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# Ecologically Sustainable Forest Management for the Eden RFA Assessment

A project undertaken as part of the NSW Comprehensive Regional Assessments  
November 1998

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# **ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT FOR THE EDEN RFA ASSESSMENT**

NSW Ecologically Sustainable Forest  
Management Group

A project undertaken for  
the Joint Commonwealth NSW Regional Forest Agreement Steering Committee  
as part of the  
NSW Comprehensive Regional Assessments

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The project has been overseen and the methodology has been developed through the NSW Ecologically Sustainable Forest Management Group which includes representatives from the New South Wales and Commonwealth Governments and stakeholder groups.

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# PROJECT SUMMARY

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This report describes a project undertaken as part of the comprehensive regional assessments of forests in New South Wales. The comprehensive regional assessments (CRAs) provide the scientific basis on which the State and Commonwealth Governments will sign regional forest agreements (RFAs) for major forest areas of New South Wales. These agreements will determine the future of these forests, providing a balance between conservation and ecologically sustainable use of forest resources.

This report is a replication of the information contained in the Ecologically Sustainable Forest Management (ESFM) Group document titled "Ecologically Sustainable Forest Management for the Eden RFA Assessment" Version 22, November 1998.

## **Project objective/s**

Ecologically Sustainable Forest Management (ESFM) will be the guiding philosophy of forest management for the future in the Eden Region. ESFM is founded on a set of basic principles that have been developed in the RFA process and which reflect the international commitments of Australia, the National Forest Policy Statement, State Government Policies and the concerns and interests of stakeholders in the forests of Eden.

These principles in simple terms identify that:

- The forest will be managed for all values;
- These values will be defined in measurable terms through the specification of performance indicators;
- All tenures will contribute to meeting goals, or where possible, quantitative target levels set for the indicators during the life of the RFA;
- Conservation and management of the forest and the values recognised within it will be undertaken on a long term basis;
- Forest management will be guided by public participation, openness to ideas, transparency in decision-making and accountability in performance against objectives;
- Forest management will be adaptable and responsive to new information, changing conditions and changing values in society.

To ensure these principles are followed, a set of indicators was defined to form the foundation for future evaluation of performance of ESFM for the Eden Region.

## **Methods**

Twenty indicators were identified, derived from the above principles, addressing cultural, economic and social values to geochemical cycles.

Some of these indicators will be monitored commencing immediately upon the signing of the RFA, others will be subject to further research and development activities during the life of the RFA. The monitoring of the indicators is specified carefully and will be implemented as a cooperative activity by land managers.

Performance review against the indicators will occur on a five-yearly basis, and will be jointly undertaken by the State and Commonwealth governments. Changes to the indicators or the monitoring systems will also be jointly agreed to by the two governments. The management response to the results of the 5-yearly review of RFA performance in implementing ESFM will be based on consultation with stakeholders and endorsed by the two governments.

The implementation of ESFM will also be guided by regulatory and socio-economic commitments, including protocols for conservation of biodiversity, protection of soil and water, protection of cultural heritage values, commitments to industry, provision of access and recreational facilities to the public and the protection of the forest and public property from threats due to wildfire and exotic pests or weeds. These practices and commitments should also be considered a key part of the RFA and their successful implementation should be monitored alongside the performance indicators.

### **Key results and products**

Implementation of ESFM in the Eden RFA must be viewed as a challenge of continuous improvement by management agencies, Indigenous people, stakeholders, industry, workers and the general public. The two governments have committed to undertake implementation activities related to the RFA that will support enhanced data collection, worker skills development, improved recognition of Indigenous economic, social, cultural and environmental values, ecological field guides, research and development and management of private lands. Successful implementation will also rely on effective mechanisms to facilitate ongoing input from stakeholders and clear accountability by management agencies for undertaking agreed actions.

The key indicators identified for the implementation of ESFM address the areas of:

- Biodiversity;
- Productive capacity;
- Soil and water;
- Economic and social values;
- Cultural and heritage values;
- Forest health and vitality.

Each of these areas are further categorised into indicator types (A-type, B-type and C-type).

The set of indicators are designed to reflect community values related to the above areas, along with associated targets which are to be monitored to ensure the performance of the RFA satisfies specified goals and public expectation.







# 1. INTRODUCTION

This report is a replication of the information contained in the Ecologically Sustainable Forest Management (ESFM) Group's document titled "Ecologically Sustainable Forest Management for the Eden RFA Assessment" Version 22, November 1998.

## **1.1 ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT AND FORESTS**

This document forms reference material related to the implementation of ESFM under the Regional Forest Agreement for Eden. It has been developed jointly by State and Commonwealth government officials and stakeholders participating in the ESFM Technical Committee under the New South Wales - Commonwealth Steering Committee managing the Comprehensive Regional Assessments and Regional Forest Agreement Process for NSW. The reference material included constitutes the results of project work undertaken for Eden, decisions taken during the integration and negotiation processes in October 1997 and the input of the Regional Forest Forum for Eden.

Ecologically Sustainable Forest Management should be seen as one of the pillars of the ongoing management of the forests of Eden. In combination with a Comprehensive, Adequate and Representative (CAR) reserve system and commitments to industry, ESFM is a guiding philosophy and policy commitment of both the State and Commonwealth Governments for future management of State Forests, National Parks and private forests. The emphasis of the work under the Regional Forest Agreement process has been on defining a framework for implementing ESFM, including the definition of principles, choosing performance indicators that reflect the full range of forest values, identifying forest practices and conservation protocols for off-reserve management and recommending improvements to the forest management systems in NSW.

The concept of ESFM must be viewed as a challenge of continuous improvement and adaptation of managers to changing public expectation, markets and scientific information. In particular it is important to the successful implementation of ESFM that there be reviews of progress on a five yearly basis, capacity building in the expertise and tools available to public and private land managers and an ability for stakeholders to remain engaged in the overall management of the regional forested landscape in the Eden area.

# 2. ESFM FRAMEWORK OF INDICATORS, TARGETS, MONITORING SYSTEMS AND RESEARCH NEEDS

## 2.1 INDICATORS

Indicators are designed to provide information in an understandable way. We have long used indicators for assessing economic performance such as Gross National Product or Per Capita income. Most people have also come to recognise Social Indicators like employment rates, life expectancy and birth rates. In ESFM, however, the use of indicators is an attempt to reflect the key environmental, social and economic aspects of a healthy regional society. This means that a ‘basket’ of indicators has been chosen that will help portray the quality of life related to the Forests of Eden. These indicators are meant to assess our performance in implementing the Eden RFA and to help assess over time whether we are achieving what we set out to do.

These indicators are not perfect, but they are meant to be a practical attempt to identify indicators across the range of themes that have been raised by the community and by specialists. The indicators will require a commitment to data collection by management agencies, communities and forest-dependant businesses. Successful implementation will also require a collective commitment by stakeholders and forest conservation and management agencies to monitor and interpret the trends in the indicators over time.

It is not possible to define in concrete terms what levels of these indicators are necessary or appropriate. It is more likely that changes will occur in every aspect of our economy, communities and our environment over time. These changes may occur from natural processes of growth or wildfire, or from changes in markets for forest products. The RFA period of 20 years means that there will be a need to cope with these changes and adjust course in our management as necessary. The indicators can be a tool to help make course adjustments when necessary.

It has been suggested that ESFM is more about debating where we want to get to, rather than where we are at today. In this regard, the targets that have been set for the indicators are meant to set a broad direction for conservation efforts, protection of catchments, industry development and other aspects of our management. The indicators and targets will apply to the Eden RFA region as a whole. They are not concrete, numerical targets, as these are too difficult to forecast and too likely to change over time. Rather, they are statements of direction that can be followed over the life of the RFA, refined as necessary, and used to test the adequacy of our management. Interpretation of the indicators will need to be undertaken carefully, as many factors can contribute to the overall performance of forest management.

## **2.2 CATEGORIES OF PERFORMANCE INDICATORS**

Three categories of performance indicators have been developed for the RFA:

- A type - data substantially available to quantify current situation and can be used to review performance after five years
- B type - data not currently available, but can be implemented during the first five years of the RFA agreement and used to review performance after five years
- C type - are recommended for design of a monitoring process within the first 5 years of the RFA period.

The following indicators are designed to reflect community values related to biodiversity, forest productivity, soil and water conservation, socio-economic benefits and cultural heritage. Each indicator has associated with it a target or targets that can be assessed over time. These indicators are based on data currently available or readily available and will be used for the monitoring and evaluation of the RFA in the first five year period.

## **2.3 MONITORING REQUIREMENTS**

Monitoring is the systematic collection of data over time to assess patterns in, and changes to, the ESFM indicators. Monitoring is critical to evaluating the performance of the RFA in terms meaningful to the community. The following section includes the methods to be used to monitor the indicators during the first five year period of the RFA. While not all tenures will be able to undertake the same degree of monitoring, it will be important to ensure as much consistency in data collection as possible. For this reason, the monitoring methods are considered an integral part of the RFA.

## **2.4 RESPONSIBILITY FOR MONITORING**

- It is proposed that the ongoing governmental responsibility for managing the implementation of the RFA be held with the Department of Urban Affairs and Planning, Resource and Conservation Division. This division would be responsible for managing an ongoing public forest forum that would be provided with regular updates by land owners and land managers on the implementation of the RFA and particularly on performance against the indicators of ESFM.
- Monitoring of indigenous cultural heritage values must include appropriate input from Indigenous Communities. Indigenous values cannot be assessed by pure science alone. A monitoring system for indigenous cultural heritage values must ensure that cultural integrity validation is part of monitoring. It must be culturally appropriate.
- During the fifth year of the RFA, a jointly sponsored Commonwealth/State review and reporting of performance on implementation of the RFA using the performance indicators will be undertaken.

The exact nature and membership of the Forest Forum would be determined by RACAC. Individual agencies, such as the NPWS and State Forests, would also be encouraged to develop advisory committees for their operations.

## 2.5 RESEARCH NEEDS

In addition to monitoring the indicators, it will be necessary to develop research programs to improve our ability to collect and interpret data. In many cases, there is a need to deepen our understanding of ecological processes, their dynamics and their response to management. In addition, there is a need to seek out improvements in forestry practices and socio-economic returns from forest management.

The research component requires a coordinated approach that clearly defines the goals, project interaction, integration with current or past research and sets priorities. A major commitment will be necessary to undertake the recommended research and to facilitate its integration into the review of the RFA.

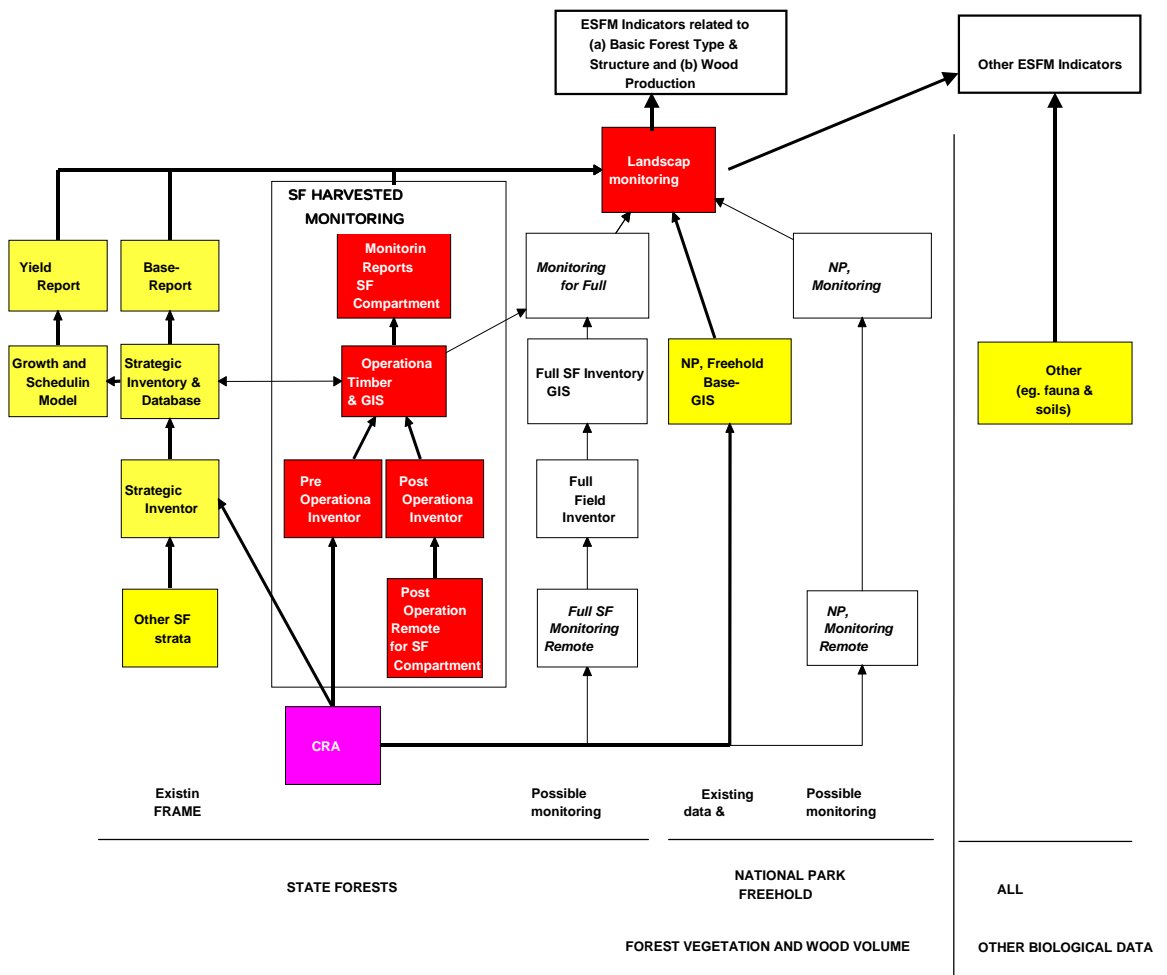
## PERFORMANCE INDICATORS

Indicators supported by populated tables, maps or text in following chapters.

Indicator with supporting base data			Page number
Indicator type	Indicator topic	Indicator code	
A type	Biodiversity	(KBS vegetation) 1.1	35
		(ecosystem) 1.1	38
		1.2	Map
		1.3	42
	Productive capacity	2.1	43
		2.3	44
	Soil and water	4.1	45
	Economic and social	5.1	47
		5.4	48
	Cultural and heritage	6.1	49
B and C types	Biodiversity	1.3	52
	Productive capacity	2.1	53
		2.2	54
	Health and vitality	3.1	55
		3.2	60
	Soil and water	4.3	65
		4.4	66
		4.5	67
	Economic and social	5.2	68
		5.3	70
		5.5	72
	Cultural and heritage	6.2	73

# 3. OVERVIEW OF DATA INPUTS AND SYSTEMS FOR MONITORING

## OVERVIEW OF DATA INPUTS AND SYSTEMS REQUIRED FOR ESFM MONITORING SYSTEM



# 4. STATE FOREST HARVESTING MONITORING PROCEDURES FOR MEASURING ESFM INDICATORS FOR EDEN CRA

Draft 30 October 1997

## 4.1 OVERVIEW

- Several different sets of data will be required for reporting of ESFM indicators, including:
  - Forecast wood volumes on State Forests (from CRA FRAMES data as improved with better inventory and growth modelling)
  - Base line data on forest type, structure, volumes on State Forests (from CRA FRAMES and CRA FTI data)
  - Data on changes on harvested compartments to forest type, structure, volumes on State Forests resulting from harvesting
  - Data on changes to forest type, structure, volumes on State Forests resulting from growth and non-harvest disturbances for compartments *not* harvested,
  - Base-line data on forest type, structure on National Parks and Freehold land (from CRA FTI)
  - Data on basic changes to forest type, structure on National Parks and Freehold land resulting from growth and disturbance
  - Other biological information (eg. fauna and flora data, soils and water data, volume and value of removals from SF) for State Forests, National Parks and Freehold



- An overview diagram that identifies the different data sources for ESFM monitoring is attached.
- Monitoring Procedures for Harvested Compartments
- Collection of data for 1 (c) (*Changes on harvested compartments with respect to forest type, structure, volumes*) is a critical monitoring function which coincides with SFNSW operational planning requirements for pre and post harvest operational assessments.
- This operational harvest monitoring function will require collection of the following data for all compartments harvested each year:
  - pre-harvest assessment of volume, species, disturbance, and forest structure using existing CRA FTI data on growth stage, and forest type
  - post harvest assessment of volume, species, disturbance, and forest structure using new remote sensing (eg. 1:15,000 scale API) of harvested compartments to update sampling strata and define the net harvested area
  - operational field inventory of regeneration and harvested areas

This data will need to be stored in a GIS and relational databases to produce monitoring reports for harvested compartments.

- The harvest monitoring procedures will generate information useful for internal SF operational planning and monitoring purposes, and for contribution to landscape monitoring of ESFM indicators.
- Cost efficiencies will arise through combining State Forest Harvest Monitoring procedures for ESFM reporting with SFNSW operational management procedures. This basic data on harvest monitoring will also contribute to reporting on other indicators.
- After completion of the CRA in each region, it is expected that FRAMES will move toward utilisation of more operational level data. This need has been recognised in the FRAMES project overview.
- Changes to be instituted by FRAMES to address operational planning and monitoring requirements are:
  - To allow for tactical level pre-harvest planning
  - To use post-harvest assessments to update FRAMES strategic data-sets
  - To integrate post harvest monitoring of regeneration into FRAMES inventory, growth and yield forecasting procedures.
- State Forest Harvested Compartments Monitoring Procedures will record data for the annual pre-harvest and post-harvest cycle. Data would be gathered at the compartment level, but would be reported at the regional level each year.
- Pre-harvest stratification will rely on existing CRA FTI stratification from 1:25,000 photography.
- Post-harvest remote sensing for all compartments will initially be conducted by manual interpretation of 1:15,000 scale aerial photographs.

## **4.2 FULL LANDSCAPE REPORTING OF ESFM INDICATORS**

- Information about changes in harvested compartments will need to be combined with baseline data and volume forecasts from FRAMES on State Forest, and other base line data on National Park and Freehold. These data need to be combined in a Landscape Monitoring

System, which integrates all data from all tenures (ie. 1 (a) to 1 (g) above) as shown in the attached diagram.

- Indicators which will be able to directly reported from this system include:
  - *Biodiversity indicator 1.1a* - Extent of forest/vegetation type by growth stage
  - *Productive capacity indicator 2.1a* - Comparison of annual removal of wood products against ecologically sustainable estimate
  - *Productive capacity indicator 2.3c* - Standing volume of log stocks
- Indicators which will require data in addition to information produced using procedures outlined above include:
  - Biodiversity indicator 1.2a - Extent of connectivity
  - Productive capacity indicator 2.2c - Monitoring of site quality
  - Economic and social indicator 5.1 - Volume and royalty of logs harvested per annum

### 4.3 NEW LANDSCAPE MONITORING PROCEDURES

- In addition to the annual reporting of criteria and indicators, it may be possible and necessary to conduct a complete re-assessment of the region before the end of the five year monitoring period to identify the extent of change changes due to growth and disturbance outside harvested compartments (ie. 1(d) and 1(f)).
- Developments in remote sensing technology (eg. high resolution satellites, radar) may reduce the costs of full regional assessments. The Montreal Implementation Group is investigating the use of new remote sensing technologies. A review of the need and possibilities of using remote sensing for landscape monitoring should be conducted in the second year of the monitoring period.
- The Eden RFA monitoring documentation for
  - *Biodiversity indicator 1.1a* - Extent of forest/vegetation type by growth stage
  - *Productive capacity indicator 2.1a* - Comparison of annual removal of wood products against ecologically sustainable estimate
  - *Productive capacity indicator 2.3c* - Standing volume of log stocks should include the following paragraphs:
    - The harvested area and changes growth stage, harvested volumes, and standing volume will be reported as part of State Forest Harvested Compartments Monitoring Procedures. These procedures will be conducted as part of SFNSW operational-level assessments that will be integrated with current FRAMES data and procedures.
    - Data for harvested compartments will need to be combined with other base line data from other non-harvested areas of State Forest and data from other tenures as part of a new Landscape Monitoring System, which will produce reports on ESFM indicators.
    - Changes in indicators reported by these harvest monitoring procedures might be difficult to detect due to the imprecision of base line data, and because of changes due to growth and disturbance in non-harvested compartments, National Parks and Freehold.
    - All monitoring procedures, including possible methodologies for full landscape monitoring, should be reviewed in the second year of reporting. This review should

consider the reliability and magnitude of changes reported for harvested compartments, against other changes in State Forest and other tenures. The potential role of remote sensing for monitoring across the full landscape will need to be examined, and consider evidence on the costs, reliability, and practicality of using remote sensing to be assembled by the Montreal Implementation Group.

■ The Eden RFA monitoring documentation for:

- Biodiversity indicator 1.2a - Extent of connectivity
- Productive capacity indicator 2.2c - Monitoring of site quality
- Economic and social indicator 5.1 - Volume and royalty of logs harvested per annum should include the following paragraphs:
  - Information compiled on forest changes using State Forest Harvested Compartments Monitoring Procedures and the new Landscape Monitoring System developed for reporting on indicators 1.1a, 2.1a, and 2.3c will be useful in contributing data for monitoring of this indicator.
  - Additional data sets and information will be required before it is possible to report on this indicator. The exact nature of these additional data, the feasibility of monitoring, and the reliability of these data has not been assessed at this point.

# 5. BIODIVERSITY – TYPE A INDICATORS

## 5.1 DEFINITION OF BIODIVERSITY

Biodiversity is the variability among living organisms and the ecological complexes of which they are a part. This includes diversity within species, among species, and of ecosystems. The protection of biodiversity enables the ecosystem to respond to external influences, to recover after disturbance, and to maintain the organisms essential for its ecological processes. Human activities should conserve ecosystems by retaining habitats, and controlling deleterious species. A reduction in the diversity of species in a region may reduce the ability of the ecosystems to function, reduce their productivity, and so reduce sustainability. Therefore, all naturally occurring species should be maintained in the ecosystem.

There is a need to enhance the level of scientific understanding, and to develop methods to direct science and policy to the achievement of sustainability. There are many approaches and methods to enhance and maintain bio-diversity, both through a comprehensive, adequate and representative protected areas system and through conservation protocols and planning on State Forests and private lands. The following indicators should provide insight over time into the effectiveness of those mechanisms in conserving bio-diversity in the forests of the Eden RFA region.

## 5.2 INDICATOR 1.1 (A TYPE)

Extent of forest ecosystem types and vegetation types by growth stage.

### 5.2.1 Targets

- Minimise loss of old growth.
- 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 on public land.
- Minimise changes in forest types on private land.

### 5.2.2 Monitoring

Method for first two targets and fourth target:

- Review current categories
  - vegetation type
  - growth stage

- acknowledge two major disturbance events
- high intensity fire
- harvesting practice/silviculture
- Track changes in categories by monitoring disturbance events and temporal change. Options include field validation, digitising from hard copy mapping and/or remote sensing. Records would be dated GIS output layers.

Bring to account on an annual and five yearly basis.

#### Method for third target

- Harvesting plans to show ecosystem type boundaries (field corrected)
- Post harvest inspections to include regeneration assessments of original over-storey species. Distribution and proportionate mix of regeneration to be recorded.

Sampling methodology and intensity of effort to be agreed.

Database to be established to bring to account degree of compliance.

#### 5.2.3 Research

- Undertake research and development into the changes of forest ecosystems and growth stages in time and space for conservation of biological diversity using adjacent alternate coupes.
- Monitor a sample of regenerating forest ecosystems before the first thinning and at 5-10 year intervals to see how plant species composition responds to logging and prescribed burning throughout the successional stages.
- Where multi-aged forest and regrowth forest in nearby alternate coupes on similar site quality is available for study, a comparison of over-storey tree species composition should be undertaken within 2 years to test the affect of current silvicultural practice on the regeneration of forest ecosystems.

#### 5.2.4 Indicator 1.1 (A type)

Extent of forest ecosystem types and vegetation types by growth stage.

Note. Two forms of this indicator are presented: one based on Keith/Bedward/Smith vegetation types, and the other on State Forests ecosystem types. The indicator has a different application depending on the focus of implementation: for State Forests, the focus is identification of field types; for NPWS, the focus is on correlation with JANIS types for conservation values.

#### INDICATOR 1.1- PART A (BASED ON KBS VEGETATION TYPES)

Vegetation type name	Size	Current (1997) growth stage					
		Candidate old growth	Disturbed old growth	mature forest	Disturbed mature forest	young forest	Recently disturbed
Dry rainforest							
Myanba eucalypt/fig forest							
Rocky top dry shrub forest							

Vegetation type name	Size	Current (1997) growth stage					
		Candidate old growth	Disturbed old growth	mature forest	Disturbed mature forest	young forest	Recently disturbed
Bunga head rainforest							
Coastal warm temperate rainforest							
Hinterland warm temperate rainforest							
Cool temperate rainforest							
Mountain wet layered Forest ( <i>E.nitens</i> )	Percentage area (ha)	25% 437	13% 221	28% 493	9% 158	18% 314	8% 137
Mountain wet layered Forest ( <i>E.fastigata</i> )	Percentage area (ha)	25% 4115	3% 481	29% 4817	10% 1700	16% 2671	16% 2704
Tantawangalo wet shrub Forest	Percentage area (ha)	26% 201	14% 110	27% 210	14% 105	10% 76	8% 63
Mountain wet fern forest	percentage area (ha)	28% 607	3% 76	44% 960	4% 86	8% 179	13% 296
Hinterland wet shrub forest	percentage area (ha)	17% 4017	1% 258	40% 9720	4% 923	31% 7466	7% 1672
Mountain wet herb forest	percentage area (ha)	20% 5757	3% 915	33% 9726	10% 2798	14% 4030	20% 5882
Basalt wet herb forest	percentage area (ha)	15% 1659	3% 382	28% 3112	12% 1332	22% 2396	19% 2051
Flats wet herb forest	percentage area (ha)	11% 271	1% 15	47% 1167	18% 439	17% 416	8% 192
Brogo wet vine forest	percentage area (ha)	12% 390	2% 75	47% 1534	4% 119	35% 1139	0% 1
Bega wet shrub forest	percentage area (ha)	26% 2855	2% 194	36% 3936	5% 527	28% 2977	3% 330
Bega dry grass forest	percentage area (ha)	17% 284	1% 21	52% 879	2% 32	27% 457	1% 18
Candelo dry grass forest	percentage area (ha)	38% 319	0% 2	38% 321	12% 98	12% 99	1% 6
Monaro dry grass forest	percentage area (ha)	24% 757	0% 0	67% 2084	0% 3	9% 276	0% 0
Numeralla dry shrub Woodland	percentage area (ha)	34% 2314	1% 78	36% 2483	5% 366	21% 1414	2% 164
Monaro grassland	percentage area (ha)	67% 56	11% 9	19% 16	0% 0	2% 2	0% 0

Vegetation type name	Size	Current (1997) growth stage					
		Candidate old growth	Disturbed old growth	mature forest	Disturbed mature forest	young forest	Recently disturbed
Monaro basalt grass Woodland	percentage area (ha)	33% 435	1% 17	29% 387	9% 117	24% 321	3% 35
Subalpine dry shrub forest	percentage area (ha)	38% 7930	3% 534	32% 6559	6% 1344	15% 3119	6% 1263
Sandstone dry shrub forest	percentage area (ha)	24% 187	0% 0	61% 484	0% 0	7% 54	8% 64
Tableland dry shrub forest	percentage area (ha)	11% 1501	1% 144	39% 5551	2% 248	27% 3836	20% 2866
Waalimma dry grass forest	percentage area (ha)	6% 76	3% 35	27% 356	1% 8	45% 584	19% 253
Wog wog dry grass forest	percentage area (ha)	13% 118	0% 0	16% 150	0% 0	62% 568	9% 83
Nalbaugh dry grass forest	percentage area (ha)	11% 198	1% 25	32% 568	12% 221	16% 281	28% 506
Wallagaraugh dry grass Forest	percentage area (ha)	10% 81	1% 5	54% 439	1% 11	21% 174	13% 110
Hinterland dry grass forest	percentage area (ha)	20% 5268	4% 999	38% 9934	5% 1386	20% 5171	13% 3349
Coastal dry shrub forest (E.longifolia)	percentage area (ha)	10% 2290	2% 509	35% 7563	14% 3004	31% 6883	7% 1631
Coastal dry shrub forest (E.muellerana)	percentage area (ha)	18% 2804	1% 113	52% 8131	1% 185	17% 2622	11% 1724
Brogo dry shrub forest	percentage area (ha)	26% 3213	6% 728	29% 3544	13% 1580	22% 2741	5% 627
Escarpment dry grass Forest	percentage area (ha)	28% 4960	1% 268	44% 7928	11% 1958	14% 2516	2% 327
Dune dry shrub forest	percentage area (ha)	54% 125	0% 1	20% 47	0% 1	19% 44	5% 12
Coastal dry shrub forest (A.floribunda)	percentage area (ha)	23% 2923	2% 255	33% 4268	1% 109	38% 4892	4% 524

Vegetation type name	Size	Current (1997) growth stage					
		Candidate old growth	Disturbed old growth	mature forest	Disturbed mature forest	young forest	Recently disturbed
Southern riparian scrub	percentage	19%	1%	42%	1%	36%	1%
	area (ha)	47	3	102	3	88	2
Northern riparian scrub	percentage	35%	1%	32%	7%	25%	0%
	area (ha)	35	1	32	7	25	0
Riverine forest	percentage						
	area (ha)						
Mountain dry shrub forest ( <i>E.fraxinoides</i> )	percentage	22%	3%	31%	3%	36%	5%
	area (ha)	371	53	536	59	615	91
Coastal dry shrub forest ( <i>E.obliqua</i> )	percentage	8%	0%	34%	1%	42%	15%
	area (ha)	1745	82	6956	164	8689	3025
Mountain dry shrub forest ( <i>E.cypellocarpa</i> )	percentage	21%	0%	67%	0%	10%	2%
	area (ha)	512	2	1666	1	242	47
Foothills dry shrub forest	percentage	25%	1%	41%	1%	15%	17%
	area (ha)	752	37	1252	37	461	516
Mountain dry shrub forest ( <i>E.sieberi</i> )	percentage	20%	1%	30%	10%	28%	11%
	area (ha)	368	13	550	190	513	197
Lowland dry shrub forest	percentage	35%	4%	38%	3%	18%	3%
	area (ha)	4775	488	5179	389	2450	459
Timbillica dry shrub forest	percentage	7%	1%	22%	1%	46%	22%
	area (ha)	1578	212	4903	226	10165	4788
Eden dry shrub forest	percentage	27%	1%	29%	1%	40%	2%
	area (ha)	4449	136	4675	83	6529	372
Bega dry shrub forest	percentage	19%	2%	23%	14%	37%	5%
	area (ha)	823	98	1001	610	1602	212
Coastal dry shrub forest ( <i>E.agglomerata</i> )	percentage	11%	1%	33%	1%	47%	7%
	area (ha)	3386	168	9979	357	14272	2224
Genoa dry shrub forest	percentage	37%	1%	46%	0%	10%	5%
	area (ha)	891	16	1108	5	251	124
Rock shrub ( <i>K.ambig</i> )	percentage	24%	0%	52%	0%	24%	0%
	area (ha)	5	0	11	0	5	0
Mountain rock scrub	percentage	21%	0%	35%	1%	41%	2%
	area (ha)	29	0	47	1	55	3
Montane heath	percentage	40%	0%	49%	0%	10%	1%
	area (ha)	46	0	57	0	12	1



Vegetation type name	Size	Current (1997) growth stage					
		Candidate old growth	Disturbed old growth	mature forest	Disturbed mature forest	young forest	Recently disturbed
Mountain nadgee heath	percentage	9%	0%	37%	0%	54%	0%
	area (ha)	3	0	13	0	19	0
Coastal lowland heath	percentage	12%	0%	57%	0%	32%	0%
	area (ha)	15	0	74	0	41	0
Swamp heath	percentage	8%	0%	31%	0%	32%	29%
	area (ha)	18	0	66	1	68	62
Lowland swamp	percentage	29%	2%	25%	2%	41%	2%
	area (ha)	171	13	150	9	245	9
Swamp forest	percentage	14%	1%	52%	0%	24%	9%
	area (ha)	111	6	403	3	183	66
Sub alpine bog	percentage	16%	5%	26%	14%	25%	15%
	area (ha)	104	33	176	91	164	100
Floodplain wetlands	percentage	22%	1%	30%	4%	40%	3%
	area (ha)	392	11	535	68	700	61
Coastal scrub	percentage	48%	0%	32%	0%	17%	4%
	area (ha)	150	0	101	0	52	11
Estuarine wetland (M.erci)	percentage	39%	0%	21%	4%	26%	11%
	area (ha)	74	0	40	7	49	20
Saltmarsh	percentage	25%	0%	50%	0%	0%	25%
	area (ha)	3	0	6	0	0	3
Estuarine wetland (Av.marin)	percentage						
	area (ha)						
Wadbilliga dry shrub forest	percentage	43%	0%	31%	0%	26%	1%
	area (ha)	11116	28	7975	17	6722	145
Wadbilliga range ash forest	percentage	52%	0%	24%	0%	24%	0%
	area (ha)	394	0	184	0	179	0
Wadbilliga mallee heath	percentage	52%	0%	31%	0%	18%	0%
	area (ha)	620	0	367	0	211	0
Wadbilliga range wet forest	percentage	46%	1%	37%	2%	10%	4%
	area (ha)	1225	24	998	67	275	96
Wadbilliga gorge dry forest	percentage	32%	0%	44%	1%	23%	0%
	area (ha)	2097	30	2863	69	1506	3
Wadbilliga river valley Forest	percentage	31%	1%	43%	2%	21%	1%
	area (ha)	558	21	776	33	378	18


**INDICATOR 1.1- PART B (BASED ON STATE FOREST ECOSYSTEM TYPES)**

Vegetation Ecosystem group	vegetation type Name	size	Current (1997) growth stage					
			Candidate old growth	Disturbed old growth	Mature forest	disturbed mature forest	young forest	Recently disturbed
<b>Rainforest</b>	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							
<b>Layered Brown barrel</b>	mtn wet layered frst ( <i>E.nitens</i> ) mtn wet layered frst ( <i>E.fastigata</i> )	percentage area (ha)	25% 4552	4% 702	29% 5310	10% 1858	16% 2985	16% 2841
<b>Messmate/ Gum</b>	tantawangalo wet shrub frst mtn wet herb frst	percentage area (ha)	20% 5958	3% 1025	33% 9936	10% 2903	14% 4106	20% 5945
<b>Brown Barrel/ gum</b>	mtn wet fern frst basalt wet herb frst	percentage area (ha)	17% 2266	3% 458	31% 4072	11% 1418	20% 2575	18% 2347
<b>Southern Blue gum</b>	hinterland wet fern frst	percentage area (ha)	23% 9447	1% 549	44% 1785 5	4% 1529	22% 8860	6% 2383
<b>Yellow Stringybark / Gum</b>	hinterland wet shrub Frst	percentage area (ha)	17% 4017	1% 258	40% 9720	4% 923	31% 7466	7% 1672
<b>Manna gum</b>	flats wet herb frst	percentage area (ha)	11% 271	1% 15	47% 1167	18% 439	17% 416	8% 192
<b>Red gum</b>	brogo wet vine frst bega dry grass frst candelo dry grass frst	percentage area (ha)	17% 993	2% 98	47% 2734	4% 249	29% 1695	0% 25
<b>River Peppermint</b>	bega wet shrub frst	percentage area (ha)	26% 2855	2% 194	36% 3936	5% 527	28% 2977	3% 330
<b>Snow gum</b>	monaro dry grass frst monaro basalt grass wdland	percentage area (ha)	27% 1192	0% 17	56% 2471	3% 120	13% 597	1% 35
<b>Monaro Grasslands / Woodlands</b>	numeralla dry shrub wdland monaro grassland	percentage area (ha)	34% 2370	1% 87	36% 2499	5% 366	21% 1416	2% 164

Vegetation Ecosystem group	vegetation type Name	size	Current (1997) growth stage					
			Candidate old growth	Disturbed old growth	Mature forest	disturbed mature forest	young forest	Recently disturbed
<b>Narrow Leaved peppermint</b>	subalpine dry shrub	percentage	38%	3%	32%	6%	15%	6%
	frst	area (ha)	7930	534	6559	1344	3119	1263
<b>Messmate</b>	sandstone dry shrub	percentage	9%	0%	35%	1%	41%	14%
	frst coastal dry shrub frst (E.obliqua)	area (ha)	1932	82	7440	164	8743	3089
<b>Stringybark / Peppermint</b>	tableland dry shrub frst	percentage	11%	1%	39%	2%	27%	20%
		area (ha)	1501	144	5551	248	3836	2866
<b>Applebox</b>	waalimma dry grass	percentage	6%	3%	27%	1%	45%	19%
	frst	area (ha)	76	35	356	8	584	253
<b>Gum/ Stringybark</b>	wog wog dry grass frst	percentage	22%	3%	41%	7%	18%	9%
	nalbaugh dry grass frst	area (ha)	1113	1299	2068	3577	8952	4422
			7		5			
	Wallagaraugh dry grass frst							
	hinterland dry grass frst							
	Escarpment dry grass frst mtn dry shrub frst (E.cypellocarpa)							
<b>Woolybutt</b>	coastal dry shrub frst	percentage	10%	2%	35%	14%	31%	7%
	(E.longifolia)	area (ha)	2290	509	7563	3004	6883	1631
<b>Yellow Stringybark</b>	coastal dry shrub frst	percentage	18%	1%	52%	1%	17%	11%
	(E.muellerana)	area (ha)	2804	113	8131	185	2622	1724
<b>Gum/box/ Stringybark</b>	brogo dry shrub frst	percentage	26%	6%	29%	13%	22%	5%
		area (ha)	3213	728	3544	1580	2741	627
<b>Bangalay Dunes</b>	dune dry shrub frst	percentage	54%	0%	20%	0%	19%	5%
		area (ha)	125	1	47	1	44	12
<b>Apple</b>	coastal dry shrub frst	percentage	23%	2%	33%	1%	38%	4%
	(A.floribunda)	area (ha)	2923	255	4268	109	4892	524
<b>Riparian Scrub</b>	sthn riparian scrub	percentage	24%	1%	39%	3%	33%	1%
	nthn riparian scrub	area (ha)	82	4	134	10	113	2
<b>River oak</b>	riverine frst	percentage						
		area (ha)						
<b>White ash</b>	mtn dry shrub frst	percentage	22%	3%	31%	3%	36%	5%
	(E.fraxinoides)	area (ha)	371	53	536	59	615	91

Vegetation Ecosystem group	vegetation type Name	size	Current (1997) growth stage					
			Candidate old growth	Disturbed old growth	Mature forest	disturbed mature forest	young forest	Recently disturbed
<b>Silvertop</b>	foothills dry shrub frst	percentage	29%	3%	32%	5%	27%	5%
<b>Ash</b>	mtn dry shrub frst (E.sieberi)	area (ha)	1116 7	772	1265 7	1309	1155 5	1756
	lowland dry shrub frst							
	eden dry shrub frst							
	bega dry shrub frst							
<b>Yertchuk</b>	timbillica dry shrub frst	percentage	7%	1%	22%	1%	46%	22%
		area (ha)	1578	212	4903	226	1016 5	4788
<b>Ash/ Stringybark</b>	coastal dry shrub frst (E.agglomerata)	percentage	11%	1%	33%	1%	47%	7%
		area (ha)	3386	168	9979	357	1427 2	2224
<b>Blue leaved Stringybark</b>	genoa dry shrub frst	percentage	37%	1%	46%	0%	10%	5%
		area (ha)	891	16	1108	5	251	124
<b>Scrub/ Heath/ Wetlands Etc</b>	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	23%	1%	34%	4%	32%	7%
		area (ha)	1121	63	1679	180	1593	336
<b>Wadbilliga Forests</b>	wadbilliga dry shrub frst wadbilliga range ash frst wadbilliga mallee heath Wadbilliga range wet frst	percentage	44%	0%	31%	0%	24%	1%
		area (ha)	1335 5	52	9524	84	7387	241
<b>Wadbilliga Forests</b>	Wadbilliga gorge dry frst Wadbilliga river valley frst	percentage	32%	1%	44%	1%	23%	0%
		area (ha)	2655	51	3639	102	1884	21

Data is sourced from the Environment and Heritage Technical Committee produced layer of vegetation community model and the FRAMES Technical Committee produced layer of growth stages. Data represents pre RFA assessment. Rainforest types are not subdivided into growth stages.

 Generally non commercial forest types

### 5.3 INDICATOR 1.2 (A TYPE)

Extent of connectivity in the forest landscape in relation to:

- threatened species habitat;
- general retained habitat on public and private land;
- conservation reserves.

#### 5.3.1 Targets

- Ensure functional connectivity through implementation of
  - conservation protocols, planning; and
  - connectivity between reserves and retained habitat.

#### 5.3.2 Monitoring

- Qualitative assessment of map based and remotely sensed data on a five-yearly basis. During the first 5 year term of the RFA, maps will be used to assess connectivity among the key features identified in the targets. During the first five years, work will also be undertaken to develop mathematical approaches to assessing connectivity.

#### 5.3.3 Research

- Several mathematical indices (ie percolation index) have been developed to assess connectivity. Oregon State University has developed a computer system (FRAGSTATS) that could automate assessment of connectivity. Efforts should be made to identify a quantitative assessment protocol by the fifth year of the RFA.
- The Montreal Process Implementation Group is undertaking research into this area.
- Research into the effectiveness of wildlife corridors and undisturbed riparian buffer strips and general retained habitat through prescriptions and protocols.

#### 5.3.4 Indicator 1.2 (A type)

Extent of connectivity in the forest landscape in relation to:

- threatened species habitat;
- general retained habitat on public and private land;
- conservation reserves.

This indicator was evaluated by a map based assessment of connectivity for each option in the RFA. The maps associated with the Regional Forest Agreement can be used to assess changes in connectivity over time.

### 5.4 INDICATOR 1.3 (A TYPE - INTERIM FOR FIRST FIVE YEARS OF THE RFA)

Management measures in place to maintain species extent and abundance.

#### 5.4.1 Targets

- Effective implementation of habitat conservation and management measures.

#### 5.4.2 Monitoring

- Reporting of compliance.

- Ensure appropriate protocols for all threatened species are identified. Identify any impacts on net harvest area. The Conservation Protocols have monitoring requirements to assess their efficacy. The monitoring program should incorporate existing data, existing survey sites and generate sufficient data for use in the five year review of the RFA.

#### 5.4.3 Research

- Assess adequacy of management measures for representative species.
- For other research needs see B and C type indicators.

#### 5.4.4 Indicator 1.3a (A Type)

Management measures in place to maintain species extent and abundance.

This table lists the protective measures related to timber harvesting that have been designed for conserving the habitat of threatened species. The measures should be subject to processes of monitoring and evaluation over the first five years of the RFA. The Conservation Protocols implemented in the Eden RFA (see Part 5 of the report) include consideration of both general habitat features across the landscape and species-specific mechanisms. The protocols are supported by pre-harvest survey systems to ensure appropriate diagnosis of prescriptions for each harvesting operation.

Protective measures	Characteristics of measure (further details in Conservation Protocols)	Species addressed	Are measures adequate for given position? Y/N
<b>General prescriptions from Conservation Protocols</b>	.		
Hollow-bearing tree retention	Minimum of 10 hollow-bearing trees must be retained per two hectares		
Recruitment tree retention	Minimum of 10 recruitment trees must be retained per two hectares		
Significant food resources	Protection of <i>Allocasurina</i> spp At least 4 mature (40 cm dbh) winter-flowering eucalypt spp per two hectares Protect mature banksia & <i>Xanthorrhoea</i> spp Retain all V-notch trees	GBC  YBG	
Wetlands	At least 10m buffer more than 0.1ha<0.5ha At least 40m buffer >0.5ha & SEPP 14 wetlands		
Heath	At least 20m buffer around heath >0.2ha<0.5ha At least 40m buffer around heath > 0.5ha		

Protective measures	Characteristics of measure (further details in Conservation Protocols)	Species addressed	Are measures adequate for given position? Y/N
Rocky Outcrops	At least 20m buffer around rock outcrops >0.1ha<0.5ha At least 40m buffer around rocky outcrops > 0.5ha		
Caves tunnels & disused mineshafts	All protected by at least 50m buffer		
Long-footed Potoroo			

# 6. PRODUCTIVE CAPACITY – A TYPE INDICATORS

## 6.1 DEFINITION OF PRODUCTIVE CAPACITY

The productive capacity of forest ecosystems relates to the ability of those systems to grow, accumulate biomass and regenerate. Productive capacity is reliant on maintaining the functioning of forest ecosystems, in terms of water, nutrient and carbon cycling and in terms of interactions among species and the environment.

Maintenance of the forest's productive capacity is important because we depend on forests directly and indirectly for a wide range of extractive and non-extractive goods and services. Their continued provision is clearly linked to the productive capacity of the forest. If this is exceeded, there is the risk of ecosystem decline. To ensure that forests continue to function, it is necessary to maintain the presence of the forest itself; to understand the levels of goods and services now provided; and to determine levels that are likely to be sustainable over long periods. The nature and degree of any changes and the factors that account for variations in productive capacity should be examined.

It is also recognised that, for various reasons, the nature of the goods and services provided from forests will change over time as a consequence of changing social and economic demands.

It is often useful to monitor changes in productive capacity as a measure of ecological processes that may be otherwise too difficult to measure. Changes in productivity or regeneration could be a signal of unforeseen agents affecting ecosystems, such as nutrient depletion or global climate change. The productive capacity of an ecosystem is also related to ecosystem resilience to disturbance and stress.

## 6.2 INDICATOR 2.1A (A TYPE)

Annual removal of timber products and non-timber products from forest ecosystems by volume.

### 6.2.1 Targets

- The allowable timber harvest rate not to be exceeded.
- Ensure the harvest rate of all non-timber forest products is sustainable.

### 6.2.2 Monitoring

- Annual reporting of volume removed against allowable timber harvest rate.



**6.2.3 Research**

- See research needs for B and C type indicators.

**6.2.4 Indicator 2.1a**

**ANNUAL REMOVAL OF TIMBER PRODUCTS AND NON TIMBER PRODUCTS FROM  
FOREST ECOSYSTEMS BY VOLUME.**

Product	private	Property	State	forests
	current actual volume	policy target volume	Current actual volume	policy target volume
Timber	1298 m <sup>3</sup>		473423m <sup>3</sup>	
Native flora	unknown		(seed) 7 kg	
Honey	78568 kg		78568 kg	
Grazing			4 occupation permits 13 crown leases	
Indigenous Product type a Product type b Etc	no data known		no data Recorded	

**6.3 INDICATOR 2.3 (A TYPE)**

Standing volume of log stocks by species groups and diameter at breast height class for multi-aged native forest and available for timber production by land tenure.

**6.3.1 Targets**

- Log stocks to be maintained within a range compatible with a sustainable sawlog industry after finalisation of the RFA.

**6.3.2 Monitoring**

- The harvested area volumes, and standing volume will be reported as part of State Forest Harvested Compartments Monitoring Procedures. These procedures will be conducted as part of SFNSW operational-level assessments, which will be integrated with current FRAMES data and procedures.
- Data for harvested compartments will need to be combined with data from non-harvested areas of State Forest and data from other tenures.
- Changes in indicators reported by these harvest monitoring procedures must be verified by field inventory, but may be difficult to detect due to the imprecision of base line data, and because of changes due to growth and disturbance in non-harvested compartments and on private land.
- All monitoring procedures should be reviewed in the second year of reporting. This review should consider the reliability and magnitude of changes reported for harvested compartments, against other changes in State Forest and other tenures. A full accounting of timber harvest and log stocks should be undertaken in the fifth year of the RFA.
- All methodology and data that is gathered on publicly owned forest should be available for either peer or stakeholder review.

**6.3.3 Research**

- Growth dynamics, silviculture and inventory of regrowth forest.

**6.3.4 Indicator 2.3 (A type)**

Standing volume of log stocks by species groups and diameter at breast height class for multi-aged native forest and available for timber production by land tenure.

**MULTI-AGED FOREST**

Commercial species	current (1997) standing merchantable (m <sup>3</sup> ) sawlog stock		
	private property	State forest	
		< 40 cm dbh	> 40 cm dbh
Silvertop ash		10700	145600
Stringybarks		16000	160300
Monkey gum		5400	74800
Messmate		4200	69400
Spotted gum		3100	12100
Tableland spp		3600	76300
Specials		700	3300
Other		3300	39300

Data is sourced from FRAMES Technical Committee process and represents pre RFA assessment.

# 7. SOIL AND WATER – A TYPE INDICATORS

## 7.1 DEFINITION OF SOIL AND WATER PROCESSES

This Criterion encompasses the conservation of soil and water resources and the protective and regulatory functions of forests. Chemical, physical and biological characteristics of aquatic systems are an excellent measure of the condition and sustainability of the forests around them.

Human activities can impact on the soil surface, expose soil to erosion, and diminish productivity. Improper timber harvesting can increase the sediment load in streams, affect in-stream habitats, and compact soils, particularly in snig tracks and log dumps. Harvesting can also increase run-off and lead to the loss of nutrients. To protect soil and maintain water quality in the Eden RFA region, a series of planning and operational controls, linked to the hazard of soil erosion in each area, has been implemented. Monitoring of the following indicators is designed to ensure that these controls are working well over time.

## 7.2 INDICATOR 4.1 (A TYPE)

Road density by category and catchment, and stream crossing density by catchment, for the total RFA area, including forest and non forest areas. Calculation of an Ecologically Sustainable Roding Index and an Ecologically Sustainable Crossing Index.

### 7.2.1 Targets

- Optimise road type and density to meet soil and water protection controls and to provide adequate access for economic timber extraction.
- Establish and set targets for continuous improvement against an Ecologically Sustainable Roding Index.
- Optimise the type and density of drainage line crossings to meet soil and water protection controls and adequate access for economic timber extraction.
- Establish and set targets for continuous improvement against an Ecologically Sustainable Crossing Index.

### 7.2.2 Monitoring

- Each agency must develop a road management plan that itemises future road construction, upgrading of roads and crossings and road closure over its estate. The monitoring needs to be linked to targets that have been set for continuous improvement against the Ecologically Sustainable Roding Index and Ecologically Sustainable Crossing Index. See Appendix C.

### 7.2.3 Research

- Model relative sediment delivery hazard from each type of road and crossing in the region through quantifying the sediment loss from each road type and each crossing type. Road types would be the six classes already noted in the tables, while crossing types would be bridges, culverts, causeways and gully stuffers, divided according to whether they are effective or not effective.
- Determination of the extent of temporary roads and crossing and what classes they fall into and set up a GIS layer for them as a basis for research and monitoring.
- Rainfall simulation studies of all road types and road construction and maintenance practices to determine relative sediment distribution.
- The Pollution Control Licence that State Forests holds with the EPA can be used as a benchmark for effective protective measures for crossings and road maintenance.

### 7.2.4 Indicator 4.1 (A type)

Road density by category and catchment, and stream crossing density by catchment, for the total RFA area, including forest and non-forest areas. Calculation of an Ecologically Sustainable Road Index and an Ecologically Sustainable Stream Crossing Index.

#### Pre RFA situation:

#### PERMANENT ROADS WITHIN STATE FOREST INCLUDING PLANTATION

Catchment Name	State forest area within the catchment within RFA area (ha)	length = metres in State forest  density = metres per 100 hectares of State forest	road classification within State forest						number in State forest  density = number per 100 hectares of State forest	Stream Crossings
			Class 1	Class 2	Class 3	Class 4	Class 5	Class 6		
Bega	15726	length (m)  density (m/100ha)	890 6	670 4	17500 111	63190 402	13110 83	69450 442	number  density (no/100ha)	122  0.8
Coastal Central	22380	length (m)  density (m/100ha)	5450 24	1210 5	41380 185	97240 434	15630 70	149150 666	number  density (no/100ha)	184  0.8
Coastal North	17194	length (m)  density (m/100ha)	6400 37	0 0	530 3	83810 487	66060 384	40840 238	number  density (no/100ha)	54  0.3
Coastal South	31103	length (m)  density (m/100ha)	22870 74	0 0	61940 199	175520 564	21180 68	110010 354	number  density (no/100ha)	254  0.8
Genoa	25987	length (m)  density (m/100ha)	8820 34	0 0	27310 105	36540 141	39890 153	54220 209	number  density (no/100ha)	381  1.5

Catchment	State forest	length = metres in State forest	road classification within State forest						number in State forest	stream
			Class 1	Class 2	Class 3	Class 4	Class 5	Class 6		
Name	area within the catchment within RFA area (ha)	density = metres per 100 hectares of State forest							density = number per 100 hectares of State forest	crossings
Murrumbidgee	326	length (m)	0	0	30	0	3240	3220	number	4
		density (m/100ha)	0	0	9	0	994	988	density (no/100ha)	1.2
Snowy	21561	length (m)	330	0	12820	24230	13370	27150	number	351
		density (m/100ha)	2	0	59	112	62	126	density (no/100ha)	1.6
Towamba	38378	length (m)	15050	320	44880	119020	60310	93130	number	491
		density (m/100ha)	39	1	117	310	157	243	density (no/100ha)	1.3
Wallagarough	51856	length (m)	24750	0	101790	231680	11570	201690	number	434
		density (m/100ha)	48	0	196	447	22	389	density (no/100ha)	0.8
TOTAL of all State Forest in RFA area	224511	length (m)	84560	2200	308180	831230	244360	748860	number	2275
		density (m/100ha)	38	1	137	370	109	334	density (no/100ha)	1.0

Where

- class 1 = primary access road (all weather road, two lanes).
- class 2 = secondary access road (generally all weather, one lane 4.2 to 5.5 formation width).
- class 3 = feeder road (generally all weather, one lane 3.7 to 4.2 metre formation width).
- class 4 = harvesting road (dry weather, natural surface, one lane, priority log haulage).
- class 5 = link road (dry weather, natural surface, one lane, and priority general management).
- class 6 = fire trail (dry weather, natural surface, four wheel drive necessary).

Data is sourced from State Forests Corporate Road Library Layer for Eden Management Area. This layer was made available for the RFA process. The data contained within this layer is drawn from State Forests' road records at 1:25,000 scale for permanent roads only. The data does not include contractor constructed logging roads built for temporary access only and subsequently allowed to revegetate following harvesting, post log burning and regeneration surveys. Data for temporary roads is not currently available.

Extend table with mean rating of ESRI and ESCI by catchment when methodology for road and crossing index adopted. See appendix 4 for methodology.

Pre RFA Situation

**PERMANENT ROADS OUTSIDE OF STATE FOREST INCLUDING BOTH FOREST AND  
NON FOREST ESTATE**

Catchment Name	area of non State forest within the catchment within RFA area (ha)	length = metres outside State forest Density = metres per 100 hectares of land outside of State forest	road classification outside State forest					Number outside State forest Number = Number per 100 hectares of land outside of State forest	Stream Crossings
			paved >=2 lanes	Roads 1 lane	Unpaved Roads		un- Known		
					>=2 lanes	1 lane			
Bega	194061	length (m)	280610	17090	82220	337870	21000	Number	1980
		density (m/100ha)	145	9	42	174	11	Density (no/100ha)	1.0
Coastal Central	37427	length (m)	170590	10120	28850	67810	42850	Number	529
		density (m/100ha)	456	27	77	181	114	Density (no/100ha)	1.4
Coastal North	71384	length (m)	79980	7960	28200	73750	10120	Number	417
		density (m/100ha)	112	11	40	103	14	Density (no/100ha)	0.6
Coastal South	32754	length (m)	17410	0	80	33280	170	Number	104
		density (m/100ha)	53	0	0	102	1	Density (no/100ha)	0.3
Genoa	26455	length (m)	9030	0	14410	57610	41430	Number	84
		density (m/100ha)	34	0	54	218	157	Density (no/100ha)	0.3
Murrumbid gee	44563	length (m)	11240	0	30550	50740	1160	Number	383
		density (m/100ha)	25	0	69	114	3	Density (no/100ha)	0.9
Snowy	111327	length (m)	9830	5570	39750	231030	41240	Number	1119
		density (m/100ha)	9	5	36	208	37	Density (no/100ha)	1.0
Towamba	64541	length (m)	27780	2360	68040	87910	35260	Number	569
		density (m/100ha)	43	4	105	136	55	Density (no/100ha)	0.9
Wallagarau gh	7189	length (m)	10520	1130	0	3050	0	Number	14
		density (m/100ha)	146	16	0	42	0	Density (no/100ha)	0.2
Unknown	138								
<b>TOTALS</b> of all Non State forest in RFA area	589739	length (m)	705460	44220	292120	943030	193220	Number	5199
		density (m/100ha)	120	7	50	160	33	Density (no/100ha)	0.9

Data is sourced from Department of Lands and Water Conservation, Land Information Centre for roads in the Eden RFA. Note that due to two different digitising sets the combined data for the Eden RFA is only available as two sets and cannot be reasonably standardised. The unknown catchment type is a digitising error that did not capture a section of the catchment boundary in the north of the RFA area between the Murrumbidgee and Coastal North catchments.

# 8. ECONOMIC AND SOCIAL – A TYPE INDICATORS

## 8.1 DEFINITION

A prevailing feature of forests is that they are renewable and, with management regimes that retain their ecological integrity, can be sustained in perpetuity. Historically, population growth and development pressures have resulted in the conversion and loss of forested land to other uses and in some cases, degradation of forest ecosystems. In addition, there has been a tendency to focus on the extraction of timber and the management of the forest land base to maximise timber production. The adoption of ecologically sustainable forest management as a goal, however, has significant implications for the use and management of forests of the Eden RFA region. Sustainable management implies:

- that land tenures and management plans will provide greater recognition of the non-timber forest goods and services;
- that the needs of future generations will be considered in decisions regarding the use, management and conservation of forests;
- that equity in rural forest based communities, rights of Indigenous peoples and impacts on employment will be considered in decision making;
- a greater degree of integration of economic and environmental objectives in decision making.

The ability to continue to deliver goods and services requires the maintenance of the forest land base and of forest ecosystem processes. Ecologically sustainable forest management also includes economic development and the value of forests as an economic resource. Economic development provides a diverse range of goods and services:

- timber products and the revenues from their sale;
- economic benefits from the conversion and sale of timber into forest products including employment, incomes, and profits;
- economic benefits from recreation, eco-tourism, private camping grounds, tourism lodges, etc;
- use of the forest to obtain subsistence products, such as food and firewood, and for gathering of nuts, berries, botanical products and medicines;
- benefits to people with permanent or temporary residences in forest areas; and

- values associated with the knowledge that a) particular rare and threatened forest flora and fauna are being protected and will continue to exist, b) forests are being conserved for future generations, and c) the option to undertake a certain type of activity in the future is available. This group of values is part of the important class of values called 'passive use' or 'non-use' values.

Production of goods and services occurs by combining inputs from forest resources, labour, capital, and various intermediate products. For example, investing in silviculture and protection can enhance forest productivity. The economic benefits associated with harvesting of forests are dependent on the level of investment. Much forest based economic benefits either would not be available or would be available at lower levels without investment in processing. Investment will occur if there is some economic incentive or motivation to invest. The supply of benefits from the forest resource is therefore dependent on the level of investment, and this in turn is based on the expected return from the investment.

Equity, social justice and cultural values are important aspects of ecologically sustainable development. The practices of forest management and utilisation are generally rural based activities. Rural economies and rural communities are distinct and face unique challenges compared to urban communities. The economies of rural forest based communities often have difficulties in adapting to rapidly changing economic circumstances. Many of these changing circumstances are also driven by events or decisions made outside the rural communities or the forest sector. Indigenous societies also have unique ties, values and knowledge of forest use and management. Strict reliance on the principles of economic efficiency and maximisation of economic wealth may result in residents of forest based communities incurring a disproportionate share of the cost of economic change.

## **8.2 INDICATOR 5.1 (A TYPE)**

Average volume and royalty value of logs harvested per annum by species and grade by tenure.

### **8.2.1 Targets**

- Log prices paid by product type that represent a fair return to the owner.
- Harvest not to exceed allowable cut by product type per 5 year period of RFA, within  $\pm 5\%$ .
- Harvest by product type not to vary by more than  $\pm 25\%$  of allowable annual cut supply commitments in any given year.
- Volume outcome to be specified in RFA.
- Ensure supply to industry includes a minimum level of logs from preferred tree species.

### **8.2.2 Monitoring**

- Statistics collected on local sale volumes by State Forests from sales records and licensed sawmill intake returns. The data must be collated and presented on a cumulative yearly basis available for public inspection.
- Notification of general royalty rate changes to the public unless presentation violates clauses contained in sales agreements.
- Production of annual financial accounts on timber revenues and timber management expenditure by State Forests.
- State Forests royalty rates for sawlogs, pulplogs, seed collection, apiary sites, grazing and mining can be measured within the Eden RFA region and compared against rates on State Forest land in other RFA regions or jurisdictions. Royalty rates often relate to the access rights to a particular value (eg, grass for grazing and flowers for honey production) and may be difficult to compare with market rates on other tenures because royalty rates may not



exist for private land. For some products (eg grazing, apiary) the royalty value will be a direct correlation to the number of (standard price) permits issued within the region.

### 8.2.3 Research

None proposed.

### 8.2.4 Indicator 5.1 (A type):

Average volume and royalty value of logs harvested per annum by species and grade by tenure.

### Pre RFA situation

#### STATE FORESTS TIMBER SALES (1996 CALENDER YEAR)

Grade	log species	(%)	Volume (m <sup>3</sup> )	royalty (\$)
Quota sawlog	silvertop ash	25	37034	1181972
	Stringybarks	21		
	monkey gum	6		
	Messmate	3		
	spotted gum	< 1		
	tableland spp	39		
	Specials	< 1		
	Other	4		
	Total			
ex-quota sawlog	silvertop ash	28	1227	19273
	Stringybarks	16		
	monkey gum	5		
	Messmate	3		
	spotted gum	1		
	tableland spp	28		
	Specials	< 1		
	Other	18		
	Total			

Grade	log species	(%)	Volume (m <sup>3</sup> )	royalty (\$)
Pulp log - multi-aged forest + thinning	Mixed		434200	8684000
Poles (1997)	Woolybutt	100	10	414
Firewood	Mixed		800	5206
Fencing	mixed durable		146	4289
Landscape	mixed durable		6	137

#### PRIVATE PROPERTY RECORDED SALES 1996

Log type	volume (m <sup>3</sup> )	Royalty (\$)
Sawlog	1000	not determined
Pulp log	298	not determined

### 8.3 INDICATOR 5.4 (A TYPE)

Employment numbers by type across all forest users in Eden region.

#### 8.3.1 Targets

- Increase number of forest related jobs.
- Increase the number of indigenous people employed in forested areas.

### 8.3.2 Monitoring

- The tabled data has been collected by the Social Assessment Unit (SAU) of DPIE specifically for the Eden RFA. A similar assessment would need to be undertaken to review these figures in 5 years time.
- ABS figures can also be used although ABS uses different wage categories and different employment divisions.

### 8.3.3 Research

None proposed.

### 8.3.4 Indicator 5.4 (A type)

#### EMPLOYMENT NUMBERS BY TYPE ACROSS ALL FOREST USERS IN EDEN REGION.

EMPLOYEE DIVISION	Total no. of employees	proportion of aboriginal employees
Forest Industries		
Hardwood - sawmilling <sup>a</sup>	37	
Hardwood - woodchips	75	
Hardwood - harvest, hauling & processing <sup>b</sup>	126	
Firewood and poles	10	
Hardwood - forest management	45	
Conservation management	33	
Non timber products		
Urban water production	na	
Hydro-electricity generation	4	
Grazing	8	
Dairy production <sup>c</sup>	Na	
Dairy manufacture <sup>c</sup>	Na	
Apiary	10	
Mining and extractive industry	?	
Tourism/recreation	Na	

Source: Post Impact Analysis and Regional Profile Analysis - Social Assessment Unit, DPIE.

a - Tablelands Sawmills in Cooma & Bombala.

b - Incorporates SAU categories 'Bush Workers, Haulage Contractors, Contractors, Truck Drivers and Additional Employees'.

c - Increment attributable to irrigation with water derived from forest catchments. Figures not available on diary farmers dependent on water from forested catchments.

Figures represent employment numbers directly dependent on the native forest resource from the Eden RFA Region the first half of 1997. Additional employees in the above categories reside within the Eden RFA Region but have not been recorded because their employment is not directly dependent on the native forest resource from the Region.

# 9. CULTURAL AND HERITAGE – A TYPE INDICATORS

## 9.1 DEFINITION

The concept of ecologically sustainable forest management transcends biological, ecological, and economic benchmarks. It is about society's values and needs and the cultural and spiritual connections of society to the forest. These cultural and spiritual connections and needs can vary substantially even among communities within a region. For example, the spiritual and cultural needs and values of indigenous peoples are unique and distinct. The spiritual and cultural value of natural forests to people who live in rural and urban environments may be quite different but equally important. These indicators consider the cultural, social and spiritual values from two perspectives. First, they consider how actions are taken to protect and manage forested land in order to protect and preserve social and cultural values. Second, they consider the psychological values associated with non-consumptive and passive use activities. The condition of the heritage feature is not established for any of the recorded places.

The identification of known indigenous cultural sites and places is not listed in appendix 1. The absence of a record in appendix 1 contributes to protection of indigenous values.

## 9.2 INDICATOR 6.1 (A TYPE)

Change in condition and number of recorded places, artefacts, sites, buildings or other structures.

### 9.2.1 Targets

- Minimise the non-natural impacts on the condition of sites.
- Ensure that appropriate mechanisms are in place to protect heritage features and that threatening processes are managed with regards to indigenous or other cultural values based on a priority of significance and management implementation.
- Ensure that the public, including indigenous groups, are involved in the monitoring and rehabilitation of their sites.
- Maintain indigenous cultural heritage values in forests.

### 9.2.2 Monitoring

- Each agency to monitor and report on condition and any changes in indigenous and listed non-indigenous cultural and heritage sites within its own tenure. Brought to account on an annual basis.

### 9.2.3 Research

- Undertake research to survey and document indigenous and non-indigenous values.

### 9.2.4 Indicator 6.1

Change in condition and number of recorded places, artefacts, sites, buildings or other structures.

#### Important Note:

- This information 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 with historic value should be considered as indicative only assessment against National estate & State heritage criteria is yet to be undertaken.

### NON-INDIGENOUS CULTURAL HERITAGE (NATIONAL ESTATE AND STATE HERITAGE VALUE)

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
Old Growth Forest Patches – Kingfisher Road, Myrtle Mt, Wolumla Peak	Social Aesthetic	Indicative only Yurrammie SF	SFNSW	Fire Logging Silviculture	PMP 1.2	Nil logging. Nil silviculture. Nil fire. Nil timber impact - currently excluded from logging.
Panbula Goldfield	Social Historic Aesthetic	Nullica SF	SFNSW	Fire Mining Logging Silviculture	PMP 1.1.8 Heritage Act 1977 AHC Act 1975	Management by prescription - light intensity logging, nil fire. Nil timber impact - currently identified as PMP 1.1.8, with management by prescription according to conservation plan.
Goodenia Rainforest	Aesthetic	Yurrammie SF	SFNSW	Fire Logging Silviculture	Rainforest	Classification as PMP 1.1.6 & 1.1.2. Maintenance of viewing lines. Moderate timber impact on surrounding forest.
Tannery Site, Gnupa SF	Potential Historic	Gnupa SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8. Management by prescription - light intensity logging, nil fire. Moderate timber impact - conservation of representative area of forest around site, needs to be clearly delineated.

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
Yambulla Goldfields & Township	Potential Historic	Yambulla SF	SFNSW	Fire Mining Logging Silviculture	Heritage Act 1977 PMP 1.1.8 PMP 1.2 PMP 1.3 PMP 1.1.7	Additional classification of significant areas as PMP 1.1.8.  Management by prescription - light intensity logging, nil fire.  Substantial timber impact - only some areas currently PMP 1.1.8, 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 Silviculture	Heritage Act 1977	Classification of significant areas as PMP 1.1.8.  Management by prescription - light intensity logging, nil fire.  Moderate timber impact - needs to be clearly delineated.
Hites Waterwheel Sawmill Site & Rockton Falls	Social Aesthetic Potential Historic	Bondi SF	SFNSW	Fire Logging Silviculture	Stream side reserve	Classification as PMP 1.1.2.  Nil timber impact – currently protected by stream side 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 timber impact – 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	Management by prescription - light intensity logging, nil fire.  Maintenance of viewing lines.  Moderate timber impact due to extensions of current PMP 1.1.6.
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	Management by prescription - light intensity logging, nil fire.  Nil timber impact - no change to current management

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
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	Classification of entire area as PMP 1.1.6.  Management by prescription - light intensity logging, nil fire.  Moderate timber impact - identification of 5m buffer for pine plantation, 20m buffer for native forest.
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.  Management by prescription - light intensity logging, nil fire.  Maintain historic values.  Maintain viewing lines.  Nil timber impact – 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	Management by prescription - light intensity logging, nil fire.  Maintain viewing lines.  Nil timber impact - no change to current management.
Fisheries Beach walk	Aesthetic	East Boyd SF	SFNSW	Fire Logging Silviculture	PMP 1.1.6	Management by prescription - light intensity logging, nil fire.  Maintain viewing lines.  Nil timber impact - . 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 timber impact – 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 timber impact – contained within current forest preserve and excluded from harvesting.

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
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 timber impact – 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	Management by prescription - light intensity logging, nil fire Maintenance of viewing lines
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 timber impact – 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. Management by prescription - light intensity logging, nil fire. Maintenance of viewing lines. Nil timber impact - no change to current management.
Wog Way Forest Drive	Aesthetic	Bondi / Coolangubra SF	NPWS & SFNSW	Fire Logging Silviculture	PMP 1.1.6	Management by prescription - light intensity logging, nil fire. Maintenance of value. Maintenance of viewing lines. Moderate timber impact - extension of current buffer.
Montreal Goldfields	Potential Historic	Bermagui SF	SFNSW, Crown Land & Private	Fire Mining Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8. Management by prescription - light intensity logging, nil fire. Low timber impact expected as mostly a freehold & crown land issue.

Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
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 timber impact - sited on cleared land within pine plantation.
Quarry Site	Potential Historic	Nalbaugh SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Unrestricted forestry. Nil timber impact - 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 timber impact - no change to current management practices.
Sleeper cutter camps, Murrrah SF	Potential Historic	Murrrah SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8. Management by prescription - light intensity logging, nil fire. Negligible timber impact - needs to be clearly delineated.
Wolumla goldfield	Potential Historic	Yurrammie SF	SFNSW, and possibly some private	Fire Mining Logging Silviculture	PMP 1.1.6	Classification as PMP 1.1.8. Management by prescription - light intensity logging, nil fire. Potentially substantial timber impact if entire area rezoned. Only some of the area is currently PMP 1.1.6 with harvesting by prescription.
Woolingubrah Inn	Potential Historic	Coolangubra SF	SFNSW	Fire Logging Silviculture	Heritage Act 1977	Classification as PMP 1.1.8. Management by prescription - light intensity logging, nil fire. Potentially substantial impact on pine resource if suggested buffer is placed. Site currently has a variable 50 -100m buffer.



Heritage Feature (Place Name)	National Estate /State Heritage Value	Location	Tenure	Threatening Processes	Current Protective Mechanisms	Management and timber resource Implications for SFNSW
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.  Management by prescription - light intensity logging, nil fire.  Maintenance of viewing lines.  Nil timber impact. Moderate timber impact however if current management prescriptions for PMP 1.1.6 are changed.

# 10. BIODIVERSITY – B TYPE AND C TYPE INDICATORS

The following indicators have been identified for further development work during the first five year period of the RFA.

## **10.1 INDICATOR 1.3B (B TYPE)**

List of representative species by extent and abundance. Representative sample to include threatened species, key functional groups and indicator species.

### **10.1.1 Targets**

- Avoid species becoming endangered.
- Improve the risk status of endangered species.
- Ensure ecosystem function is maintained.
- Ensure the efficacy of conservation protocols.

### **10.1.2 Monitoring**

- The monitoring requirements will be developed during the first five year period of the RFA. These could include monitoring population size and habitat availability over time.

### **10.1.3 Research**

- Identify threatened species, key functional groups and indicator species.
- A key aspect of research is to establish a strengthened foundation for our understanding of individual species and their habitat, food and shelter requirements to add to the scientific basis for the review of conservation protocols. In addition, efficient population monitoring and census techniques are needed.
- Refine methods for estimating population size and dynamics.
- Refine habitat models to aid in targeting survey and to improve species management.
- Monitor population size and habitat availability over time.
- Study the interaction among species and their contribution to ecosystem function.

**10.1.4 Indicator 1.3b (B type)**

List of representative species by extent and abundance. Representative sample to include threatened species, key functional groups and indicator species.

**Important Note:**

The following species should be considered as indicative, and will require population of tables according to the species best known by the process.

Functional Group	Species considered	Estimated Population	Population Target	Suitable Habitat	Target Habitat
Hollow dependent fauna	Greater Glider (monitor wide range of pops)				
	Yellow-bellied Glider				
	Powerful Owl				
	Sooty Owl				
	Masked Owl				
<b>Arboreal fauna</b>	Koala				
<b>CWR</b>	Bush Thick-nee				
	Eastern Bristlebird				
	Brush-tailed Phascogale				
	Tiger Quoll				
	Southern Brown Bandicoot				
	Long-footed Potoroo				
	Long-nosed Potoroo				
	Brush-tailed Rock Wallaby				
	Smoky Mouse				
	White-footed Dunnart				
<b>Carnivores</b>	Tiger quoll				
<b>Frogs</b>					
<i>Mixophes balbus</i>	Stuttering frog				
<i>Heleioporus australiacus</i>	Giant Burrowing frog				
<i>Litoria lesueri</i> * may have difficulty extrapolating results to threatened frogs	Leseur's frog				
<b>Bats</b>					
<i>Miniopterus schreibersii</i>	Common Bent-wing				
<i>Falsistrellus tasmaniensis</i> or <i>Scoteanax rueppellii</i>	Eastern False Pipistrelle or Greater Broad-nosed (to be determined)				
	Eastern Horseshoe Bat				
<b>Birds</b>	Red-Browed Treecreeper				
	Pink Robin				
	Olive Whistler				
	Yellow-tailed Black-Cockatoo				
	Glossy Black-Cockatoo				
	Square-tailed Kite				
	Satin Flycatcher				
	Leaden Flycatcher				
	Varied Sittella				
Plants???					
Nectivores??					
Herps???					

# 11. PRODUCTIVE CAPACITY – B TYPE AND C TYPE INDICATORS

## 11.1 INDICATOR 2.1B (B TYPE)

Annual removal of timber and non-timber products from forest ecosystems compared with those estimated to be ecologically sustainable by tenure.

### 11.1.1 Targets

- The determined ecologically sustainable yield not to be exceeded.

### 11.1.2 Monitoring

- The harvested area and changes in growth stage, harvested volumes, and standing volume will be reported as part of State Forest Harvested Compartments Monitoring Procedures.
- Identify the non-timber products being harvested, their method of regulation, if applicable, and report against their sustainable yield if known.
- Ecologically sustainable levels do not exist for some product types eg water, seed, honey, and grazing. Work needs to be done to establish sustainable levels for products other than timber. For example, grazing it can be related to carrying capacity, the apiary association may be able to direct work on sustainable honey production (eg number of hives per hectare for particular forest types).

### 11.1.3 Research

- Research into the growth dynamics, silviculture and inventory of native forests.
- Research into the sustainable yield of non-timber products.

**11.1.4 Indicator 2.1b (B type)**

Annual removal of timber and non timber products from forest ecosystems compared with those estimated to be ecologically sustainable by tenure.

Product	private	Property	State	forests
	Current actual volume	RFA target volume	Current actual volume	RFA target volume
Timber	1298 m <sup>3</sup>		473423m <sup>3</sup>	
native flora	unknown		(seed) 7 kg	
Honey	78568 kg		78568 kg	
Grazing			4 occupation permits 13 crown leases	
Indigenous Product type a Product type b Etc	no data known		no data Recorded	

**11.2 INDICATOR 2.2 (C TYPE)**

Site quality and conservation of nutrients in forest ecosystems.

**11.2.1 Targets**

Ensure the maintenance of site quality within natural ranges.

**11.2.2 Monitoring**

Research will be conducted during the first five year period of the RFA to define monitoring systems for future years.

**11.2.3 Research**

- Evaluation of potential models for calculation of nutrient budgets and their likely response to variable timber harvesting practices and fire regimes.
- Refer to the related research being undertaken by the Montreal Implementation Group for assessment of changes in soil organic matter and bulk density (interim indicators 4.1d and 4.1e).

**11.2.4 Indicator 2.2 (C type)**

Site quality and conservation of nutrients in forest ecosystems.

Evaluation of Eden EIS 1986 for relationship between nutrient budgets (available and total major nutrients) and harvesting systems.

# 12. HEALTH AND VITALITY – B TYPE AND C TYPE INDICATORS

## 12.1 INDICATOR 3.1 (B TYPE)

List of biological factors influencing forest health and vitality including weeds, feral animals, insects and diseases.

### 12.1.1 Targets

- Cost effective control of pest and weed species and forest diseases to benign levels.
- Reduce the impact of processes that negatively affect ecosystem health and vitality. (NPWS)
- Reduce the level of feral species populations.

### 12.1.2 Monitoring

- Individual agencies (NPWS, SFNSW, & RLPB) to collect and annually report on biological factors in a consistent manner.
- Measure populations of several target species for extrapolation across the region during intensive control programs. Target species are pigs, goats, foxes/dogs, cats and rabbits.
- Agencies to develop complaints register on biological factors received from the community.

### 12.1.3 Research

- Research to test the link between feral animal control efforts and the response of endangered species.
- Survey the extent of Bell-miner/psyllid insect interaction, associated die-back and examine the possible relationship with logging history.

**12.1.4 Indicator 3.1 (B type)**

Lists of biological factors influencing forest health and vitality including weeds, feral animals, insects and diseases).

**NATIONAL PARK & NATURE RESERVES**

Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort**	Measure of effectiveness	Current monitoring
Rabbit	Restricted areas	Minor (veg. Effects, soil erosion)		Baiting. Virus release (calici & mixo)	\$5 540 1996/97	Spotlighting to estimate density. Dung counts Warren activity (secondary) Vegetation monitoring (plot or photopoint)	Contract Rural Lands Protection Board to monitor via spotlighting & other methods. Records not kept - aimed at targeting areas needing future pest control rather than past effectiveness.
Fox	Widespread	Significant (threatened spp, esp little terns, potoroos)		1080 baiting (in conjunction with dogs)	\$21 250 1996/97	Spotlight counts (more variable results than sand plots) * blank sand plots with lure chemicals & unpoisoned baits * trap success * bait removal	No strategic monitoring program, but records kept of numbers shot and of visits during free-feeding prior to baiting.
Cats	Unknown	Unknown (threatened species)		Trapping	\$1 635 1996/97	* spotlight counts * blank sand plots with lure chemicals & unpoisoned baits * trap success * bait removal	No strategic monitoring program, but records kept of numbers shot.
Dog	Widespread	not a NPWS priority, but control undertaken on perimeters of park to assist neighbours		1080 baiting (in conjunction with foxes)	\$23 220 plus \$10 000 for survey 1996/97	Spotlight counts * blank sand plots with lure chemicals & unpoisoned baits * trap success * bait removal	No strategic monitoring program, but records kept of numbers shot and of visits during free-feeding prior to baiting.

Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort**	Measure of effectiveness	Current monitoring
Pigs	Widespread	Moderate (soil erosion, fouling of water)		Trapping, then shooting.	\$18 150 1996/97	* ground or aerial counts * counts at water * dung counts * surveys of pig signs * free-feeding before & after control program (quantity of bait consumed)	No strategic monitoring program, but records kept of numbers shot.
Goat	Widespread	Significant (soil erosion, grazing effects)		Radio tracking, then shooting.	\$33 400 1996/97	* aerial and ground head-counts * dung counts	No strategic monitoring program, but records kept of numbers shot.
Pine trees	Widespread	Significant, potentially large (change in veg communities, visual disturbance)		Felling and basal herbicide.	\$3 000 1996/97	* Photopoints * Plots	Subjective visual assessment only.
Arum Lily	Restricted pockets	Low (altered veg communities)		Herbicide spraying (backpack).	\$440 1996/97	* Photopoints * plots	Subjective visual assessment only.
Blackberry	Restricted areas	Low (altered veg communities)		Herbicide spraying (backpack).	\$1 000 1996/97	* Photopoints * plots	Subjective visual assessment only.
Bitou Bush	Small areas in NPWS lands, adjacent to large areas on other land tenures.	Low, but potential (noxious weed)		Hand weeding.	\$1 100 1996/97	* Photopoints * plots	Subjective visual assessment only.
Tree of Heaven	Small areas	Minor (altered veg communities)		Chop down, apply herbicide.	\$220 1996/97	* Photopoints * plots	Subjective visual assessment only.
Fireweed	Restricted to disturbed areas.	Low (altered veg communities)		Herbicide plus revegetating to shade out.	\$1 000 1996/97	* Photopoints * plots	Subjective visual assessment only.



Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort**	Measure of effectiveness	Current monitoring
Serrated Tussock	Restricted areas adj to SF where it is a problem.	Minor (altered veg communities)		Herbicide	\$1 700 1996/97	* plots	Subjective visual assessment only.
Nodding Thistle	Restricted pockets	Minor (altered veg communities)		Herbicide	\$250 1996/97	* Photopoints * plots	Subjective visual assessment only.
Paterson's Curse	Restricted areas	Minor (altered veg communities)		Herbicide	\$250 1996/97	* Photopoints * plots	Subjective visual assessment only.
Willow tree	Remote waterways and gullies.	Low, but potential (altered waterways)		Helicopter survey and access to poison and chop.	\$2 250 1996/97	* Photopoints * plots	Subjective visual assessment only.
Crofton Weed	Restricted to 2 areas.	Low, (new weed in this area & immediate program to remove) but potential for greater impact		Herbicide	\$150 1996/97	* plots	Subjective visual assessment only.
African Lovegrasses	Restricted	Low, but C1 species		Herbicide and hand weeding.	\$1 900 1996/97	* plots	Subjective visual assessment only.
Blue Periwinkle	Restricted areas	Minor (altered veg communities)		Herbicide	\$320 1996/97	* Photopoints * plots	Subjective visual assessment only.
Broom	Small areas	Minor (altered veg communities)		Herbicide	\$270 1996/97	* Photopoints * plots	Subjective visual assessment only.



Qualitative information is sourced from NPWS district pests control operators and is anecdotal rather than quantitative. Any studies of measurable extent or impact, or population densities that have been undertaken have been over restricted areas. Operational costs do not include overheads or salaries. NPWS Field Services Division have estimated the true cost to be approximately double than shown.

### Rabbits

- **Spotlighting Method:**
  - drive a fixed route
  - count all rabbits seen
  - repeat counts for 3 nights
  - if average of these counts has a coefficient of variation >20%, need to count for more nights
- **Minimising Variation:**
- **\*spotlight at the same time each night**
  - take the same route in the same direction
  - travel at the same speed
  - use the same spotlight power
  - use the same vehicle and observer
  - has observer at the same height
  - spotlight under the same weather conditions
- **Problems:**
  - cannot compare estimates between seasons as vegetation heights will affect counts. (Can compare between the same season in different years)
- **Photopoint Technique**

### Goats

- **Head Count Method:**
  - count only light coloured goats
  - count 200 goats and determine the proportion that is light coloured
  - Total no of goats = no of light goats spotted from air/ proportion of light coloured goats
- **Dung Count Method:**
  - set up permanent plots which cover a range of habitat types, aspects and altitudes
  - count pellet accumulation every 3 months
  - results expressed as no of pellets/m<sup>2</sup>/unit of time OR presence/absence eg % of plots with dung per 3 months.
- **Problems:**
  - rain causes pellets to wash away or aggregate
  - if sheep are present, their dung is easily confused with goat dung
- **Pigs:**
  - Survey of signs will not usually provide an accurate assessment of pre-control abundance, but may give good information on the rate of reduction in abundance

### Foxes:

- Behaviour of animals after a shoot may be different, giving biased spotlight counts post control.
- The no of animals visiting a bait station cannot be gauged from tracks on sand plots.

## STATE FORESTS

Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort	Measure of effectiveness on population	Current monitoring
Pig	Widespread	Significant (soil erosion, fouling of water, grazing effects)	Illegal release.	Tapping, then shooting. Snares.	High (\$44611 1996/97)	Evidence of animals, public complaints in interface areas.	
Dog/Fox	Widespread	Significant (prey on native animals, spread disease).	Loss or release of hunting and domestic animals.	1080 poison using mound baiting techniques. Snares. Rubber jawed traps.	High (\$13748 1996/97)	Evidence of animals, public complaints in interface areas.	
Cat	Widespread	unknown (potential prey on native animals)	Ample food. Release of domestic animals.	Currently testing traps and various techniques.	Low (\$1068 1996/97)	Sightings, evidence of animals.	
Goat	Restricted areas.	Low, Grazing effects	Ample food. Release of domestics.	Shooting	Low	Sightings, evidence of animals.	
Deer	Restricted areas.	Low, Grazing effects	Ample food. Release of domestics.	Shooting	Low	Sightings, evidence of animals.	
Rabbit	Restricted areas.	Low, grazing effects	Intensive logging.	1080 poison	Low	Evidence of animals.	
Blackberry	Restricted areas.	Minor, altered vegetation.	-	Herbicide: Active chemical – piclorom and triclopyr.  Common used trade name – Grazon	Low **	Evidence of weeds	

Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort	Measure of effectiveness on population	Current monitoring
Serrated Tussock	Restricted areas.	Minor, altered vegetation.	-	Herbicide (use ceased while alternative products examined): Active chemical – flupropanate sodium. Common used trade name – Frenock	Low **	Evidence of weeds	
Scotch Thistle	Common		Intensive logging. Road edge clearing	Herbicide: Active chemical - glyphosphates		Evidence of weeds	
Nodding Thistle	Restricted areas.	Minor, altered vegetation.	-	Herbicide: As advised by Dept of Agriculture and local shires.	Low **	Evidence of weeds	
Patterson's curse.	Restricted areas.	Minor, altered vegetation.	-	Herbicide: Active chemical – metsulfuron methyl. Common used trade name – Brushoff	Low **	Evidence of weeds	

\*\* total for 1996/97 \$2591

**PRIVATE PROPERTY (SOURCE FROM RURAL LANDS PROTECTION BOARDS)**

Biological factor	Extent	Impact	Accelerating cause	Control measure	Level of effort	Measure of effectiveness on population	Current monitoring
no data available within time frame for Eden RFA							

**12.2 INDICATOR 3.2 (B TYPE)**

Impact of fire on forest-related values.

**12.2.1 Targets**

- Prescribed burning regimes to reflect a balance between the protection of property and public assets and the conservation of forest related values.
- Reduction in impacts of fire on forest related timber values and avoidance of major wildfire events.

**12.2.2 Monitoring**

- Monitoring against the above targets will require research. The existing reporting mechanisms by State Forests and NPWS will be undertaken.
- Wildfire - Monitoring and reporting on the occurrence and impact of wildfire will be done on an individual agency basis (SFNSW, NPWS, and NSWRFSS) through the fire reporting system of each agency.
- Prescribed fire - Monitoring and reporting on the effectiveness of the planning and execution of prescribed burning programs will be done through the State-coordinated district bushfire management committee system for fuel reduction reporting. The Bushfire Management Committees in the Eden RFA are Bega Valley, Bombala, Cooma-Monaro and Eurobodalla.

**12.2.3 Research**

- Results of the Eden (Yambulla SF) Burning Study to be published.
- Research into the most appropriate prescribed burning and wildfire management regimes.
- Research the interaction between silviculture systems and wildfire risk (ie is the overall risk of wildfire in multi-aged forest and periodically regenerated even-aged forest significantly different).

**12.2.4 Indicator 3.2 (B type)**

- Impact of fire on forest related values.
- Information applicable to State forest

**TABLE A WILDFIRE – STATE FOREST**

STATE FOREST WILDFIRE	Low Intensity * (10 in 10 years)	Medium Intensity * (6 in 10 years)	High Intensity * (1 in 10 years)
Area burnt (average)	200 ha	320 ha	15,500 ha
Area burnt (range)	0 - 1,000	100 - 1,500	5,000 - 26,000
Objective - the overarching objective of wildfire suppression is the "Protection of Life, Property, Assets and Environmental Values".	A lower intensity wildfire is likely to be a lesser threat to life and property and more likely to be a threat to assets and environmental values. Protection objectives would be weighted toward the protection of assets and environmental values.	A medium intensity wildfire is likely to be a lesser threat to life but a greater threat to property, forest assets and environmental values. Protection objectives would be weighted toward the protection of property, assets and environmental values.	A high intensity wildfire is likely to be a significant threat to life and property. Protection objectives would be weighted toward the protection of life and property.
Impact on water, biodiversity, property and timber.	Water: Some impact on mid to upper slopes where fire crosses drainage lines. Lowest chance of wildfire crossing riparian strips. May occur in only one catchment. Forest canopies intact little impact from normal rain event. Vegetation structure: Mosaic of burnt and unburnt grass and shrub layer. Limited effect on medium strata. Little effect on forest canopy. Property: Nil to little effect on human property or assets. Timber: Low level impact. Some scarring of lower boles leading to defect or infiltration point for attack and decay. Minimal crown scorch (up to 5-10m). Will impact on young regrowth.	Water: Impact on mid and upper slopes. Fire will enter riparian strips and travel through all but the most wet forest areas. Likely to cross more than one catchment area. Forest canopy largely intact (patch scorched) some localised impact from normal rain event. Vegetation structure: Mosaic of burnt and unburnt grass and shrub but to a lesser extent. Will effect the medium strata and forest canopy in patches on mid to upper slope Property: Some risk of loss to human property and assets. Greatest risk to poorly maintained or unattended properties. Well managed with existing fire fighting equipment.	Water: Impact on all forested area. Fire will cross riparian strips and travel through all forested areas. Will cross more than one catchment. Nil or little forest canopy remaining, marked impact from normal rain event. Vegetation structure: No mosaic of burnt and unburnt. Effects all strata on all slopes (lower, mid and upper). Can cause death of trees of all ages but mostly very young or senescing trees. Can create patches of even aged regrowth. Can cause localised removal of some species. Property: Distinct risk of loss to human life and property. Often cannot be managed using existing fire fighting equipment (or any known equipment).

STATE FOREST WILDFIRE	Low Intensity * (10 in 10 years)	Medium Intensity * (6 in 10 years)	High Intensity * (1 in 10 years)
		Timber: Notable impact. Scarring of lower boles leading to defect or infiltration point for attack and decay. Full crown scorch in patches usually on mid to upper slopes. Heavy impact on young regrowth and medium strata.	Timber: Extensive impact. Deep scarring on most of the timber, leading to defect or infiltration point for attack and decay. Full crown scorch over extensive areas of forest. Heavy impact on all forest strata and timber
Control measures to achieve objectives.	Initial Attack: Direct - hand tools only Direct - Earthmoving equipment Direct - hand tools with knapsacks Indirect - hand tool line, no back-burn Indirect - existing roads and tracks, no back-burn Main Suppression: Indirect - existing roads and tracks, no back-burn Indirect - earthmoving machine line, no back-burn Indirect - hand tool line with back-burning Indirect - roads and tracks with back-burning Indirect - earthmoving machine line with back-burning	Initial Attack: Direct - earthmoving equipment Indirect - roads or tracks, no back-burning Indirect - roads and tracks with back-burning Main Suppression: Indirect - existing roads or tracks, no back-burning Indirect - earthmoving machine line with back-burning Indirect - roads and tracks with back-burning	Initial Attack: Indirect - roads and tracks, no back-burning Indirect - roads and tracks with back-burning Main Suppression: Passive - overnight conditions of dew or high humidity (combined with) Indirect - roads and tracks with back-burning Passive - previous prescribed burn Indirect - earthmoving machine line, no back-burning
Level of effort Average Hours	150 (hours)	320 (hours)	8,500 (hours)
Range Hours	0 - 1,100 (hours)	0 - 1,500 (hours)	7,000 - 10,000 (hours)

The separation of wildfire into intensity classes has been done using information pertaining to the Fire Danger Rating (FDR) on the day that the fire started. The intensity of the fire is inferred from the FDR recorded. No direct measure of fire intensity is available.



**TABLE B PRESCRIBED FIRE – STATE FOREST**

Type of prescribed burn	Low Intensity	Medium / High Intensity	Objective	Impact	Control measures to achieve objective	Level of effort
General Area Burnt  (avg) (range)	7,000 ha 3,500 - 12,000 ha	NIL	<p>The objective of general prescribed burning is to provide a mosaic of burnt and unburnt patches covering between 40-60% of the intended area.</p> <p>This objective can provide a range of benefits to the maintenance of biodiversity, forest health and vitality and to the protection of a valuable timber resource.</p>	<p>Water: Burning is carried out in cooler months when it's less likely that a fire will run overnight or cross a riparian strip. Fire may cross a drainage line on mid to upper slopes.</p> <p>Vegetation structure: A mosaic of burnt and unburnt patches in the grass and shrub layer and medium strata. This may have both positive and negative affects on species.</p> <p>Property: Little to no effect on adjacent property. Can benefit property protection in case of wildfire.</p> <p>Timber: Some minor scarring of lower boles is possible. Fire will sometimes climb into a tree's crown if it travels up the bark of a fibrous barked tree. Has a benefit in reducing the effects of a wildfire on the timber. Crown fires have been shown to fall to ground fires as the result of prescribed burning.</p>	The control measures used to achieve the burning objective are moisture differentials between the treated and untreated areas, natural boundaries and human made boundaries (roads, tracks etc).	<p>100 ha = 12 hours</p> <p>1000 ha = 35 hours plus 2 hours helicopter</p>
Strategic Area Burnt  (avg) (range)	3,000 ha 1,500 - 5,000 ha	NIL	<p>The objective of strategic prescribed burning is to provide a mosaic of burnt to unburnt patches covering up to 80% of the intended area.</p>	<p>Water: Burning is carried out in cooler months when it's less likely that a fire will run overnight or cross a riparian strip. Fire may cross a drainage line on mid to upper slopes.</p>	The control measures used to achieve the burning objective are moisture differentials between the treated and untreated areas, natural boundaries and human made boundaries (roads, tracks etc).	<p>100 ha = 12 hours</p> <p>1000 ha = 35 hours plus 2 hours helicopter</p>

Type of prescribed burn	Low Intensity	Medium / High Intensity	Objective	Impact	Control measures to achieve objective	Level of effort
			Strategically placed to maximise the effectiveness of the prescription for the protection of life, property, assets and environmental values.	<p>Vegetation structure: A mosaic of burnt and unburnt patches (less than general burning) in the grass and shrub layer and medium strata. Fire will sometimes climb into a tree's crown if it travels up the bark of a fibrous barked tree. This may have both positive and negative affects on species.</p> <p>Property: Limited effect on adjacent property or assets. Burning often done in cooperative manner between adjacent land-holders to maximise the strategic value of the prescription. Can benefit property protection in case of wildfire.</p>		
				Timber: Some scarring of lower boles is possible. Fire will sometimes climb into a tree's crown if it travels up the bark of a fibrous barked tree. Has a benefit in reducing the effects of a wildfire on timber quality. Crown fires have been shown to fall to ground fires as the result of prescribed burning.		
Post Logging Area Burnt (avg) (range)	3,650 ha 2,000 - 4,000 ha	700 ha 450 – 900 ha	The objective of post logging prescribed burning is to reduce fuels to a manageable level for the protection of young regrowth. This equates to reducing fine fuels by 80% and large fuels by 35%.	<p>Water: Burning is contained to logged areas and is not likely to run overnight or cross a riparian strip. Fire may cross a drainage line on mid to upper slopes.</p> <p>Vegetation structure: The fire will burn in a mosaic based on the area logged.</p>	The control measures used to achieve the burning objective are moisture differentials between the treated and untreated areas, natural boundaries and human made boundaries (roads, tracks etc).	50 ha = 15 hours

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Type of prescribed burn	Low Intensity	Medium / High Intensity	Objective	Impact	Control measures to achieve objective	Level of effort
				<p>Property: Little to no effect on adjacent property. Can benefit property protection in case of wildfire.</p> <p>Timber: Will assist in regeneration and assist in protection of regrowth forest from wildfire.</p>		



# 13. SOIL AND WATER – B TYPE AND C TYPE INDICATORS

## 13.1 INDICATOR 4.2 (B TYPE)

Changes to macro-invertebrate diversity in streams.

### 13.1.1 Targets

- Targets to be set based on National River Health Monitoring Initiative, with benchmarks set for aquatic systems in southeast NSW (Baseline Ecological Study of the Bega River System, Australian Water Technologies Report Number 97/251, March 1988 – prepared for the Far South Coast Catchment Management Committee; plus data in the 1994 Eden Management Area Environment Impact Statement).

### 13.1.2 Monitoring

- Monitoring should be based on protocols developed for National River Health Monitoring Initiative.

### 13.1.3 Research

- Undertake studies to identify baseline or benchmark macro-invertebrate diversity in key sampling sites as a basis for design of monitoring system.

## 13.2 INDICATOR 4.3 (C TYPE)

Extent and proportion of physical disturbance from harvesting and post harvest fire.

### 13.2.1 Targets

- Physical disturbance of subsoil and topsoil not to exceed the maximum and average percentage target for each harvest system. The current targets are an extrapolation of the limited scientific data available for logging in the south east. The figures represent current standards. Targets should be reviewed based on any research that extends knowledge on the impact of disturbance on soil and water resources.
- Following research, the physical disturbance of subsoil and topsoil must not exceed the predetermined disturbance level that maintains or improves site quality.
- Determination of what the allowable disturbance is before ecological impacts are too great to maintain ecological sustainability and prevent those physical disturbances that exceed these impacts.

### 13.2.2 Monitoring

- State Forests harvesting supervision process continue to report on occasions of excessive soil disturbance.
- Continue monitoring of logging operations with post logging surveys to capture disturbance occurrence and assess results against targets.

### 13.2.3 Research

- Using aerial photographs and ground surveying, systematically benchmark the degree of disturbance for each harvest system that will be used. Examine the range of variation within each harvest system and categorise factors leading to high levels of disturbance. Identify approaches to reducing disturbance.
- Research the relationship of physical disturbance and ecological sustainability to assist development of new target values.
- Research the consequences on the environment of practices causing physical disturbance.

### 13.2.4 Indicator 4.3 (C type)

Extent and proportion of physical disturbance from harvesting and post harvest fire.

#### **RECOMMENDED PRELIMINARY TARGETS, SUBJECT TO RESEARCH EVALUATION.**

Harvest system	sub soil exposed on general harvest area, snig tracks, dumps & internal logging roads (% of net harvest area)		Top soil exposed on general harvest area (% of net harvest area)		Total exposure of soil including top soil exposed on snig tracks, dumps and internal logging roads (% of net harvest area)	
	Average	Maximum	Average	maximum	average	maximum
A1	2	5	0	2	2	8
A2	3	7	0	3	4	11
B0	3	8	0	5	4	14
B1	3	10	1	10	5	20
B2	3	15	1	10	5	25
	Average	Maximum	Average	maximum	average	maximum
B3	12	20	4	10	20	40
C1	15	25	10	15	30	55
C2	5	8	5	8	10	16

Source: Extrapolated from collated research projects by Steve Lacey, soil research scientist SFNSW, and Robert Towler, senior soils specialist SFNSW.

### **13.3 INDICATOR 4.4 (B TYPE)**

Proportion of catchment (by percentage) likely to be harvested from 1997-2019 by harvest system as an immediate substitute for determination of possible cumulative effects on water quality.

#### 13.3.1 Targets

- Optimise the temporal and spatial distribution of timber harvesting within and across catchments.
- Achieve long term levels of water quality from forest catchments for the protection of aquatic ecosystems and primary contact recreation as identified in the ANZECC (1992) guidelines or specific objectives set through the water reform process.

#### 13.3.2 Monitoring

- Monitor spatial and temporal distribution of harvesting on a five yearly interval.

**13.3.3 Research**

- Examine the water quality effects of thinning.
- Evaluate the best method to monitor or model increases in suspended sediment loads following logging operations. This may involve mapping of saturated zones in relation to prescription buffers, logging intensity and antecedent rainfall. It could also involve modelling the probability of significant pollution for different harvesting intensities under current SEMGL using rainfall simulator data (eg Croke et al, 1997) and the results of saturated zone mapping.
- Determination of bed-load accretion at road crossings and from stream bank erosion in logged upper catchments.
- Select an area for catchment hydrology research on Ordovician metasediments to complement the Yambulla and Tantawangalo sites.

**13.3.4 Indicator 4.4 (B type)**

**PROPORTION OF CATCHMENT (BY PERCENTAGE) LIKELY TO BE HARVESTED FROM  
1997-2019 BY HARVEST SYSTEM AS AN IMMEDIATE SUBSTITUTE FOR  
DETERMINATION OF POSSIBLE CUMULATIVE EFFECTS ON WATER QUALITY.**

Catchment Name	Total Catchment size within RFA area (ha)		Harvested forest by harvest system from 1997-2019								
			A1	A2	B0	B1	B2	B3	C1	C2	total
Bega	209787	area (ha) proportion									
Coastal Central	59807	area (ha) proportion									
Coastal North	88578	area (ha) proportion									
Coastal South	63857	area (ha) proportion									
Genoa	52442	area (ha) proportion									
Murrumbidgee	44889	area (ha) proportion									
Towamba	102819	area (ha) proportion									
Wallagaraugh	59045	area (ha) proportion									
<b>TOTAL</b>	814251	area (ha) proportion									

Refer to part 5 and the Assessment of Forest Practices for the Eden RFA for description of harvest systems.

**13.4 INDICATOR 4.5 (B TYPE)**

The relative proportion (as a percentage) of forest growth stages from 1997-2019 by catchment as an immediate substitute for the rating of water yield.

**13.4.1 Targets**

- Set targets to balance growth stages across the landscape, in order to maintain dry weather flows.

**13.4.2 Monitoring**

- Describe the methodology to track growth stages by catchment. When methodology is established, assess changes in the balance among growth stages against targets for each catchment.

- Request that the CRC on catchment hydrology identify suitable sub catchments for either modelling or monitoring of harvest impact on water quantity using important urban supplies catchments. (eg Kiah bores, Myrtle Creek at the Wyndham bore on the Pamula-Wyndham road, Tantawanglo diversion weir, Moran's Crossing on the Bemboka River and Brogo dam).
- As part of the interpretation of this indicator, identify how much of each tenure falls within the RFA and the proportion of each catchment that it occupies. Identify the proportion of each catchment that is productive forest (private and public), protected (ie parks), cleared or agricultural land. Determine the net change over 20 years and the direction of any growth stage shift.

### 13.4.3 Research

- Identify potential targets for an optimum range of growth stages in catchments to provide water quantity needs.
- Publish recent results from Yambulla and Tantawangalo Research Catchments as soon as they become available and extrapolate results to predict impacts at a larger catchment scale using modelling techniques.
- Continue to monitor Yambulla and Tantawangalo weirs to investigate long term trends and the effects of tinning in the Yambulla catchment.
- Examine the hydrological effects of thinning regrowth forest.
- Develop modelling tools to integrate parameters from Indicators 4.1, 4.3 and 4.5 and other studies to predict changes in flow duration curves at the sites recommended under monitoring 4.5.2.

### 13.4.4 Indicator 4.5 (B type)

**THE RELATIVE PROPORTION (AS A PERCENTAGE) OF FOREST GROWTH STAGES  
FROM 1997-2019 BY CATCHMENT AS AN IMMEDIATE SUBSTITUTE FOR THE RATING  
OF WATER YIELD.**

Catchment Name	current (1997) gross area within catchments by growth stages (hectares)							
	Rainforest	old growth	old disturbed	Mature	Mature disturbed	Young forest	recently logged	cleared
Bega	4023	29200	2149	42439	7193	25670	4246	94867
Coastal Central	932	7410	693	21567	789	9554	3459	15404
Coastal North	2567	21051	1739	16393	4358	7278	2018	33177
Coastal South	901	10344	439	14262	81	26703	2244	8883
Genoa	84	5695	526	15497	482	7441	6221	16497
Murrumbidgee	0	6008	149	7452	349	2271	505	28155



Catchment Name	current (1997) gross area within catchments by growth stages (hectares)							
	Rainforest	old growth	old disturbed	Mature	Mature disturbed	Young forest	recently logged	cleared
Snowy	0	5123	741	8847	4408	7270	6184	100316
Towamba	1561	16454	1965	28244	5036	15963	6785	26811
Unknown		0		52			2	83
Wallagaraugh	557	4738	275	17379	496	23021	10743	1836

Data is sourced from the Environment and Heritage Technical Committee produced layer of broad catchment zones and the FRAMES Technical Committee produced layer of growth stages. Refer to the Environment and Heritage Technical Committee growth stage project for specifications on attributes for each growth stage.

The unknown catchment type is a digitising error that did not capture a section of the catchment boundary in the north of the RFA area between the Murrumbidgee and Coastal North catchments.

NOTE: refer to attached map for location of catchment boundaries.

# 14. ECONOMIC AND SOCIAL – B TYPE AND C TYPE INDICATORS

## 14.1 INDICATOR 5.2 (B TYPE)

Total volume, value of products and production, and flow-on economic contribution relative to the cost of production for all products.

### Targets

- Royalty, production costs, value of product and economic contribution to represent sound economic principles.
- Increase the net value of production per unit of raw material harvested.
- Maximise value from forest products and production within the context of ESFM.

### 14.1.1 Monitoring

- Identify a monitoring system for the flow-on contribution from forestry production. Information on cost of production/product difficult to obtain - commercial-in-confidence data must be respected.

### 14.1.2 Research

- Develop indicators of net economic benefit to the community, including Indigenous peoples (that is, cost/benefit analysis, rather than gross industry outputs).
- Develop research methods to effectively collect data on economic contribution of products and production to the community.

### 14.1.3 Indicator 5.2 (B type)

#### TOTAL VOLUME, VALUE OF PRODUCTS AND PRODUCTION, AND FLOW-ON ECONOMIC CONTRIBUTION COMPARED TO COST OF PRODUCTION FOR ALL PRODUCTS.

Product	Tenure	Volume	Royalty (\$)	Total gross value (product value) (\$)	Total regional direct and flow-on effects (gross output \$)	cost of production (\$)
Sawlogs -	SFNSW	38,700m <sup>3</sup> <sup>a</sup>	1,400,000 <sup>a</sup>	5,800,000 <sup>a</sup>	104,015,000 <sup>i</sup>	3,858,833 <sup>g</sup>
Hardwood	Private land	1,000 m <sup>3</sup>	25,000		incl. in j	

Product	Tenure	Volume	Royalty (\$)	Total gross value (product value) (\$)	Total regional direct and flow-on effects (gross output \$)	cost of production (\$)
Sawlogs -	SFNSW	80,700m <sup>3 b</sup>	1,257,000 <sup>b</sup>	??	19,799,000	??
Softwood	Private land	negligible	Negligible	Negligible	incl. in above	
pulp -	SFNSW	463,142t	9,200,000	36,100,000	incl. in j	incl. in g
Hardwood	Private land	298t			incl. in j	
pulp -	SFNSW	0	0	0	0	0
Softwood	Private land	0	0	0	0	0
Firewood	SFNSW	695t	5,206			
	Private land					
native flora	SFNSW	7 kg (seed)	162 (seed)			
	NP	not app.	Not app.	Not app.	not app.	not app.
	Private land	not app.	Not app.	Not app.	not app.	not app.
Water	SFNSW					
	NP					
	Private land					
	Total	18,100 ML <sup>k</sup>				
Apiary	SFNSW	7,040 hives	9384.32	136,316		
(wax and	NP	not app.	Not app.	Not app.	not app.	not app.
honey)	Private land	7,040 hives	9384.32	136,316		
	Total	157,136 kg		272,632 <sup>h</sup>	481,026	36,370
Grazing	SFNSW	728 head	4,799			
	NP	not app.	Not app.	Not app.	not app.	not app.
	Private land					
Mining	SFNSW			1,200,000		
	NP					
	Private land			3,600,000		
	Total	190,000t		4,800,000 <sup>e</sup>		
Indigenous	SFNSW					
	NP					
	Private land					
Recreation	SFNSW	16,100 visitor numbers	-	323,610 – 404,593 <sup>l</sup>	77,280 - 305,900 <sup>d</sup>	72,500
	NP	66,100 vis. numbers	-	1,328,610 – 1,661,093 <sup>i</sup>	317,280 - 1,225,900 <sup>d</sup>	1,352,000 <sup>c</sup>
	Private land	not app.	Not app.	Not app.	not app.	not app.
	Total	522,700			14,749,000	1,424,500

Shaded boxes represent those areas where data is not available.

a includes quota and salvage log grades.

b includes sawlog and roundwood grades.

c estimated 52% of overall \$2.6m expenditure and employment primarily associated with tourism and recreation

d estimates of consumers' surplus associated with visits to forested lands using a range of \$4.80 & \$19 per visit

- e annual value of mineral production using records for 1994/95 & 1995/96. Value considered greater due to lack of records for some operators.
- g commercial expenditure by State Forests' (associated mainly with timber production and other forest product sales) for the Eden Management Area
- h total of \$273,000 includes \$13,357 of wax production - not tenure specific.
- i using expenditure per visit of \$20.10 and \$25.13 multiplied by 66,100 visits to **forest orientated** NP sites and 16,100 visits to SF sites.
- j total direct and flow-on effects Pre IAP (1995-'96) of the hardwood timber industry (sawlogs and pulp).
- k total town water and irrigation supplies (1991-'92) for the Bega and Towamba catchments only.

**Sources:** Tables from 'A report on forest wood resources and wood based industries in the Eden CRA Region'.

For **hardwood timber** and **pulp** values (1995-'96) - Table 18; for **softwood timber** values (1995-'96) - Table 25 & 26; for **seed** and **firewood values** (1996-'97) - Table 12; for **grazing values** (1996-'97) - Table 13. **Water values** sourced from 'Hydrology of the Eden CRA Region' - Table 7. **Apiary values** sourced from 'Report on Apiary in the Eden CRA Region' - Table 2.3-2.5. **Mining values** sourced from 'Outlook for mining in the Eden Study Area' - DRAFT. **Recreation values** sourced from 'Economic value of recreation and tourism in Forests of the Eden RFA'. **Direct** and **flow-on effects** sourced from 'Regional Economic Impacts: Eden RFA Region' - Tables 5.2-5.10.

Dairy irrigation in the Bega Valley is worth \$13 million per annum, according to the EPA 'Proposed Interim Objectives for the NSW Waters, South Coast Catchments' (1997).

#### FOR TARGET NUMBER 2 (INDICATOR OF VALUE ADDING).

Volume	Annual net value of production	Per unit of volume	Net present value of land and tree resource rents
28,300 m <sup>3</sup>	\$ 14.7 million	\$519/m <sup>3</sup>	\$ 180 million

Source: FORUM data for Ref Pt. 1, Eden Options Report.

## 14.2 INDICATOR 5.3 (B TYPE)

Availability and usage of recreational/tourism facilities.

### 14.2.1 Targets

- Availability of recreational facilities should be balanced relative to demand for public use.

### 14.2.2 Monitoring

- Each agency to collect quantitative statistics on available facilities and recreational opportunities including existing sites or any new sites. The annual collation of these statistics should include the percentage increase or decrease of availability and usage of recreational facilities and opportunities from previous years.
- Collate by activity, any survey reports undertaken by local tourism promotion agencies to gain a perspective on changes in frequency of forest use.

### 14.2.3 Research

None proposed.

**14.2.4 Indicator 5.3 (B type)**

Availability and usage of recreational/tourism facilities.

**FOREST ORIENTATED RECREATIONAL OPPORTUNITIES IN STATE FORESTS OF THE  
EDEN RFA**

RECREATIONAL FACILITY NAME	STATE FOREST	OPPORTUNITY TYPE	NO. OF CAMP SITES, DISTANCE OF TRACKS, ETC.	ESTIMATED USAGE RATES
Bermagui Picnic Area	Bermagui SF	Picnics, walks	walking trail	2000 pa
Rockton Falls	Rockton SF	Picnics, waterfall	Table , BBQ	500 pa
Nalbaugh Falls	Bombala SF	Picnics, waterfall	Tables, BBQ	100 pa
Newtons crossing	Proposed Wallagaraugh Flora Reserve	Camping, picnicking	3 campsites, 2 BBQ, 2 tables, toilet, water tank, bins.	200 pa day 150 pa o/night.
Fisheries beach	Twofold Bay	Beach related opportunities only	10 campsites.	1500 pa day 1000 pa o/night.
Scrubby Ck.	East Boyd SF	O/night van use/ picnicking.	Parking area for over night van use (5 vans), 2 toilets, 2 BBQ, 4 tables, water tank, bins, Interps shelter.	2000 pa day 1500 pa o/night.
Burrawang	East Boyd SF	Picnicking/ walk access.	2 tables, water tank, toilet, 2 BBQ, Interps shelter, access to 2.5 km walk up m. Imlay (one way).	2000 pa
Broadwater	Broadwater Road	Picnicking/ swimming	2 tables, BBQ, bin. Access to swimming hole in Yowaka River.	300 pa
Maxwell's Rainforest Walk & Picnic Area	Nadgee SF	Picnicking/ R/forest walk.	3 BBQ, 3 Tables, Water Tank, Bins. Access to 1.5km R/forest walk, Interps shelter.	1000 pa
Ludwigs Ck.	Nadgee SF	Picnicking.	2 BBQ, 3 Picnic Tables, Toilet, Bins.	100 pa
Pambula River.	Nethercote Rd	Picnicking.	BBQ, 3 Tables, Bins.	100 pa
Imlay Ck.	Imlay Rd	Picnicking.	BBQ, 2 Tables, Toilet, Bins.	200 pa
Nethercote Falls	Nethercote Falls Flora Reserve	Picnicking/ swimming	Bin, 200m track to falls.	1000 pa
Allan Brook	Allan Brook Rd	picnicking / swimming.	BBQ, Bin.	50 pa
Wallagaraugh Forest Drive.	Nadgee SF	Drive / Picnicking.	Approx. 25 km drive (from highway to highway).	2000 pa
Myrtle Mountain		Picnicking / lookout.	Toilet, 3 BBQ, 4 Tables, Bins, view over Bega Valley.	1000 pa
Goodenia Rd.	Interim Forest Area – Yurammie	Picnicking / R/forest walk.	Walking track through R/forest approx 700m, BBQ.	50 pa
Wonboyn River	Bull Creek Forest Road	Fishing / Camping	Open Camping	medium usage
		4WD tours (contract)		50 to 70 tours pa
		4WD tours (SF)		10 to 15 tours pa
		Rallies (car)		1 pa
		Rallies (cycle)		1 pa
		Horse tours		10 to 20 tours pa

**FOREST ORIENTED RECREATIONAL OPPORTUNITIES IN NATIONAL PARKS OF THE EDEN RFA REGION.**

Recreational Facility Name	Opportunity Type	Facilities, no. of camp sites, dist. of trails	Usage Rates	Source of Vis. Nos.
<b>Wallaga Lake NP</b>			500	1994 figures
Mumbulla Creek Picnic Area, Biamanga NP	Swimming, picnics, waterfall	toilet, BBQ, tables	20,000	Estimate
<b>Mimosa Rocks NP</b>	<b>Beach opportunities only</b>			
<b>Bournda NP</b>			100,000	Traffic counter
Kangarutha Track	Bushwalking	9km walk track one way		
North Tura	Lookout, bush walking	Toilet, disabled access to lookout	40,000	Traffic counter
<b>Ben Boyd NP</b>	<b>Beach opportunities only</b>			
<b>Nadgee Nature Reserve</b>	Wilderness	Track head for wilderness walk, toilet, BBQ	12,000	Traffic counter
Wilderness Walk	3-4 day walk in wilderness	Nil	2,000	Permits
<b>Mt Imlay NP – Walk</b>			1,000	1994 figures
<b>South East Forests NP</b>				
Pipers Lookout-Bemboka	Short walk, views, lookout, picnic	Composting toilet, tables, disabled	Many	
Myrtle Mountain Lookout-Yurammie	Views, picnics	BBQ, table, toilet	1,000	Conservative estimate
Wolumla Peak	500m walk to lookout, picnics	BBQ, table, toilet	1,000	Conservative estimate
Six Mile Creek walk-Tantawangalo	Short walk from Rest Area to waterfall	Car park, toilet, BBQ, tables, interps.	8,000	Estimate
Big Jack Rest Area-Coolangubra	Picnic, short walks	Interps, BBQ, tables, disabled	300	Estimate
White Rock River Rest Area-Genoa	Walk along riverbank, picnic	Interps, BBQ, tables, toilets, disabled	800	Estimate
Total			186600	

**14.3 INDICATOR 5.5 (B TYPE)**

Gross income index related to forests.

**14.3.1 Targets**

- Increase gross community income related to forests.

**14.3.2 Monitoring**

- Customised income data can be obtained for particular sectors as part of the Australian Bureau of Statistics 1996 census. Gross weekly income was obtained for employees of industries A03 Forestry & Logging and C23 Wood and Paper Product Manufacturing. The total number employed in each sector to get a total gross annual income for these two industries multiplies the median annual income for these two industry sectors. 2001 census data can be used to repeat this process.

- Data on employees of State government forest management agencies are compiled together with all other State government employees under industry M81 11 State Government Administration. Census data cannot therefore be used because forest management employees cannot be isolated from other government employees. For this reason DPIE Social Assessment Unit data on income for NPWS and SFNSW employees sampled was used for this component of the forest sector. This data however does not include income levels for those employed in softwood plantation management.
- It is important to note that the two SLAs (Statistical Local Area) used above are greater in area than the Eden RFA Region. This is because only part of the Bombala Shire SLA is within the Eden RFA Region.

### 14.3.3 Research

None proposed

### 14.3.4 Indicator 5.5 (B type)

#### GROSS INCOME INDEX RELATED TO FORESTS

ABS statistical local areas (SLA) for 1996	Area (sq. kms)	gross annual income	
		gross community	forest sector
Bega Valley Shire	6282	\$ 209,688,024	\$7,814,976
Bombala Shire	1933	\$ 26,228,280	\$ 5,232,864
Total	8215	\$ 235, 916, 304	\$ 15,823,140 *

\*Includes value of \$2,775,300 gross income of NPWS and SFNSW employees directly dependent on native forests in the Eden RFA Region. Derived from DPIE Social Assessment Unit data collected as part of the Eden RFA.

# 15. CULTURAL AND HERITAGE – B TYPE AND C TYPE INDICATORS

## 15.1 INDICATOR 6.2 (C TYPE)

Level of community participation in decision making in issues related to forest management, which are of interest to indigenous and non-indigenous people.

### 15.1.1 Targets

- Increase level of participation by all stakeholders in the decision making process related to forest management.
- To design effective mechanisms for the participation of indigenous peoples in forest management.

### 15.1.2 Monitoring

- RACD to provide annual report on operations of the Forest Forum to RACAC and Commonwealth government. Full review of public participation process to be undertaken during the fifth year of the RFA including public satisfaction.
- Monitoring for indigenous participation.

### 15.1.3 Research

- Research into other countries' methods and agreements relating to indigenous people's participation in forested land management.

### 15.1.4 Indicator 6.2 (C type)

Level of community participation in decision making on issues related to forest management which are of interest to indigenous and non indigenous people.



**Current process of participation on State Forests**

State Forests consult with the relevant stakeholder group, usually a Local Aboriginal Land Council or historical society. Joint management arrangements are yet to be determined.

Local Aboriginal Land Councils (LALC) are involved in pre-logging surveys for aboriginal sites. State Forests Planning Manager for the Eden Region has given a verbal undertaking to the Eden LALC that State Forests will comply with the Councils wishes in avoiding disturbance of any sites identified from surveys.

The survey process involves the Eden LALC marking sites in the field and advising the State Forests Planner to discuss management by avoidance. Registration of sites is the responsibility of the Council with the National Parks and Wildlife Service.

# 16. ENVIRONMENT PROTECTION AUTHORITY – ISSUE OF POLLUTION CONTROL LICENCE TO STATE FORESTS OF NSW

## 16.1 INTRODUCTION

Soil erosion and sedimentation associated with forestry activities need to be controlled by careful management of the logging and roading activities that cause soil disturbance, and restrictions placed on both the areas and times which logging activities can occur. Logging and roading activities have the potential to result in diffuse (or non-point) source water pollution, and the management of these activities is an essential part of sound forest management.

## 16.2 THE LICENCE

State Forests NSW has applied for, and has been issued with, a pollution control licence from the Environment Protection Authority (EPA). This licence is different from other licences issued by the EPA due to the diffuse nature of the pollution resulting from logging operations. The EPA is not able to place an effluent limit on specified discharge points for logging or roading operations because pollution may enter different sections of the drainage system at varying locations.

The EPA's overall approach to the management of diffuse source pollution is to encourage pollution control at the source, through the adoption of "*best management practices*" (BMPs). This approach has been incorporated into State Forests' pollution control licence since April 1995.

State Forests' pollution control licence is designed to ensure that '*effective and practical measures*' are taken to protect the aquatic environment from water pollution caused by logging

operations, by either preventing the generation of pollutants, or by trapping them as close to the source as possible. Operations covered by the licence include the harvesting of pulplogs and sawlogs, and any roading or burning activities associated with this harvesting.

### **16.3 REQUIREMENTS OF LICENCE**

The pollution control licence issued to State Forests provides a planning and operational framework within which performance objectives and conditions are required. These conditions are considered to be the planning and operational basis for the protection of the aquatic environment. Where State Forests seeks coverage under the pollution control licence, logging and roading operations must be conducted in accordance with the licence. The licence requires State Forests of NSW to:

- Undertake site-specific pre-operational planning;
- Undertake site and soil assessments;
- Determine the inherent soil erosion and water pollution hazard (including mass movement, dispersibility and seasonality);
- Develop site-specific techniques and management practices in accordance with the performance objectives and conditions for harvesting, roading and burning operations;
- Carry out water quality monitoring to determine if logging operations are having an effect on water quality;
- Maintain both an operational register, and a complaints register, and
- Develop and implement a strategy to train State Forests and industry staff in soil and water management.

The pollution control licence also requires State Forests to submit a report and a certificate of compliance each year. The report must include summaries of the complaints register and operations register; water quality monitoring and results analysis; post-operational audits; and developments in BMPs. The report must also examine and discuss the efficacy of the conditions of the licence in protecting water quality. The certificate of compliance is to contain details of monitoring and compliance as well as certain information regarding the non-compliance of conditions.

The EPA is committed to reviewing the key components of the licence including the hazard assessment model, the water monitoring program and the BMP conditions to ensure that practical measures are being undertaken to protect the aquatic environment from potential water pollution from logging operations. In this regard the licence is a dynamic management tool which will be improved with increased knowledge and better techniques. It is also important to note that under the *Protection of the Environment Operations Act 1997* the pollution control licence will be reviewed at least once every three years.

# APPENDIX A

## PRINCIPLES OF ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT

There have been significant advances in forest policy at international, national and State levels in recent years. The central theme of these policy developments has been the concept of ecologically sustainable forest management (ESFM). Both the Commonwealth and NSW governments have committed to implementing ESFM as part of the Eden RFA. The following principles are designed to bring together the policies relating to forest conservation and management, to provide guidance to forest land managers. These principles have been the basis for identifying performance indicators, operational practices and conservation protocols for the Eden RFA.

### **Principle 1: Maintain or increase the full suite of forest values for present and future generations across the NSW native forest estate**

- The principle of intergenerational equity (that in meeting the needs of the present generation, the ability of future generations to meet their own needs is not compromised) is embodied in this principle.
- Ensure that ESFM at the regional and smaller scales is implemented by ecologically appropriate planning and operational practices, and that ESFM targets are set and indicators of performance are monitored.
- Ensure the long-term maintenance of the full range of values of the existing NSW forest estate. The intention is to maintain or increase not only the full range of values, but also the magnitude or level at which those values are maintained or increased.
- Encourage the increased production of plantation-grown timber and the social and economic benefits flowing from this increased production to supplement the wood supply from native forests.

#### **Aims include:**

#### **A Biodiversity**

- Biological diversity of forests at the ecosystem, species and genetic levels where biological diversity includes natural patterns of ecosystems, species and gene pools in time and space. Addresses the requirements of vulnerable species; assist with the recovery of threatened species; assist with the recovery of threatened species; and maintain the full range of ecological communities at viable levels. Protect landscape values including the careful planning of operations and the reservation of appropriate patches and corridors of vegetation.

#### **B The productive capacity and sustainability of forest ecosystems**

- Maintain ecological processes within forests (such as the formation of soil, energy flows and the carbon, nutrient and water cycles, fauna and flora communities and their interactions).
- Maintain or increase the ability of forest ecosystems to produce biomass whether utilised by society or as part of nutrient and energy cycles.
- Ensure the rate of removal of any forest products is consistent with ecologically sustainable levels.

- Ensure the effects of activities/disturbances that threaten forests, forest health or forest values are benign.

### **C Forest ecosystem health and vitality**

- Reduce or avoid threats to forest ecosystems from introduced diseases, exotic plants and animals, unnatural regimes of fire or flooding, wind shear, land clearing and urbanisation.
- Promote good environmental practice in relation to pest management.
- Ensure the effects of activities/disturbances within forests, their scale and intensity, including their cumulative effects are controlled and benign.
- Restore and maintain the suite of attributes (ecological condition, species composition and structure of native forests) where forest health and vitality have been degraded.

### **D Soil and Water**

- Maintain the chemical and biological functions of soils by protecting soils from unnatural nutrient losses, exposure, degradation and loss.
- Maintain the physical integrity of soils by protecting soils from soil erosion, mass movement, instability, compaction, pulverisation and loss.
- Protect water quality (physical, chemical and biological) by measures controlling disturbance resulting from forest activities.
- Identify and maintain at appropriate levels, water yield and flow duration in catchments.

### **E Positive contribution of forests to global geochemical cycles**

- Maintain the positive contribution of forests to the global geochemical cycle (includes climate, air and water quality and deposition).

### **F Long-term social and economic benefits**

- Maintain and enhance, on an ecologically sustainable basis, production of wood and wood products, including value adding, investment and resource security.
- Provided it is ecologically sustainable, set, maintain or enhance the level of use of non-wood products and uses, including bee-keeping, grazing, mining, recreation and tourism, reliable water supply.
- Maintain and enhance, on an ecologically sustainable basis, the provision of employment and community needs such as economic diversification, investment skills, education, job stability, training and indigenous needs.
- Encourage the establishment and use of plantation forests on existing cleared land to expand soil and economic values.
- Maintain and enhance the intangible social welfare benefits which forest provide.

### **G Natural and cultural heritage values**

- Protect social, natural and cultural heritage values and sites, including aesthetic, landscape, historic, cultural, educational, scenic, spiritual and scientific values, including indigenous values and sites.

**Principle 2: Ensure public participation, access to information, accountability and transparency in the delivery of EFSM**

- Ensure public participation in decision-making processes at local, State and Federal levels.

- Ensure comprehensive, timely and reasonable public access to information.
- Ensure transparency<sup>1</sup>, openness<sup>2</sup> and accountability<sup>3</sup> in decision making processes and performance.

**Principle 3: Ensure legislation, policies, institutional framework, codes, standards and practices achieve ecologically sustainable forest management of the native forest estate through requirements and/or by providing incentives.**

- Establish a process for shared management and administration, recognising the customary and traditional rights of indigenous people and the interests of private land-holders and other stakeholders in an area's management.
- Ensure compliance with stated goals and objectives.

**Principle 4: Apply precautionary principle for prevention of environmental degradation**

- The incorporation of the precautionary principle into decision-making has been endorsed by State and Commonwealth Governments (Commonwealth of Australia 1992 p. 49, IGAE 1992) and is defined as 'where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
  - a. Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
  - b. An assessment of the risk-weighted consequences of various options.

**Principle 5: Apply best available knowledge and adaptive management processes**

- ESFM would utilise the concept of adaptive management and continuous improvement based on best science and expert advice and targeted research on critical gaps in knowledge, monitoring or evaluation.

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<sup>1</sup> Transparency in a process is the degree to which the public or stakeholder groups understand the decision-making process and can see who is taking decisions.

<sup>2</sup> Openness in a process is the degree to which it allows interested parties to participate in the decision-making process.

<sup>3</sup> Accountability in a process is the ability to identify who is responsible for implementing agreed decisions.

# APPENDIX B

## FORESTRY PRACTICES DETERMINED IN THE RFA OUTCOME

Table 1: Harvesting and silvicultural practices determined for use in the Eden RFA with rationale in relation to timber production. THIS TABLE WILL BE FINALIZED WITH PRACTICES APPROVED IN THE RFA OUTCOME. ONLY THE PRACTICES AVAILABLE IN THE RFA OUTCOME WILL BE LISTED

Timber Management (Logging and Silviculture Practices)				
Intensity	Type of Practice	Description	Factor	Rationale
<b>LIGHT INTENSITY</b>	<b>A1</b> light selective logging	Single tree selection logging of less than 10% of basal area.	Timber production	May require some extension of logging disturbance for regrowth.  Regeneration of timber species particularly sensitive to competition may be difficult in moist forest types and development of techniques is required.  Post logging burning would not be generally possible.
			Economic/social	High cost of planning and harvesting with very low potential for timber yield.  High operating costs.
			Conservation	Care and attention needed to minimise understorey disturbance during harvesting.

Intensity	Type of Practice	Description	Factor	Rationale
	<b>A2</b> medium selective logging	Single tree selection logging of less than 30% of basal area.	Timber production	May require some extension of logging disturbance for regrowth.  Regeneration of timber species particularly sensitive to competition may be difficult in moist forest types and development of techniques is required.  Post logging burning would not be generally possible.
			Economic/social	High cost of planning and harvesting with very low potential for timber yield.  High operating costs.
			Conservation	Care and attention needed to minimise understorey disturbance during harvesting.
<b>MODERATE</b>	<b>B0</b> small group Selection	Falling a maximum of 4 trees in one group  Comprising a total gap diameter no greater than 30 metres  than 30 metres	Timber production	
			Economic/social	
			Conservation	
	<b>B1</b> 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-forest and C2 thinning of regrowth.	Timber production	Suppressed regeneration at margins of groups remains a difficulty and may require release in following cutting cycles.  Inability to burn debris may increase fire risk to regeneration.
			Economic/social	
			Conservation	Allows ready manipulation of nesting and browsing habitat.
	<b>B2</b> patch cutting	Harvest using patches of 100-200 metres diameter comprising no more than 20% of  net harvest area	Timber production	Post logging fuel reduction may still be difficult.  More productive for timber values than B1.
			Economic/social	High management costs may still be anticipated.



Intensity	Type of Practice	Description	Factor	Rationale
INTENSIFIED MANAGEMENT		– with A1 selective logging of multi-aged forest and C2 thinning of regrowth.	Conservation	Retaining a considerable degree of coupe level structural diversity provided significant untreated areas are retained throughout all cycles.
	B3 extensive tree removal	Current practice of harvesting with advanced growth retention, and seed tree & habitat tree retention of prescribed density and quality.	Timber production	Significant site production losses in regeneration suppression by over wood if retained stems are maintained in an even canopy cover.  Post logging burning can be more efficient.
	C1 intensive logging	Harvesting with retention of seed trees only.	Economic/social	Current application.
			Conservation	Long term viability of habitat trees and recruitment trees an issue where individual stems are retained.  Retains a level of habitat function.
			Timber production	Maximises growth rate of regeneration.
			Economic/social	Suited for application of cable harvesting systems in areas of steep terrain or high stocking.
	C2 regrowth thinning	Thinning generally from below (with some removal of poor form trees not required as habitat)	Conservation	Aesthetic impact is high and careful planning is required to avoid impacts on landscape values.
Timber production			Recovers material that would otherwise be lost through competition and can promote the diameter growth of residual stems.	
			Economic/social	Improve the economics of management of selected stands.  Pulp wood has desirable properties.  There are cost penalties associated with thinning at small tree size when silvicultural advantages might be greatest.
			Conservation	

Intensity	Type of Practice	Description	Factor	Rationale
	C3 regrowth spacing		Timber production	There can be problems with coppice or understorey competition.
			Economic/social	Requires careful timing to minimise operational costs while securing high growth response.
			Conservation	May cause a small reduction in site water use where spacing removes a large proportion of stems, but effect may only be short lived.
	C4 regrowth fertilising		Timber production	Fertiliser application can boost growth in stands with good soil water availability.
			Economic/social	Further knowledge of the relationship between growth response, site and stand characteristics is needed to effectively target stands when economic response would be greatest.  Should be restricted to stands with high economic growth potential.
			Conservation	

(Source: ESFM Practices Report, chapter 6, RACAC Secretariat)

# APPENDIX C

## PROPOSAL FOR DEVELOPING AN ECOLOGICALLY SUSTAINABLE ROADING INDEX (ESRI) AND AN ECOLOGICALLY SUSTAINABLE CROSSING INDEX (ESCI)

Draft 17 of the *Ecologically Sustainable Forest Management for the Eden RFA Assessment* has recently been reassessed, including the indicators, targets, monitoring and research needs for the soil and water section. During the reassessment, it was determined that an Ecologically Sustainable Roading Index and an Ecologically Sustainable Crossing Index could be used as a mechanism against which to benchmark improvement. The Ecologically Sustainable Roading Index has been modified to include feedback from State Forests.

### METHODOLOGY FOR ECOLOGICALLY SUSTAINABLE ROADING INDEX (ESRI)

#### Assumptions:

- All road drainage is constructed and maintained to current best management practice (BMP) standards contained in Schedule 5 of the pollution control licence issued to State Forests by the EPA. If the road is not drained to this standard, then the indicator value is multiplied by 3.5.
- All roads, including permanent and temporary roads, are to be included in index calculations.

#### Calculations

##### BMP drained roads

$$ESRI = R_n \times [(C_n \times P_n \times L_1) + (C_n \times P_n \times L_2)] + R_n \times [(C_n \times P_n \times L_3) + (C_n \times P_n \times L_4)] + \dots$$

##### Not BMP drained roads

$$ESRI = \{ R_n \times [(C_n \times P_n \times L_1) + (C_n \times P_n \times L_2)] + R_n \times [(C_n \times P_n \times L_3) + (C_n \times P_n \times L_4)] + \dots \} \times 3.5$$

#### where:

ESRI = Ecologically Sustainable Roading Index (dimensionless indicator)

L = Length of road section (in kilometres)

R<sub>n</sub> = Regolith Class (Murphy, C.L., Fogarty, P.J. and Ryan, P.J. 1998, Soil Regolith Stability Classification for State Forests in Eastern New South Wales)

REGOLITH CLASS	REGOLITH CLASS DESCRIPTION	DIMENSIONLESS INDICATOR (ranking between classes)
R1	Low sediment delivery / high coherence /	0.1
R2	Low sediment delivery / low coherence	0.2
R3	High sediment delivery / high coherence	0.4
R4	High sediment delivery / low coherence	0.5

**C<sub>1</sub> - C<sub>6</sub> = Road Class**

ROAD CLASS	CLASS DESCRIPTION	DIMENSIONLESS INDICATOR (ranking between road types)
1	primary access road	1
2	secondary access road	2
3	feeder road	4
4	harvesting road	7
5	link road	8
6	fire trail	9

P = Position of the road in the landscape

Side Slope	Location		
	Ridge*	Mid-slope*	Streamside*
0 < 10	1	2	6
10 < 20	2	3	7
20 < 25	3	4	8
25 >	4	5	9

**\* - Location Definitions**

- Any section of road within 50m (horizontal distance) of a mapped stream, or an unmapped 1st order stream, is a streamside road.
- Any section of road greater than 50m (horizontal distance) from a mapped stream, or an unmapped 1st order stream, and within 25m (horizontal distance) of the ridge line as shown on the 1:25,000 topographic mapping, is a ridge road. Due to slope averaging by the GIS, ridge top roads may appear to be located on steep lands.
- Any section of road that does not fall into either of the first two definitions is a midslope road.

**Implementation**

Each segment of road is to be assessed separately. (Eg. Where a road passes through two different regoliths, and two different slope categories, up to four segments would need to be assessed). ESRI is to be calculated for each compartment, with the results being aggregated for individual forest, region and state-wide assessments.

**Objective**

As ESRI is a dimensionless indicator, the absolute value is not the primary concern. ESRI will provide to managers a relative indicator of ecologically sustainable roading by measuring relative improvement from year to year at different scales. (Eg. If ESRI returns a value of X for NSW in 1999, and only 80% X in 2000, then there has been a 20% improvement in the ESRI over the course of the year. This could have been achieved by improved road drainage, reduced road lengths, repositioning or upgrading of roads, or a combination of these factors).

**Sample Calculation**

Two sections of road are located in the same compartment, and have the following features:

Attribute	Road Section A		Road Section B	
	Condition	Value	Condition	Value
Regolith Class	R3	0.4	R2	0.2
BMP Drained	Yes	1	No	3.5
Road class	Harvesting	7	Feeder	4
Position of the road	Ridge <10°	1	Midslope 10<20°	3
Load length	1250m	1.25	700m	0.7

Using the equation:

$$ESRI = R_n \times [ ( C_n \times P_n \times L_1 ) + ( C_n \times P_n \times L_2 ) \dots ] + \{ R_n \times [ ( C_n \times P_n \times L_1 ) + ( C_n \times P_n \times L_2 ) \dots ] \} \times 3.5$$

the information from the table above is included. The equation becomes:

$$\begin{aligned} \text{ESRI} &= 0.4 \times [ ( 7 \times 1 \times 1.25 ) ] + \{ 0.2 \times [ ( 4 \times 3 \times 0.7 ) ] \} \times 3.5 \\ \text{ESRI} &= 0.4 \times [ 8.75 ] + \{ 0.2 \times [ 8.4 ] \times 3.5 \} \\ \text{ESRI} &= 9.38 \end{aligned}$$

Over a 12 month period, the roading may be upgraded to further reduce the potential for water pollution to occur. In this example, the road and drainage standard is improved, and a small section of harvesting road is permanently closed and rehabilitated. The resulting table of data is as follows:

Attribute	Road Section A		Road Section B	
	Condition	Value	Condition	Value
Regolith Class	R3	0.4	R2	0.2
BMP Drained	Yes	1	Yes	1
Road class	Harvesting	7	Feeder	4
Position of the road	Ridge <10°	1	Midslope 10<20°	3
Load length	1000m	1.0	700m	0.7

Again using the equation:

$$\text{ESRI} = R_n \times [ ( C_n \times P_n \times L_1 ) + ( C_n \times P_n \times L_2 ) \dots ] + \{ R_n \times [ ( C_n \times P_n \times L_1 ) + ( C_n \times P_n \times L_2 ) \dots ] \} \times 3.5$$

the information from the table above is included. The equation becomes:

$$\begin{aligned} \text{ESRI} &= 0.4 \times [ ( 7 \times 1 \times 1.0 ) ] + 0.2 \times [ ( 4 \times 3 \times 0.7 ) ] \\ \text{ESRI} &= 0.4 \times [ 7 ] + 0.2 \times [ 8.4 ] \\ \text{ESRI} &= 4.48 \end{aligned}$$

### Interpretation

Over a 12 month period in this compartment, the potential for water pollution from these sections of road has been reduced. This is a positive reflection on the management of these sections of road.

## METHODOLOGY FOR ECOLOGICALLY SUSTAINABLE CROSSING INDEX (ESCI)

### Assumptions

All crossings, including permanent and temporary crossings are to be included.

### Calculations

$$\begin{aligned} \text{ESCI} &= R_n \times [ ( MP_1 \times MP_2 \times MP_3 \times ED_x ) + ( MP_1 \times MP_2 \times MP_3 \times ED_x ) + \dots ] + \\ &R_n \times [ ( MP_1 \times MP_2 \times MP_3 \times ED_x ) + ( MP_1 \times MP_2 \times MP_3 \times ED_x ) + \dots ] + \end{aligned}$$

where:

ESCI = Ecologically Sustainable Crossing Index (dimensionless indicator)

Rn = Regolith Class (Murphy, C.L., Fogarty, P.J. and Ryan, P.J. 1998, Soil Regolith Stability Classification for State Forests in Eastern New South Wales)

REGOLITH CLASS	REGOLITH CLASS DESCRIPTION	DIMENSIONLESS INDICATOR (ranking between regolith classes)
R1	low sediment delivery / high coherence	0.1
R2	low sediment delivery / low coherence	0.2
R3	high sediment delivery / high coherence	0.4
R4	high sediment delivery / low coherence	0.5

MP<sub>1</sub> – MP<sub>3</sub> = Crossing Management

Management Practice	Complies	Does Not Comply
1 Effective drainage within 30m of the crossing	1	8
2 Graveling approaches within 30m of the crossing	1	6
3 Graveling of the crossing surface	1	5

ED<sub>1</sub> – ED<sub>5</sub> = Engineering Design from no design to 1 in 50 year event design.

Engineering Design	Weighting Factor
1 No Engineering design	15
2 Engineering design to a 1 in 5 year event	5
3 Engineering design to a 1 in 10 year event	3
4 Engineering design to a 1 in 20 year event	2
5 Engineering design to a 1 in 50 year event	1

**Implementation**

- Each crossing is to be assessed separately.
- ESCI is to be aggregated for each compartment, with the results being aggregated for individual forest, region and statewide assessments.

**Objective**

As ESCI is a dimensionless indicator, the absolute value is not the primary concern. ESCI will provide to managers a relative indicator of ecologically sustainable crossing by measuring relative improvement from year to year at different scales. (Eg. If ESCI returns a value of Y for NSW in 1999, and only 80% Y in 2000, then there has been a 20% improvement in the ESCI over the course of the year. This could have been achieved by improved crossing drainage, a reduction in the number of crossings, improved management of the crossings, or a combination of these factors).

**Sample Calculation**

Two crossings are located in the same compartment, and have the following features:

Attribute	Crossing A		Crossing B	
	Condition	Value	Condition	Value
Regolith Class	R3	0.4	R3	0.4
Effective Drainage within 30m of the crossing	Yes	1	Yes	1
Graveling approaches within 30m of the crossing	Yes	1	No	6
Graveling of the crossing surface	No	5	No	5
Level of Engineering Design	1 in 10 year	3	1 in 5 year	5

Using the equation:

$$ESCI = R_n \times [(MP_1 \times MP_2 \times MP_3 \times ED_x) + (MP_1 \times MP_2 \times MP_3 \times ED_x) + \dots] + R_n \times [(MP_1 \times MP_2 \times MP_3 \times ED_x) + (MP_1 \times MP_2 \times MP_3 \times ED_x) + \dots] +$$

the information from the table above is included. The equation becomes:

$$ESCI = 0.4 \times [ (1 \times 1 \times 5 \times 3) + (1 \times 6 \times 5 \times 5) ]$$

$$ESCI = 0.4 \times [ 15 + 150 ]$$

$$ESCI = 66$$

Over a 12 month period, the crossings may be upgraded to further reduce the potential for water pollution to occur. In this example, further gravelling work is carried out on the crossings. The resulting table of data is as follows:

Attribute	Crossing A		Crossing B	
	Condition	Value	Condition	Value
Regolith Class	R3	0.4	R3	0.4
Effective Drainage within 30m of the crossing	Yes	1	Yes	1
Gravelling within 30m of the crossing	Yes	1	Yes	1
Gravelling of the crossing surface	Yes	1	No	5
Level of Engineering Design	1 in 10 year	3	1 in 5 year	5

Again using the equation:

$$ESCI = R_n \times [(MP_1 \times MP_2 \times MP_3 \times ED_x) + (MP_1 \times MP_2 \times MP_3 \times ED_x) + \dots] + R_n \times [(MP_1 \times MP_2 \times MP_3 \times ED_x) + (MP_1 \times MP_2 \times MP_3 \times ED_x) + \dots] +$$

the information from the table above is included. The equation becomes:

$$ESCI = 0.4 \times [ (1 \times 1 \times 1 \times 3) + (1 \times 1 \times 5 \times 5) ]$$

$$ESCI = 0.4 \times [ 3 + 25 ]$$

$$ESCI = 11.2$$

### Interpretation

Over a 12 month period in this compartment, the potential for water pollution from the crossings has been reduced. This is a positive reflection on the management of these crossings.