coastal dry shrub frst	percentage	8%	-66%	8%	48%	-65%	158%
	(E.longifolia)	area (ha)	194	-336	623	1452	-4507	2573
yellow stringybark	coastal dry shrub frst	percentage	-5%	-84%	-14%	768%	-46%	68%
	(E.muellerana)	area	-136	-95	-1155	1420	-1211	1179

		(ha)						
gum/box/ stringybark	brogo dry shrub frst	percentage	7%	-73%	3%	18%	-50%	207%
		area (ha)	213	-533	105	288	-1369	1297
bangalay dunes	dune dry shrub frst	percentage	0%	-100%	0%	2800%	-57%	-33%
		area (ha)	0	-1	0	28	-25	-4
apple	coastal dry shrub frst (A.floribunda)	percentage	-10%	-95%	-19%	2316%	-84%	558%
		area (ha)	-295	-243	-824	2524	-4090	2926
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage	6%	-100%	1%	800%	-72%	50%
		area (ha)	5	-4	1	80	-81	1
river oak	riverine frst	percentage						
		area (ha)						
white ash	mtn dry shrub frst (E.fraxinoides)	percentage	5%	-96%	1%	844%	-87%	73%
		area (ha)	19	-51	5	498	-536	66
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage	-4%	-73%	-2%	583%	-81%	172%
		area (ha)	-466	-566	-294	7632	-9328	3022
yertchuk	timbillica dry shrub frst	percentage	-2%	-77%	-44%	1503%	-74%	135%
		area (ha)	-28	-163	-2176	3396	-7498	6470
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage	-11%	-80%	-28%	1364%	-78%	428%
		area (ha)	-363	-134	-2780	4869	-11103	9510
blue leaved stringybark	genoa dry shrub frst	percentage	-2%	-94%	-3%	3320%	-53%	28%
		area (ha)	-20	-15	-33	166	-133	35
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath	percentage	3%	-75%	3%	423%	-44%	-28%
		area (ha)	32	-47	51	761	-703	-94

	swamp heath lowland swamp swamp forest sub alpine bog floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh estuarine wetland (Av.marin)							
wadbilliga forests	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath wadbilliga range wet frst	percentage area (ha)	0% 30	-63% -33	0% 7	8535% 7169	-96% -7082	-39% -93
wadbilliga forests	wadbilliga gorge dry frst wadbilliga river valley frst	percentage area (ha)	2% 42	-98% -50	1% 21	1641% 1674	-90% -1691	24% 5

Non commercial forest types

A2 timber harvesting with no logging of old growth and C2 thinning

This is shown in Table 5.2.

TABLE 5.2
CHANGE IN EXTENT OF GROWTH STAGES FROM 1997 AND 2019 BY VEGETATION ECOSYSTEM GROUP (A2 TIMBER HARVESTING WITH NO LOGGING OF OLD GROWTH AND C2 THINNING)

Vegetation ecosystem group	Vegetation type name	Change in size	Calculated change in growth stage from 1997 to 2019					
			candidate old growth	disturbed old growth	mature forest	disturbed mature forest	young forest	recently disturbed
rainforest	dry rf myanba euc/fig frst rocky top dry shrub frst a silve/p brogo shrub rf bunga head rf coastal warm temperate rf hinterland warm temperate rf cool temperate rf							
layered brown barrel	mtn wet layered frst *(E.nitens)* mtn wet layered frst *(E.fastigata)*	percentage	28%	0%	31%	15%	9%	17%
		area (ha)	5082	54	5659	2715	1668	3070
messmate/ gum	tantawangalo wet shrub frst mtn wet herb frst	percentage	22%	0%	34%	15%	11%	18%
		area (ha)	6606	102	10210	4379	3289	5287
brown barrel/ gum	mtn wet fern frst basalt wet herb frst	percentage	19%	0%	32%	12%	19%	17%
		area (ha)	2557	44	4233	1581	2511	2211
southern blue gum	hinterland wet fern frst	percentage	24%	0%	42%	17%	8%	8%
		area (ha)	9895	63	17159	7051	3223	3232
yellow stringybark/ gum	hinterland wet shrub frst	percentage	17%	0%	37%	22%	10%	14%
		area (ha)	4153	74	8791	5305	2441	3293
manna gum	flats wet herb frst	percentage	11%	0%	50%	20%	13%	5%
		area (ha)	278	9	1253	509	317	135
red gum	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage	18%	0%	48%	10%	23%	1%
		area (ha)	1063	27	2755	596	1322	31
river	bega wet shrub frst	percentage	28%	1%	37%	10%	21%	3%

peppermint		area (ha)	2982	67	4056	1114	2284	316
snow gum	monaro dry grass frst	percentage	27%	0%	55%	6%	10%	1%
	monaro basalt grass wdland	area (ha)	1196	12	2459	265	460	39
monaro grasslands/ woodlands	numeralla dry shrub wdland monaro grassland	percentage	35%	1%	36%	6%	20%	2%
		area (ha)	2395	61	2499	385	1399	163
narrow leaved peppermint	subalpine dry shrub frst	percentage	39%	1%	33%	7%	16%	3%
		area (ha)	8167	289	6787	1448	3358	702
messmate	sandstone dry shrub frst	percentage	9%	0%	25%	28%	11%	27%
	coastal dry shrub frst (E.obliqua)	area (ha)	1962	18	5390	5968	2320	5792
stringybark/ peppermint	tableland dry shrub frst	percentage	11%	1%	31%	20%	18%	19%
		area (ha)	1552	85	4371	2874	2574	2690
applebox	waalimma dry grass frst	percentage	8%	0%	25%	45%	18%	3%
		area (ha)	109	2	326	592	242	41
gum/ stringybark	wog wog dry grass frst nalbaugh dry grass frst wallagaraugh dry grass frst hinterland dry grass frst escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)	percentage	24%	1%	41%	17%	10%	6%
		area (ha)	11863	489	20768	8701	5251	3003
woolybutt	coastal dry shrub frst (E.longifolia)	percentage	12%	1%	37%	25%	11%	14%
		area (ha)	2590	177	8140	5542	2389	3042
yellow stringybark	coastal dry shrub frst (E.muellerana)	percentage	19%	0%	45%	17%	9%	10%
		area (ha)	3000	21	6969	2657	1439	1494
gum/box/ stringybark	brogo dry shrub frst	percentage	29%	2%	29%	21%	11%	8%
		area (ha)	3609	205	3610	2653	1396	960
bangalay dunes	dune dry shrub frst	percentage	55%	0%	21%	13%	8%	3%
		area (ha)	125	0	47	30	19	7
apple	coastal dry shrub frst	percentage	23%	0%	27%	19%	8%	23%

	(A.floribunda)	area (ha)	3021	13	3440	2466	1073	2958
riparian scrub	sthn riparian scrub nthn riparian scrub	percentage area (ha)	24% 85	1% 2	39% 135	13% 44	22% 78	1% 3
river oak	riverine frst	percentage area (ha)	0	0	0	0	0	0
white ash	mtn dry shrub frst (E.fraxinoides)	percentage area (ha)	23% 398	0% 3	31% 541	36% 617	5% 79	5% 89
silvertop ash	foothills dry shrub frst mtn dry shrub frst (E.sieberi) lowland dry shrub frst eden dry shrub frst bega dry shrub frst	percentage area (ha)	29% 11557	1% 214	31% 12334	24% 9286	6% 2279	9% 3545
yertchuk	timbillica dry shrub frst	percentage area (ha)	8% 1682	0% 66	12% 2719	20% 4306	16% 3478	44% 9621
ash/ stringybark	coastal dry shrub frst (E.agglomerata)	percentage area (ha)	11% 3460	0% 37	24% 7189	23% 6892	11% 3414	31% 9393
blue leaved stringybark	genoa dry shrub frst	percentage area (ha)	37% 893	0% 4	45% 1075	8% 182	5% 123	5% 119
scrub/ heath/ wetlands etc	rock shrub (K.ambig) mtn rock scrub montane heath mtn nadgee heath coastal lowland heath swamp heath lowland swamp swamp forest sub alpine bog floodplain wetlands coastal scrub estuarine wetland (M.erci) saltmarsh	percentage area (ha)	23% 1165	0% 17	35% 1727	18% 876	18% 891	6% 297

	estuarine wetland (Av.marin)							
wadbilliga	wadbilliga dry shrub frst	percentage	44%	0%	31%	24%	1%	0%
forests	wadbilliga range ash frst	area (ha)	13388	19	9527	7258	297	152
	wadbilliga mallee heath							
	wadbilliga range wet frst							
wadbilliga	wadbilliga gorge dry frst	percentage	32%	0%	44%	21%	2%	0%
forests	wadbilliga river valley frst	area (ha)	2705	1	3660	1781	193	12

Non commercial forest types

5.3.2 Connectivity

ESFM aims to ensure functional connectivity through implementation of:

- conservation protocols; and
- maintenance of ecosystem function.

Connectivity is maintained along the tablelands through the north-south corridor and through the Devils Hole and Stanton Rock area between the coastal forest and tablelands. The option establishes a number of reserves in areas of former leasehold land which are isolated from other reserves but are connected by extant vegetation on privately managed lands. These areas would become 'island ecosystems' if the surrounding land were cleared. There are also some national park areas proposed that are surrounded by State Forests. While connected to other Park areas by forested land, this land will not be continuous old growth forest and may not be effective for all species.

On the coast there are still some breaks in the continuity of forests and there may be a need to work towards establishing conservation agreements with private landowners in the north coastal area of the Eden RFA. In the southern part of the region adjacent to the Nadgee wilderness, a strengthened corridor into the hinterlands from the coast is included.

5.3.3 Management Measures for Conservation of Flora and Fauna

ESFM aims to assess the implementation of habitat conservation measures (Table 5.3).

TABLE 5.3
PROPOSED PROTECTIVE MEASURES FOR BIODIVERSITY CONSERVATION OFF-RESERVE

Protected measures (General Prescriptions from Conservation Protocols)	Characteristics of Measure	Species Addressed
Hollow-bearing tree retention	Minima of: 6 hollow-bearing trees per ha must be retained in good habitat across the landscape; 4 hollow-bearing trees per ha must be retained in moderate habitat across the landscape; 2 hollow-bearing trees per ha must be retained in low habitat across the landscape.	Glossy black Cockatoo, Yellow-tailed black Cockatoo, Powerful Owl, Masked Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied glider, Greater Glider, Squirrel Glider, Regent Honeyeater, Brush-tailed phascogale, hollow dependent bats

Recruitment tree retention	A habitat clump shall be retained to surround one in three retained hollow-bearing trees.	as above
Significant food resources	Protection of Allocasurina spp. At least 4 mature (40 cm dbh) winter-flowering Eucalypts per 2 ha, protection of mature banksia and Xanthorrhea spp., Retain all V-notch trees, Retain representative understory vegetation	Glossy black cockatoo, Yellow-bellied glider, Squirrel Glider, Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox, Brushtailed Phascogale
Wetlands	At least 10m buffer on areas between 0.1 and 0.5 ha, at least 40m buffer on areas greater than 0.5 ha or SEPP 14 wetlands	frogs, Black Bittern, herpetofauna, rare plants
Rocky Outcrops	At least 20m buffer around rocks and associated heathland between 0.2 and 0.5 ha, at least 40m buffer around heathlands > 0.5 ha	Passerines, herpetofauna, plants
Caves,tunnels and disused mineshafts	All protected by at least 50m buffer	Cave-dependent bats
Rainforest	Protect all rainforest. 20m buffer on warm temperate rainforest	Olive Whistler, rare plants, herpetofauna
Riparian buffer	Fauna stream buffers (i) 1st order streams, 10m (iii) 2nd order streams, 20m (iv) 3rd order, 40m	threatened frogs, habitat for forest-dependent fauna

Having achieved JANIS targets, residual protection of individual species should not be required. However, to promote good conservation management off-reserve, the following prescriptions are proposed:

- for the Koala, a 50 m exclusion zone would be established around individual animals encountered. In addition 150 ha of high quality habitat would be retained within a 2 km radius.
- for the owls, a landscape-level habitat management plan would be implemented. This would be designed to have no impact on total harvest, but would affect the timing and spatial pattern by requiring the retention of 25% of planning areas of about 10 000 ha each (across all tenures) in high quality foraging habitat. This habitat would be defined as regrowth, mature or old growth forest, greater than ten years of age with a weighting factor relating to time since logging and forest type.
- for the smoky mouse and southern brown bandicoot, intensified programs of feral animal control would be undertaken in areas where the limited number of sightings of these animals have occurred.
- there would be a need for intensified survey and habitat mapping for the Stuttering Barred Frog and the Giant Burrowing Frog. The conservation status of these species would be reviewed after five years.

5.3.4 Wood Supply

ESFM aims to ensure that the allowable timber cut is not exceeded until an ecologically sustainable yield is determined and that targets are set within range after examination of data compatible with an ecologically sustainable sawlog industry.

1 B3 timber harvesting and C2 thinning

This scenario generates 16 150 m^3 of sawlogs over a twenty three-year period and 236 000 tonnes of pulpwood. As a benchmark, this is achieved using existing practices. Timber harvesting is undertaken using B3 and C1 practices from mature and old growth forests on State Forests, and through C2 systematic thinning of regrowth forests.

It is expected that there will be limited additional impact of the Conservation Protocols on this scenario because JANIS targets are largely met and no further exclusions would be needed. Table 5.4 contains full details of the wood supply for this scenario.

TABLE 5.4
WOOD SUPPLY FOR B3/C2 SCENARIO

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	2440	13153	100694	5.4	41.3	572	4378
Coastal	High	3702	36591	162981	9.9	44.0	1591	7086
Hinterland	Low	6672	42463	529476	6.4	79.4	1846	23021
Hinterland	High	13447	116010	1255421	8.6	93.4	5044	54584
Tableland	Low	650	9242	78468	14.2	120.6	402	3412
Tableland	High	4157	86775	582706	20.9	140.2	3773	25335
TOTAL							**13228**	**117815**
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		13356	48478	1460057	3.6	109.3	2108	63481
Hinterland		9586	8597	756340	0.9	78.9	374	32884
Tableland		4520	9732	497374	2.2	110.0	423	21625
TOTAL							**2905**	**117990**
GRAND TOTAL							**16132**	**235805**

A2 timber harvesting with adjustment for Old Growth and C2 thinning

The second part of the scenario uses selection harvesting (A2) across the whole forest estate in association with Conservation Protocols. The wood volume provided by this is 12 825m^3 and 206 000 tonnes of pulpwood. The consequent impact on wood supply is very high. Table 5.5 contains full details of the wood supply for this scenario.

TABLE 5.5
WOOD SUPPLY FOR A2/C2 SCENARIO

Multiple-aged forest								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal	Low	2440	9865	75520	4.04	30.95	429	3283
Coastal	High	3702	27443	122236	7.41	33.02	1193	5315
Hinterland	Low	6672	31848	397107	4.77	59.52	1385	17266
Hinterland	High	13447	87008	941565	6.47	70.02	3783	40938
Tableland	Low	650	6931	58851	10.66	90.48	301	2559
Tableland	High	4157	65081	437030	15.66	105.14	2830	19001
TOTAL							9921	88361
Regrowth								
Location	Sawlog Product-ivity	Net Area	Total Volume		Average Volume/ha		Total Volume/yr	
			Sawlog	Pulpwood	Sawlog	Pulpwood	Sawlog	Pulpwood
Coastal		13356	48478	1460057	3.6	109.3	2108	63481
Hinterland		9586	8597	756340	0.9	78.9	374	32884
Tableland		4520	9732	497374	2.2	110.0	423	21625
TOTAL							2905	117990
GRAND TOTAL							12825	206351

5.3.5 Soil and Water

ESFM aims to:

- minimise road density
- minimise the density of drainage line crossings
- define the range for allowed percentage cut in regrowth areas per 5 years by catchment
- balance growth stages across landscape
- maintain dry weather water flows at a level expected from the catchment if it were undisturbed by logging and regeneration

- determine long term levels from ANZECC guidelines.

B3 timber harvesting and C2 regrowth thinning

The application of current integrated harvesting (B3) and regrowth thinning from below (C2) as a benchmark to existing tenure has the following impact on (i) the proportion of the surface area of the catchment which is harvested over the twenty three-year period in relation to harvest practice and (ii) extent of change in growth stage, for the Eden catchments.

1. Proportion of the catchment harvested by harvest practice (Indicator 4.1), as shown in Table 5.6.

The scenario indicates that only two catchments would be subject to cumulative harvesting that would exceed 5%. These are the Coastal Central at greater than 5% and the Wallagaragh at 19%. This reflects the fact that these two catchments are the areas of greatest concentration of residual State Forest. Overall, 4% of the Eden RFA area would be subject to timber harvesting in the 23 year period. It must be noted that these calculations reflect both forested and non-forested areas.

TABLE 5.6
PROPORTION OF CATCHMENT HARVESTED FROM 1997-2019 BY HARVEST SYSTEM

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha)						3188		2499	5687
		proportion						2%		1%	3%
Coastal Central	59807	area (ha)						5900		493	6393
		proportion						10%		1%	11%
Coastal North	88578	area (ha)						2249		159	2408
		proportion						3%		0%	3%
Coastal South	63857	area (ha)						2573		9898	12470
		proportion						4%		16%	20%
Genoa	52442	area (ha)						1679		1791	3470
		proportion						3%		3%	7%
Murrumbidgee	44889	area (ha)						0		0	0
		proportion						0%		0%	0%
Snowy	132888	area (ha)						1702		1573	3275
		proportion						1%		1%	2%
Towamba	102819	area (ha)						5106		2302	7408
		proportion						5%		2%	7%
Wallagaraugh	59045	area (ha)						11119		5938	17057
		proportion						19%		10%	29%
TOTAL	814251	area (ha)						33515		24654	58169
		proportion						4%		3%	7%

2. Extent of change in growth stage (Indicator 4.5), as shown in Table 5.7.

The largest impacts in terms of changes in growth stages are found in the Coastal South and Wallagaragh catchments (Table 8). In these two areas, approximately 10% of the Old Growth and between 77 and 94% of Old Growth Disturbed will be harvested. In addition it is estimated that the Coastal South catchment will sustain a reduction of about 18% in mature forest and the Wallagaragh about 39%. The major increase occurs in the mature disturbed category which increases by over 8 000 ha across all catchments. This category reflects the systematic thinning of regrowth forests. There is a significant decline in young forest as these types are thinned and evolve into mature disturbed types. The extent of recently logged

forest types increases consistently because of timber harvesting. This is somewhat of an artefact of the transition matrix, however, which does not allow these types to succeed to young forest. The use of selection logging regimes is unlikely to result in different outcomes from the above.

Overall, it is difficult to forecast the impact on water yield due to the shifts from young forest to mature and from Old Growth to immature. While, the significant increase in thinned regrowth in the Coastal South and Wallagaragh may increase water yield, this may be balanced by the expansion in the area of regrowth created by harvesting of mature and Old Growth forests which would reduce water yield.

TABLE 5.7
PERCENT VARIATION IN GROWTH STAGE GROSS AREA FROM 1997 TO 2019 BY CATCHMENT

Catchment name	percentage variation from 1997 to 2019 for gross area within catchments by growth stages							
	rainforest	old growth	old disturbed	mature	mature disturbed	young forest	recently logged	cleared
Bega	0%	4%	-85%	6%	164%	-67%	85%	0%
Coastal Central	0%	-1%	-75%	-16%	402%	-47%	154%	0%
Coastal North	0%	3%	-67%	9%	61%	-65%	59%	0%
Coastal South	0%	-10%	-93%	-18%	20627%	-91%	517%	0%
Genoa	0%	-2%	-81%	-6%	871%	-37%	-1%	0%
Murrumbidgee	0%	1%	-54%	0%	30%	-3%	-7%	0%
Snowy	0%	4%	-64%	6%	-22%	13%	-3%	0%
Towamba	0%	4%	-76%	-2%	123%	-44%	31%	0%
Unknown	0%	0%	0%	1%	0%	0%	6%	0%
Wallagaraugh	0%	-12%	-77%	-39%	1669%	-69%	143%	0%

A2 timber harvesting with adjustment for Old Growth and C2 thinning

This is shown in Table 5.8.

TABLE 5.8
PROPORTION OF CATCHMENT HARVESTED FROM 1997-2019 BY HARVEST SYSTEM

Catchment name	Catchment area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787			2931 1%						2499 1%	5687 3%
Coastal Central	59807			5366 9%						493 1%	5859 10%
Coastal North	88578			1996 2%						159 0%	2408 3%
Coastal South	63857			2216 3%						9898 16%	12470 20%

Genoa	52442			1340 3%						1791 3%	3470 7%
Murrumbidgee	44889			0 0%						0 0%	0 0%
Snowy	132888			1586 1%						1573 1%	3275 2%
Towamba	102819			4650 5%						2302 2%	7408 7%
Wallagaraugh	59045			10420 18%						5938 10%	17057 29%
TOTAL	814251			30504 4%						24654 3%	58169 7%

5.3.6 Socio-economic considerations

ESFM aims to:

- review royalty rates by product type against fair market rates in other comparable jurisdictions
- ensure harvest does not exceed ecologically sustainable wood supply commitments by product type over 5 year period of RFA, within 5%.
- ensure harvest, by product type, does not vary by more than 25% of ecologically sustainable wood supply commitments in any given year
- ensure that the volume outcome is driven by option choice
- ensure minimum levels of preferred species.

B3 timber harvesting and C2 thinning

ROYALTY

Sawlogs: 16132 m^3@$38.52=$62 1405

Pulp (multiaged): 117815 t@$20.05= $2362191

Pulp (regrowth): 117990 t@$10.03= $1183440

TOTAL $4 167 036

There will be significant impact on the total royalty rates paid, the size of the forest industry and the labour force employed in the forest sector. The rapidity of this transition will make development of alternative employment and business opportunities difficult. In the longer term it may be possible to mitigate some of the employment and income losses by establishing conservation-oriented businesses in tourism, recreation, and cultural heritage experiences. This would still be likely to require government support in terms of infrastructure, worker retraining and marketing and promotion.

A2 timber harvesting and C2 thinning

ROYALTY

Sawlogs: 12825 m^3@$38.52 =

$49 4019

Pulp (multiaged): 88361 t@$20.05= $1771638

Pulp (regrowth): 117990 t@$10.03= $1183440

TOTAL $3 449 097

This combination of timber harvesting practices and CAR reserve design has the most significant socio-economic impact of all the scenarios on royalty rates, size of the forest industry and labour force employed in the forests sector.

5.3.7 Cultural and Heritage Considerations

ESFM aims to:

- monitor and review condition of sites
  - identify mitigating actions if necessary; and
  - assess efficacy of protective measures
- ensure that protective mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous cultural values or other identified values
- ensure indigenous groups are employed to undertake monitoring.

Table 5.9 contains places (non-indigenous and National Estate) requiring special management. In addition to those listed in the table, other areas having indigenous cultural heritage values will

need to be appropriately protected. Notable amongst these is Biamanga, an area currently in National Park and so not subject. from which logging should be excluded.

TABLE 5.9
CULTURAL HERITAGE PLACES REQUIRING SPECIAL MANAGEMENT

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management Implications for SFNSW	Resource Implications
Old Growth Forest Patches - Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Siviculture	PMP 1.2	Nil logging, Nil silviculture Nil fire	Nil currently excluded from logging
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Siviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Forest management by prescription - light intensity logging, nil fire.	Nil additional impact on resource - area already identified and managed as PMP 1.1.8 Forest management by prescription and has conservation plan
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Clasification as PMP 1.1.6 & 1.1.2 Maintenance of viewing lines	Moderate impact on surrounding eucalypt forest
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - conservation of representative area of forest around site sought, needs to be clearly delineated, included in PMP and managed by prescription
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Substantial - some areas within area delineated currently PMP 1.1.8 Forest management by prescription, 1.2 excluded from harvesting, 1.3 excluded from harvesting, and 1.1.7 excluded from harvesting
Whipstick mines and village site	Historic	Gnupa SF	SFNSW	Fire Mining Logging Siviculture	Heritage Act 1977	Classification of signifiacnt areas as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Moderate - needs to be clearly delineated, included in PMP and managed by prescription
Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Streamside reserve	Classification as PMP 1.1.2	Nil, currently protected by streamside buffer and excluded from harvesting.
Murrah State Forest (koala habitat)	Social Aesthetic	Indicative only Murrah SF	SFNSW	Fire Logging Silviculture	unknown		

Myrtle Mountain Lookout	Social Aesthetic	Tantawangalo SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2	Nil logging, Nil silviculture Nil fire Maintain access	Nil, currently PMP 1.1.2 and excluded from harvesting.
Wallaga Lake	Social Aesthetic	Bermagui SF	SFNSW, Crown land & NPWS	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Moderate impact on resource due to extensions of PMP 1.1.6 boundary outside current delineated area than currently exist
Davidson's Whaling Station	Social Historic Aesthetic	East Boyd SF / Ben Boyd NP	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 AHC Act 1975 NPW Act 19 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire	Nil - no change to current management
Cow bail trail / Chimneys trail / cuttings	Historic Aesthetic	Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	Heritage Act 1977 NPW Act 19 PMP 1.1.6	Classifiaction of entire area as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire	Moderate - 5m buffer for pine areas within State Forest, 20m buffer for native forest areas within State Forest - requires identification as PMP 1.1.6 harvesting by prescription
Edrom Lodge	Historic Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977 PMP 1.1.3	Additional classification as PMP 1.1.8 and PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintain historic values Maintain viewing lines	Nil, currently PMP 1.1.3 education harvesting by prescription.
Burrawang Picnic Ground	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.2 PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest management by prescription - light intensity logging, nil fire Maintain viewing lines	Nil -. no change to current management
Ludwigs Creek	Aesthetic	Nadgee SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting
Maxwells forest walk	Aesthetic	Maxwells Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current forest preserve and excluded from harvesting
Newtons Crossing camping area	Aesthetic	Wallagaraugh Reserve, Timbillica SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7	Additional classification as 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - contained within current PMP 1.1.7 boundary and excluded from harvesting

Scrubby Creek picnic area	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6 PMP 1.1.2	Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Nethercote Falls	Aesthetic	Nethercote Flora Reserve	SFNSW	Fire Logging Silviculture	PMP 1.3 AHC Act 1975	Additional classification as PMP 1.1.6 Maintenance of value Maintenance of viewing lines	Nil - current flora reserve, excluded from harvesting
Nalbaugh Falls	Aesthetic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	PMP 1.1.7 PMP 1.1.2	Additional classification as PMP 1.1.6 Forest management by prescription - light intensity logging, nil fire Maintenance of viewing lines	Nil - no change to current management
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Forest Management by prescription - light intensity logging, nil fire Maintenance of value Maintenance of viewing lines	Moderate - extent of buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Siviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - light intensity logging, nil fire	Mostly private & crown land issue, if determined to be partly on State Forest may require PMP
Prison Farm, Bondi SF	Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Maintenance of value	Nil - on cleared land within pine plantation
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Razor-back Fire Trail	Potential Historic	Murrabrine SF	SFNSW & NPWS	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry	Nil - no change to current management practices
Sleeper cutter camps, Murrah SF	Potential Historic	Murrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Negligible - needs to be clearly delineated included in PMP and managed by prescription
Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Siviculture	PMP 1.1.6	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial if entire boundary as delineated applied - some of the area is currently PMP 1.1.6 harvesting by prescription
Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire	Potentially substantial on pine resource) if buffer suggested is considered, site currently has 50 -100m buffer.

Tantawangalo Road and Lookout	Aesthetic Potential Historic	Glen Bog SF	SFNSW & NPWS	Fire Logging Silviculture	PMP 1.1.6	Additional classification as PMP 1.1.8 Forest management by prescription - - light intensity logging, nil fire Maintenance of viewing lines	Nil - moderate if it is proposed that current management prescriptions be changed - within current PMP 1.1.6 boundary harvesting by prescription

- The information in Table 11 should be considered indicative only - detailed assessments and documentation of places are yet to be finalised
- Current condition of places identified has not been able to be stated as detailed information on places has yet to be received.

All places identified as having historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

Conservation and management of cultural heritage values will be via existing national parks procedures, State Forest PMP classification and specific protocols for newly identified sites. The assessment proposes that cultural heritage, in terms of the aboriginal community, would become a co-management responsibility. This would take the following into account:

a recognition of cultural heritage and traditional use values by State Forests and the NSW NPWS

an agreement on access to those values and traditional uses by the Aboriginal communities

recognition in management planning of these values, the protective measures or access required, and the mechanism to ensure Aboriginal participation in the management of those values

an annual co-management board between the Aboriginal communities and the land management agencies to examine the management proposed for cultural heritage values, and to examine opportunities for expanded participation by the Aboriginal community in the economic activities in the conservation and production forest area.

5.4 CONCLUSION

This scenario attempts to maximise JANIS targets in dedicated reserves. There is a resultant significant impact on wood supply to industry to a point where viability is questioned. In general the scenario places many of the JANIS targets into conservation reserves, strengthens the level of biodiversity conservation in National Parks and improves connectivity in the protected area system. There would need to be a limited number of protocols to further protect JANIS values in the production forest. The impact of these on wood supply is expected to be limited because JANIS targets are largely met.

6. COMPUTER APPLICATIONS OF MANAGEMENT SCENARIOS

6.1 INTRODUCTION

The NSW ESFM Technical Committee sought advice on how ecologically sustainable forest management (ESFM) issues could be considered in the integration phase of the Eden CRA. They requested that modelling tools be investigated such that ESFM issues, in general and management scenarios for achieving ESFM, could be considered during this phase.

The Commonwealth/NSW Scoping Agreement identifies as an objective:

> *The Commonwealth and New South Wales Governments believe that the long-term ecologically sustainable management of forests and the development of competitive and efficient forest industries are compatible objectives and therefore they are committed to providing a basis for these objectives in the regions covered by this Agreement, thereby ensuring: the protection of conservation values; the basis for an internationally competitive forest products industry; and the effective use of other economic and social resources of the regions.*

In addition to this statement, ESFM objectives for Eden are to:

- optimise targets for sustainability indicators in Eden over time across the full suite of tenures, in relation to thresholds and conditions that can be linked to any reserve design options
- consider the appropriate balance between conservation and economic and social goals in the realisation of ESFM in Eden
- consider across tenures in a temporal context, the various management requirements to meet ESFM needs associated with the tenure class and tenure management intentions for Eden.

The Scoping Agreement identifies what needs to be undertaken as part of an assessment of ESFM. The scoping agreement describes these as including:

> *The Commonwealth and New South Wales Governments agree that ecologically sustainable forest management will require a variety of mechanisms, including: the implementation of a comprehensive, adequate and representative (CAR) reserve system, complementary off-reserve management, appropriate codes of forest practice and management plans. Both Governments recognise that an important and integral part of this process is the consideration of economic and social factors in determining and implementing such mechanisms. The Governments agree to prepare the necessary documents including performance indicators as an integral part of the RFAs.*

It is quite clear that the purpose of a Regional Forest Agreement (RFA) is to achieve an appropriate balance between conservation and economic/social objectives taking into account guidelines, objectives and principles of the ecologically sustainable management of forests

within the region. Further it is recognised that ESFM will be implemented through a CAR reserve system (formal, informal, presciption and private forest components), forest management plans (reserve and non reserve), and forest management strategies, practices and prescriptions. Indicators will be monitored through the period of the RFA to provide information on the delivery of ecologically sustainable management of forests.

The ESFM Technical Framework sets out three project areas which interlink throughout the integration process. Project Area (PA) 5 is identified in the ESFM technical framework as the development of management scenarios/options/-overall targets for each RFA. This project area builds on information gathered from projects on indicators (PA3), practices (PA4) and assessments undertaken by other technical committees. The development of management scenarios has an iterative linkage with the option development phases of integration and finalisation of the RFA. Modelling tools were considered and developed based on these objectives for ESFM.

To realise ESFM it is important to understand the required management intention of the land base in the context of preserving, conserving and managing the suite of values found in the regional forest estate. This context has to be understood in terms of the spatial and temporal configuration of values and the appropriate balance of these values. Four principles were used as a basis of this understanding:

- managing for all values
- maintaining a longterm view so as not to compromise the ability of future generations to meet their own needs
- decisions are made openly, transparently and with accountability
- an adaptive approach to management.

One of the most challenging aspects of the Regional Forest Agreement will be to integrate the land use allocation process with the ongoing expectation for forest management, whether on protected areas, State Forests or private land. The ESFM committee established a set of projects that would clarify the purpose of forest management in simple, yet concrete terms. The projects provided a framework of 'sustainability indicators' that should reflect the key values that we recognize as being important in forest management planning. They also identified how different forestry practices impact on these indicators. Knowing how practices impact on indicators, we can assess how programs of forest management over time may contribute to meeting particular target levels, thresholds or ranges of condition against each indicator.

The Eden integration process examined reserve design within the framework of JANIS criteria. The process, using C-Plan and linking outputs to socio-economic indicators lead to options being generated for potential reserve strategies. ESFM considered the management problem from the direction of sustainability indicators, where, in principle, all tenures contribute to meeting targets over time for ESFM. Therefore at the coarsest level, land tenures will carry different responsibilities over time to meet ESFM targets, but in total they should meet all targets, thresholds or conditions.

In assessing scenarios of management, there was consideration given to how much weight different tenure forms will be asked to carry in contributing to different targets. The ESFM-CAR interactions were central to developing a complete scenario.

During the integration process, the ESFM Group (also called ESFM Technical Committee) examined potential targets, thresholds and conditions that were linked to any reserve design option. The primary approach to considering management scenarios was the use of whole forest planning models. Given the complexity of these models and the need to weave them together with the various data layers, models and outputs from the other assessment streams, there was a degree of risk that a functional system may not be developed in time for beginning negotiations of options during the integration process. A contingency approach was also developed. The contingency approach applied to the negotiation phase and did not foreclose use of modelling tools in the latter stages of integration leading to finalising an option for the RFA.

Even though the modelling tools were operational the contingency approach was used based on an assessment of what ESFM indicators, practices and targets were linked to the reserve design option. This assessment used FRAMES and the rules derived from the forest practices project linked to agreed indicators. The reason for using the contingency approach rather than the modelling tools was that the Technical Committee could not agree on the decision rules to be applied in the modelling tool leading into negotiations. This report describes work towards developing systems to model management scenarios.

6.2 THE MODELLING TOOL APPROACH

NSW CRA process involves the application of four main streams of assessment of forest values: environment and heritage, economic and social, wood resources and ecologically sustainable forest management.

Currently, there is no single mechanism or modelling approach which can bring together these assessments to understand how a particular option provides for ESFM. A comprehensive approach was required if all values are to be considered when developing options or scenarios with regard to ESFM targets. Such an approach also had to consider the tools being used to determine conservation priorities, woodflow and economic impacts.

- A reserve selection method (implemented in the package C-Plan) identified conservation priorities in a planned reserve system. Principles that are incorporated in this tool include the reserve concepts of reserve design, irreplaceability, complementarity and reserve goals. C-Plan identifies forest areas based on their irreplaceability value and can allocate them to the formal reserve estate or land that needs to be subjected to prescriptions, so as to contribute to JANIS criteria.
- An Eden forest scheduling tool was used to model yield scheduling, wood resource flow (quantity, quality, species, product) and wood yield. Management considerations and constraints are captured through netting factors (eg. proportional reduction in estate area).
- The combination of FORUM and a specific regional input/output table for non-wood industries provides direct economic values of land units and measures of the economic impacts of implementing identified options.

6.2.1 Design Specifications Forest Planning, Management and ESFM Sustainability Tools

It was believed that a land use and management planning approach should be adopted in which a number of forest or non forest land units across a region will be represented as consisting of a range of ESFM values present. On the basis of these values, a number of land use or management options would be identified and allocated to the land units to generate different scenarios.

Development of management options and scenarios in terms of ESFM will have as a goal the management of forests so that they are sustained in perpetuity for the benefit of society by ensuring that the values of the forests are not lost or degraded for current and future generations. Emphasis will be on the management of the forest resource in such a way as to realise these goals. Such a goal may differ from that which: optimises the CAR in reservation forests and; optimises the economic sustainability of forest related industries.

Functions that provide both spatial and temporal simulation and that are capable of explaining how ecologically sustainable resource use can be achieved were identified as being required. Elements could include modelling of resources (grazing, apiary, water, tourism/recreation and other non-wood resources), and environmental impact and off reserve management considerations.

Other functions needed to support consideration of ESFM options included:

- statistical and modelling tools, including risk assessment
- land capability assessment
- catchment modelling
- implications for national estate values.

It was important that the forest planning and management tools apply land allocation guidelines consisting of constraints and priorities for land use or management. Management options could then be traded-off in an efficient and repeatable manner aimed at achieving a balanced land use and management allocation (management plan) for a region.

A further specification of the modelling tools was the consideration of the use of the technology for the period of the RFA and transportability to other NSW RFAs. The specification of the functionality of the tools was:

a) facilitate the bringing together of information (multilayered and multiattributed);

b) demonstrate the meeting of target goals set for management;

c) provide simulation capacity to represent trend analyses in identified indicators;

d) determine sustainability targets;

e) provide information on management strategies and associated constraints.

Specific objectives were to develop an information system which:

- integrates complex information from a range of inputs;
- provides consistent, transparent and credible analyses;
- operates in spatial and temporal frames;
- allows for flexibility and variability to help determine sensitivities and constraints;
- is capable of simulating spatial, environmental resource, economic and social implications of different resource use and management options;
- includes a user friendly interface for interactive examination and experimentation with a range of scenarios;
- has the ability to report outputs at a range of levels in the information heirachy.

6.2.2 System architecture

A number of modelling tools were considered. It was noted that SPECTRUM was also under consideration by FRAMES. Given the time constraints of the Eden CRA, a prototype system of SPECTRUM and Whatif?/LUPIS was considered as the only feasible way of running ESFM management options and scenarios. It was planned that the prototype system would be incrementally developed throughout the options development phases as new requirements were identified.

Two computer modelling tools, Whatif?/LUPIS and SPECTRUM, were developed to help explore management scenarios and consideration of ESFM. Whatif?/LUPIS through specification of guidelines (commitment, exclusion and preference), enables management intentions to be spatially presented and balanced. SPECTRUM provides the capacity to model silvicultural regimes and prescriptions and their consequent temporal effects on a range of values that can be linked to indicators. The confidence levels for these software tools are dependent upon the models, assumptions and underlying data used to model management scenarios.

6.3 WHATIF?/LUPIS

Whatif?/LUPIS decision support framework was developed using Whatif?, an object-oriented decision support system and scenario analysis package. Whatif? provides a structured set of tools that enable users to interact, express their ideas and apply information to help resolve economical and ecological resource-related issues. Whatif? provides a modelling framework and reporting tool to facilitate the development of scenario modelling tools. The WhatIf? decision support tools developed by ROBBERT Associates, Ottawa, follow the design approach outlined by Gault *et al.* (1987). Whatif? tools have three main components: TOOL (Tool On Object Language), an interactive coding language for manipulating data objects; SAMM (Scenario And Model Manager), which provides the interface linking sets of models; and Documenter, a text and graphics system for preparing structural and relationship diagrams and for preparing framework documentation.

LUPIS is a landuse planning algorithm which has been incorporated into the Whatif? framework. User friendly interfaces such as linking spatial outputs to Arcview, still need to be developed.

6.3.1 LUPIS algorithm

LUPIS (Land Use Planning and Information System) is a spatial decision support system developed by the CSIRO Division of Wildlife and Ecology for assisting with the identification of a preferred management or land use plan for a nominated area conditional upon inputs and values expressed by the user. LUPIS is designed to assist in the implementation of a broad-based comprehensive approach to land resource allocation, that is, the capability of incorporating many aspects for consideration for every land use included in the exercise. It is comprehensive in that it has the capability of simultaneously considering numerous competing land uses in an allocation study.

The LUPIS algorithm is a surrogate for linear programming. It provides an optimised solution for allocating landuse and management regimes occurs dependent upon the constraints (guidelines and associated weightings) applied. The model can assist with the identification of a preferred management or landuse for particular areas based upon user defined inputs and values.

The general single party planning methodology in which LUPIS can be used is described by Cocks et al. (1983) and applied in documented series of studies including Cocks and Ive (1988). More recently this methodology has been extended to accommodate multi-party planning as reported in Cocks et al. (1995) and Cocks and Ive (1996).

The approach adopts an issue-oriented response to the need for a planning exercise. In the absence of any issues it is arguably unwarranted to undertake

a land use planning study. The issues promoting the need for a study must have land use implications, that is, different land use allocations and patterns must offer alternative responses to the issues.

Allocation guidelines (or simply guidelines, Cocks et al. (1986)) are developed as an active response to the issues and seek to extol best current land use practice response to the issues. When developing guidelines the sentiments of an issue may apply to more than one land use in which case it is preferable to duplicate the guideline so that each copy applies to one and only one land use. Collectively the guidelines define the land allocation options that are feasible and subject to the importance attached to guidelines determine the preferred land use allocation.

Guidelines are classified into three types: commitment, exclusion and preference.

Commitment guidelines ensure that particular areas are committed to a specific landuse or management regime. An example would be to commit areas identified for dedicated reserves by C-Plan to “dedicated reserve” areas.

Exclusion guidelines exclude inappropriate landuse or management regimes. An example would be: “exclude logging from erosion hazard areas”.

Preference guidelines allocate particular parcels of land to the intended landuse or management regime ‘as far as possible’. An example would be to allocate a particular silvicultural regime to a set of defined circumstances.

The user (ESFM Working Group) can identify the range of issues applying to the landbase in the study area. Issues would include those raised at the Regional Forest Forum and through the ESFM indicator project (Project Area 3) and practices project (Project Area 4). The user would develop guidelines to allocate particular landuses or management regimes to reflect the issues at hand. As a general rule, one guideline would apply to only one landuse or management regime. Where an issue applies to a number of landuses, the guideline would be replicated. The model is capable of weighting (through votes) particular guidelines based on user defined needs. This facilitates a type of sensitivity analysis for individual guidelines (only applies to preference guidelines).

Although in principle a guideline can be relevant to more than one land use it is preferable, particularly in the case of preference guidelines, to have each guideline address a single specific land use. Single land use guidelines have the advantage of allowing greater opportunity for finely adjusting an allocation and, if rigidly adhered to, can provide substantial savings in file size requirements. Namely, if each guideline relates only to one land use then the file storage requirements for each mapping unit is equivalent to a vector, the number of elements equivalent to the number of preference guidelines. Alternatively if provision is made for a guideline to relate to more than one land use then provision has to be made for dimensioning an array with sufficient elements providing for the product of guidelines by land uses for each mapping unit.

6.3.2 Development of Whatif?/LUPIS

Whatif?/LUPIS was developed to facilitate consideration of the two central mechanisms of ecologically sustainable forest management - that is, (i) land allocation and management decisions and (ii) guidance for future management, particularly in off-reserve situations. Whatif?/LUPIS can optimise the allocation of management regimes and prescriptions within predefined constraints or ESFM goals. C-plan allocates forest required for formal reserves, and Whatif?/LUPIS could then allocate the remaining forest to meet ESFM needs. Whatif?/LUPIS requires guidelines to be specified. Each guideline requires at least one suitability rating, or index, for all decision units for each land use or management option being evaluated. Alternative plans or scenarios may be generated depending on the priorities applied (i.e. by weighting guidelines), such as conservation interests vs production interests.

There are no prerequisite data requirements that can be stipulated. All data requirements flow from the guidelines; the only data required is that needed to implement the guidelines. Therefore, once the guidelines are developed the data requirements can be deduced. For the purpose of Eden integration, compartments and coupes were used as the planning unit. These units were common beween the various tools used in integration

To operationalise the guidelines, rules are required which use the data collected in response to the guidelines to generate ratings. These ratings reflect the attractiveness of each mapping unit from the perspective of each guideline. Ratings are therefore indexed to the guideline, the land use and the mapping unit to which they relate for commitment, exclusion and preference guidelines.

In the case of commitment and exclusion guidelines the ratings for each guideline must take

a value of either 0 or 1, and no value in between. A rating of 0 indicates that the land use is no longer a candidate, while a rating of 1 indicates the land use may still be a candidate on a particular mapping unit.

In the case of a preference guideline however, a rule operates on relevant data to develop a *guideline satisfaction rating* (hereafter rating) for each mapping unit to generate a rating with a value equal to or between 0 and 1 such that the higher the value the more attractive the mapping unit is from the perspective of the guideline's intention.

Whatif?/LUPIS was designed to provide SPECTRUM with allocated areas, defined management regimes/prescriptions and information on constraining variables. Whatif?/LUPIS could also provide information on how an option meets ESFM goals and other indicators.

6.3.3 Eden Whatif?/LUPIS model

The land use algorithm used in Whatif?/LUPIS for Eden deals with assigning land uses. Landuses considered are given in Table 1.

The ESFM Group was unable to seek agreement on the guidelines to be used in the model. As a result the Group was not prepared to use Whatif?/LUPIS for developing management scenarios during the negotiation process of option development. A similar decision was made concerning SPECTRUM described below.

6.4 SPECTRUM

The management of native forests is becoming increasingly difficult with the need to trade-off multiple-uses of forests sustainably. A trade-off is a process of balancing conflicting objectives and arises from having more than one objective which cannot be simultaneously achieved. Therefore, a trade-off implies an opportunity cost in terms of benefits that are forgone. Computer models are used to aid trade-offs in multiple-use forest management. Some examples of multiple-use are recreation, water production, timber harvesting and wildlife management. Management, in the context of trading-off, is about control or directing influence of a system to achieve a desired outcome.

It is a complicated exercise to monitor and account for the behaviour of forests especially when the forests are being utilised for different uses. The exercise is exacerbated by attempting to predict a control sequence (a set of control actions over time) that would achieve the desired forest state or structure (i.e. size, age and density of the forest) that ensures the perpetuity of a sustainable forest utilisation. Simple models can be represented by simple mathematical functions.

By explicitly formulating the input (variable that can be measured and directly influenced by the observer) and output (variable that can be measured and indirectly influenced by the observer) of the mathematical function, a simple optimisation model can be formulated. To determine the control sequence (set of inputs) for a desired behaviour (set of outputs), this formulation is solved by using an appropriate optimisation technique. The optimisation formulation would consist of an objective function to optimise (maximise or minimise) that directly relates to the output and system constraints i.e. the mathematical

Figure 1
LUPIS Flow diagram (After Ive 1996).

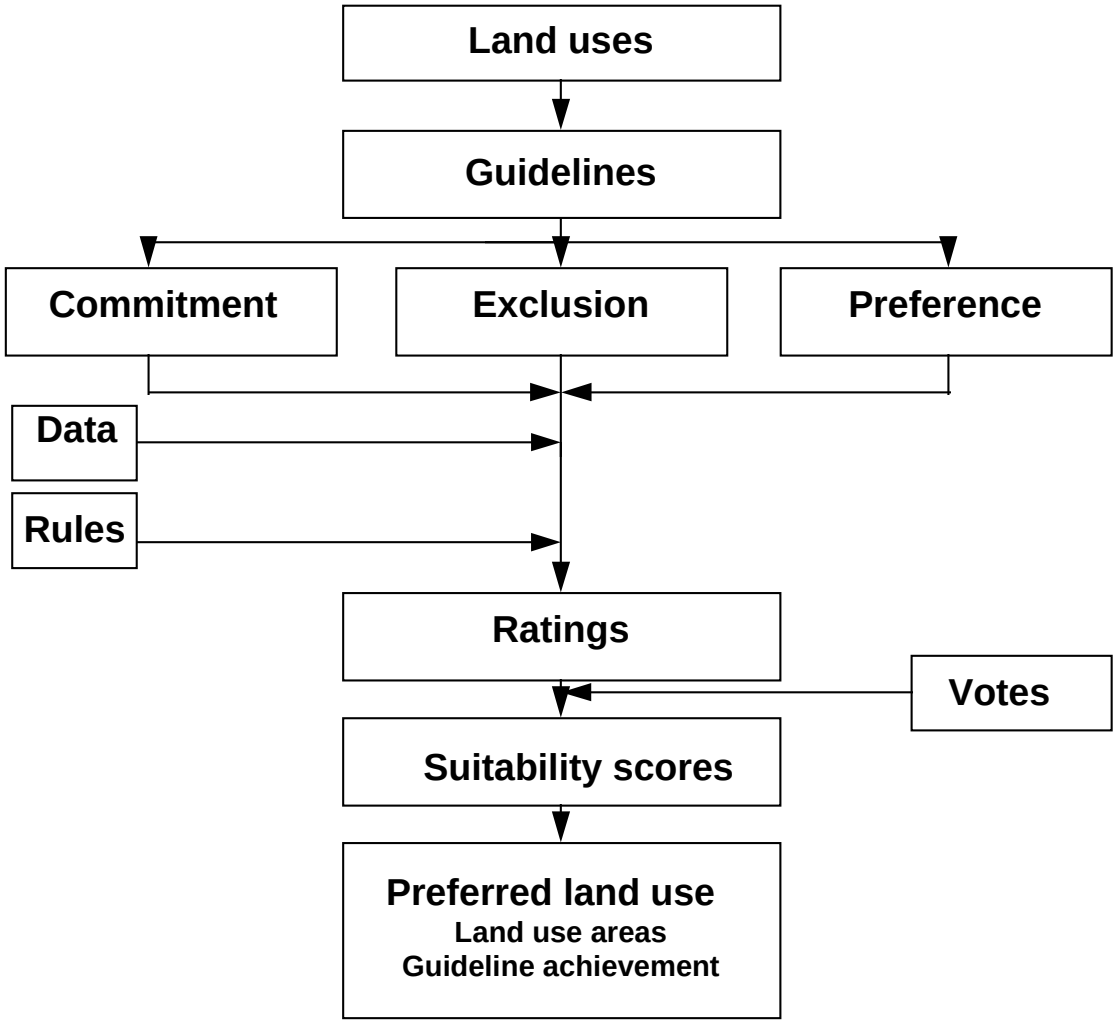


TABLE A2.1
LIKELY EDEN LAND TENURE AND MANAGEMENT INTENTIONS

Code	Class	Description	Activity
		JANIS FORMAL	
Cur Res [1]	Current conservation reserves (IUCN 1-4)	Current reserves that fit the formal category of CAR and count towards JANIS criteria	Conservation, no harvesting, mining, grazing or apiary (industry) access, low level recreation
SPZ [2]	New conservation reserves (IUCN 1-4) - includes State's Special Protection Zone	Full compartments listed by C-Plan required for JANIS criteria	Conservation, no industry access, low level recreation
		JANIS INFORMAL	
Inf Res [3]	Reserves - with non-timber industry access (IUCN 6)	Full compartments or current reserves listed by C-Plan as being required for JANIS as well as non-timber industries and fit the informal category of CAR	Conservation, mining or apiary access, no harvesting, low to medium level recreation
SMZ [4]	Special Management Zone (conservation/heritage)	Sub coupes listed by C-Plan required for JANIS	Conservation, no harvesting, low to medium level recreation
SFI [5]	Special Forest Industry - i.e. Non-logged Industry Forest (conservation/heritage/non-	Sub coupes listed by C-Plan required for JANIS and industry	Conservation, mining or apiary access, no harvesting; low to medium level recreation

	timber industries)		
JANIS PRESCRIPTION			
SPF 1 [6]*	Special Prescription Forest (conservation/heritage)	Partial logging allowed in areas requiring specific conservation prescriptions to meet JANIS or for managing National Estate values	Light, medium or group selection harvesting regimes, specific fire regime **(How do the protocols interface with this classification?)**
PRESCRIPTION FOREST			
PR [7]*	Prescription Reserves (buffer strips, hazard categories, etc.)	Public forest not loggable for particular management reasons (may contribute to JANIS)	Conservation, mining or apiary access, no harvesting low to medium level recreation
FIRE [8]*	Fire Protection Forest	Forest requiring fire prescriptions for strategic protection reasons	Forests regularly prescribed burnt for protection reasons and available to various logging regimes
MIF [9]*	Mixed Industry Forest (other industry uses - includes leasehold land)	Forest subject to grazing, mining, apiary, recreation and timber.	Forests used for timber, apiary, mining, grazing and recreation. Specific conservation values may be managed for.
LMS [10]*	Light-medium Selection	Public forests subject to harvesting in the context of ESFM	Subject to moderate logging and fire management regimes
ILF [11]*	Integrated Logging General Forest Management (heavy, integrated logging regime)	Public forests subject to harvesting in the context of ESFM	Subject to heavy selection and clearfell (with retention) logging and fire management regimes
IMF [12]*	Intensive Managed Forest	Public forests subject to regimes promoting timber products	Subject to intensive silvicultural regimes including clearfelling, short rotation and regrowth thinning.
PRIVATE LANDS			
GPF [13]	General Private Forests	Private forests available for grazing and harvesting and subject to ESFM	Subject to various logging, clearing and grazing regimes
OTHER			
Plant 1 [14]	Plantation Forestry	Existing public and private plantations	Public and private plantation forestry
Plant 2 [15]	Plantation Potential	Cleared lands suitable for plantations	Plantation forestry
Sci For [16]	Research Forests	Public or private forest which have had or will have significant forest-related research or monitoring studies	Long-term research in conjunction with conservation and/or industry use
Non For [17]	Non forest/urban	Cleared agriculture and urban	Non-forestry landuse

* = State's General Management Zone

function; upper and lower bounds of the control sequence; and time-interval, initial and terminal times for the optimisation problem.

Some examples of optimisation techniques are: heuristic methods; classical differential calculus; Langrange multiplier; calculus of variation; linear programming (LP); interactive multiple goal linear programming; dynamic programming; maximum

principle; genetic algorithms; and simulated annealing. Choosing the appropriate technique to use will not be discussed in this report, as each technique has it's advantages and disadvantages. It is, however, well recognised that the system equations are fundamental to achieving reliable results for any optimisation formulation.

The optimisation formulation *per se* only constitutes 10-20% of the total effort spent in the analysis of any system (Phillips and Harbor 1991). Optimisation techniques only provide a convenient mathematical environment for determining the 'best' outcome within given constraints. Therefore, despite the deterministic nature of most optimisation techniques, accurate system equations in an optimisation formulation can go a long way in providing reliable information on which to base a decision.

6.4.1 SPECTRUM model

SPECTRUM is a matrix-generator for LP that is specifically designed to schedule the management of a forest land over time. SPECTRUM has a pull-down menu front-end that runs native on the DOS platform. It consists of a data entry system, model manager, matrix generator and report software (SPECTRUM Manual 1997). SPECTRUM accepts tabular information of the size of each management unit (in hectares), potential silvicultural and management prescriptions for each management unit, revenue and costs associated with each prescription and constraints on the management units (e.g. harvest levels must be non-declining over time). The matrix-generator interprets the model data and creates rows and columns for the LP software that attempts to maximise an objective function such as water production subject to given constraints (Carroll, Landrum and Pious 1995). The current SPECTRUM matrix can be solved using a LP solver called C-WHIZ. Developments are under way to allow the use of other LP solvers such as LINDO.

The main features of SPECTRUM are as follows (SPECTRUM Manual 1997):

- relational database entry system;
- mathematical programming capabilities including linear, goal and mixed integer formulations;
- flexible objective function specification including MAX/MIN and MIN/MAX;
- ability to handle multiple mathematical programming options to model/simulate management scenarios across landscapes;
- vegetation mortality and decision tree modelling features; and
- capability to include linear and nonlinear functions for time-series ecosystem variables that depend on the vegetation parameters.

The output from SPECTRUM is an allocation of the prescriptions that may be applied to the management units in each time period to achieve the desired objective. Problems incorporating maximum logging patch size and adjacency constraints that constraint timber harvesting based on whether adjacent stands have been recently harvested may be implementable if the problem is formulated as a mixed integer or integer programing problem. A beta version of a visualisation tool called SPECTRAVISION, which is a modified version of ArcView3, may be used to verify a mixed-integer or integer programing solution. The tool gives the ability to visualise optimisation results that are area-based and thus enable adjacency constraints to be monitored.

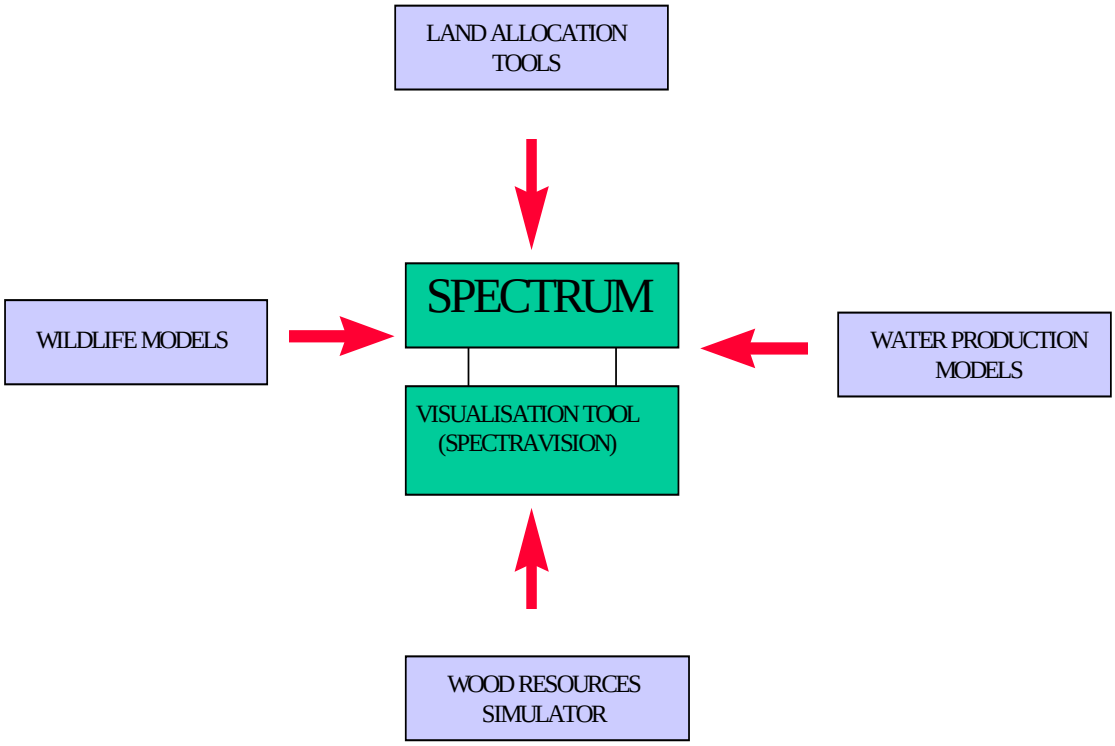
SPECTRUM is a recent development of FORPLAN that was originally developed by Dr. K.N. Johnson and USDA Forest Service (Fort Collins Computer Center) in an effort to address trade-offs between timber production and other land uses. FORPLAN version 1 was released in 1980, followed by version 2 in 1983. Further developments were done on different platforms building on the capabilities of the previous versions. SPECTRUM has a comparatively better user-interface with benefits for addressing ecosystem management in strategic planning. Since it is a new product published material pointing out its strengths and weaknesses is limited. A review of the weaknesses of the previous FORPLAN (Turner *et al.* 1994) which are addressed in the current SPECTRUM, give some idea of the improvements made to date.

Burgman (1993) reported on the use of FORPLAN in Victoria, and concluded that the flaws in FORPLAN applications '… resulted from the way in which FORPLAN was used rather than the models themselves'. Barber and Rodman (1990) attributed the shortcomings in FORPLAN usage to institutional bias, lack of analytical rigour, personal advocacy and unrealistic expectations. Turner et al. (1994) indicated the need for specialised simulation packages for wood resources, water, wildlife etc., to complement FORPLAN such that high precision can be achieved by incorporating

nonlinear behaviours from these simulation packages.

From these conclusions the success of SPECTRUM lies in the data that is fed into it. Because the SPECTRUM shell and manual is readily available including service support from USDA Forest Service (Fort Collins), concentration should be on refining the simulation packages for the forest resource, that provide the necessary input data to process in SPECTRUM. A flow diagram below summarises some of the simulation tools that may be used to provide information used in SPECTRUM:

Figure 2
SPECTRUM flow diagram.



6.5 DISCUSSION

A working version of Whatif?/LUPIS was successfully developed on a Unix platform. A number of scenarios were run based on the existing tenure arrangements. Areas required for intensive management and conservation through prescription were identified. The tool was found to be robust and provided important insights into the management scenario problem. An improvement would be a better interface with ARCVIEW or ARCINFO. This tool could be better suited to the modelling of practices and management regimes across the landscape.

A windows-driven IBM version of SPECTRUM was developed successfully for Eden. Information was visualised through ARCVIEW and response model data (eg. wood yield, economic models and water production) successfully incorporated.

It is recognised that the allocation of forest land into the CAR reserve system should primarily be determined through C-Plan. This tool could be used to flag forests required for prescription components. Equally, Whatif?/LUPIS could help C-Plan identify candidate areas for prescription management. Based on this information, a combination of Whatif?/LUPIS and SPECTRUM then can indicate appropriate management intentions for the remaining forest estate including the prescription component of CAR. Further Whatif?/LUPIS will inform the neighbourhood structure required for adjacency considerations in the SPECTRUM model. SPECTRUM would provide scheduling on projected yield or indicators (economic indicators, and wood and water yield) for the planning horizons chosen.

Within the forest estate there are two main categories of management intent. The first category includes those areas where timber

harvesting will be excluded while the second allows for timber harvesting. SPECTRUM and Whatif?/LUPIS would provide the necessary explanatory tools to model management options and scenarios. SPECTRUM provides temporal modelling and Whatif?/LUPIS provides a snapshot in time plus temporal modelling facilities. Both modelling tools provide quite different modelling capabilities to consider management options and scenarios. Further, through the incorporation of indicators, these tools can provide information on how well ESFM is being achieved under different scenarios and options.

Decision scenarios allow the policymaker to anticipate and understand risk and to discover new options for action. Well-documented scenarios provide a way of exploring alternative futures, and can support informed debate about the policy decisions built into the scenarios and the resolution of their tensions (Malafant and Fordham, 1997). Both SPECTRUM and Whatif?/LUPIS are useful tools for considering policy, management and planning questions. The outputs from ESFM could provide the basis for a strategic plan of management for the Eden RFA area.

Consideration of ESFM in the context of Eden was considerably complex and difficult particularly given limitations in data and tight timelines. The approach being undertaken to assess ESFM in the context of the Eden RFA was a first. The knowledge gained from this ESFM project could contribute significantly to the development of the final option, consideration of implementation issues leading into the RFA, and the application of information technology post RFA and as well as in other NSW CRAs.

6.6 REFERENCES

Barber, K.H. and Rodman, S.A. (1990) FORPLAN: the marvellous toy. *Journal of Forestry* 88:26-30.

Buongiorno, J. and Gilles, J.K. (1987) Forest Management and economics. New York, NY 10022, Macmillan Publishing Company.

Burgman, M. (1993) Wildlife Information and Forest Planning: a review with reference to FORPLAN. University of Melbourne, Creswick.

Carroll, B., Landrum, V. and Pious, L. (1995) Timber Harvesting Scheduling with Adjacency Constraints: Using ARC/INFO to make FORPLAN realistic. Boise Cascade Corporation. Conference Proceeding.

Cocks, K.D. and Ive, J.R. (1988) Evaluating a computer package for planning public lands in New South Wales. *Journal of Environmental Management*, 26: 249-60.

Cocks, K.D. and Ive. J.R. (1996) Mediation support for forest land allocation: The SIRO-MED system. *Environmental Management, 20(1) 41-52.*

Cocks, K.D., Ive, J.R. and Clark, J.L., (eds) (1995) Forest processes and tools for evaluation, mediation and allocation: Report on a case-study of the Batemans Bay area, New South Wales, Australia. CSIRO Division of Wildlife and Ecology in collaboration with CSIRO Division of Forestry. Canberra, CSIRO Division of Wildlife and Ecology Project Report No 7 (pp128).

Cocks, K.D., Ive, J.R. and Davis, J.R. (1986) Policy guidelines for the management of public natural lands. *Land Use Policy*, 3(1): 9-20.

Cocks, K.D., Ive, J.R., Davis J.R. and Baird, I.A. (1983) SIRO-PLAN and LUPLAN: An Australian approach to land-use planning. 1. The SIRO-PLAN land-use planning method. *Environment and Planning B: Planning and Design*, 10(3): 331-45.

Gault, F.D., Hamilton, K.E., Hoffman, R.B. and McInnis, B.C. (1987). The design approach to socioeconomic modelling. Futures, February, pp. 3-25.

Malafant, K.W.J. and Fordham, D.P. (1997) Integration Frameworks in Agricultural and Resource Planning and Management. Climate Prediction for Agricultural and Resource Management, Canberra, Australia, 6-8 May, p.287-304.

Phillips, C.L. and Harbor, R.D. (1991) Feedback Control Systems. Englewood Cliff, Prentice-Hall, Inc.

SPECTRUM Manual (1997) Ecosystem Management Analysis Centre anad Rocky Mountain Forest & Range Experiment Station, Fort Collins, Colorado.

Turner, B.J., Church, R. and Dargavel, J. (1994) FORPLAN in Australia - a critical review. In *Management Systems for a Global Economy with Global Resource Concerns* (eds Sessions, J and Brodie, D). Proceedings of the 1994 Symposium on Systems Analysis in Forest Resources Pacific Grove CA, p 270-82.

USDA Forest Service (1980) Planner's Introduction to Linear Programming. USDA For. Serv. Gen. Tech. Rpt NC-131?

APPENDIX 1
Details of Conservation approach to protecting old growth forests off reserve.

- A table of JANIS reservation targets which were un-met by the SFNSW/NPWS reserve design was generated from C-plan.
- The oldgrowth forest ecosystem type targets were considered first.
- The planning units containing patches of oldgrowth of poorly reserved forest ecosystem types were identified and allocated to the appropriate sawlog productivity class by area.
- In general, only patches of oldgrowth that were more than about half the planning unit were selected for oldgrowth ecosystem reservation. On average, oldgowth ecosystem types occupied about half to two thirds of the planning units selected.
- Significant areas of oldgrowth types 46a, 32, 26, 19, 24, 42, 34, and 37 were selected. Only trivial areas of other oldgrowth forest ecosystem types are still available on public lands.

AREA OF OLDGROWTH FOREST ECOSYSTEMS SELECTED FOR RESERVATION BY SAWLOG PRODUCTIVITY CLASS:

Coastal		Hinterland		Tablelands	
Low	High	Low	High	Low	High
790	592	635	2062	226	867

- It is proposed that these selections become flora reserves within the State Forests estate and are therefore protected from logging.
- High quality habitat oldgrowth (version including tiger quoll habitat) was added to the above selections, without restriction on the proportion of the planning unit. There were 3028 ha. of this not included in the oldgrowth ecosystem selection.
- The sawlog and pulpwood contributions of these areas was set to zero.
- An area of some 11900 hectares of Koala habitat was selected in the Bermagui, Murrah, Mumbulla, Yurammie and East Tantawangalo forests. It is proposed that A1 selective logging (10% canopy removal) be carried out in these areas, with an attempt to avoid preferred Koala browse species.
- Two additional corridors, in the Broadwater and Northern Yambulla forests were selected for A1 selective logging.
- All other areas are proposed for A2 (30% canopy removal) selective logging or B2 thinning.
- A fully refined option might take into account some addition reservation of oldgrowth in high quality Sooty Owl habitat and 5.ha. buffers around rare plants. The resource implications of these additions are expected to be negligible.
- In the time available, it was not possible to calculate the impact of not logging minor patches of high quality habitat oldgrowth on the growth stage by forest ecosystem table (indicator 1.1). However, this is likely to be small because of the diluting effects of other tenures.

The category A indicators used in the ESFM assessments are those judged to be technically feasible to implement immediately. They do not cover many important issues, such as possible changes in site quality, water quality/aquatic habitat quality and forest ecosystem health and vitality. The expected lesser impact of selective logging on soils, catchment values and biodiversity throughout the logged landscape should be

considered in evaluating the relative merits of intensive and selective logging systems, even if quantitative indicators are not yet developed.

Appendix 2
Harvesting Practices

Timber Management (Harvesting Practices)		
Intensity	**Type of Practice**	**Description**
LIGHT INTENSITY	**A1** light selective logging	Single tree selection logging of less than 10% of basal area.
	A2 medium selective logging	Single tree selection logging of less than 30% of basal area.
MODERATE INTENSITY	**B0** small group selection	Falling of no more than 4 trees in one group comprising a total gap diameter no greater than 30 metres.
	B1 group selection	Harvest using small canopy openings up to 75 metres diameter comprising no more than 20% of net harvest area - with A1 selective logging of multi-aged forest and C2 thinning of regrowth.
	B2 patch cutting	Harvest using patches of 100-200 metres diameter comprising no more than 20% of net harvest area - with A1 selective logging of multi-aged forest and C2 thinning of regrowth.
	B3 extensive tree removal	Current practice of harvesting with advanced growth retention, and seed tree & habitat tree retention of prescribed density and quality.
INTENSIFIED MANAGEMENT	**C1** intensive logging	Harvesting with retention of seed trees only.
	C2 regrowth thinning	Thinning generally from below (with some removal of poor form trees not required as habitat)
	C3 regrowth spacing	
	C4 regrowth fertilising	