Clarence Env. Centre.

Assessment of Environmental Impact
Forestry Commission of NSW

Proposed Hardwood Operations

CHAELUNDI STATE FOREST

PUBLIC EXHIBITION

The Forestry Commission proposes to undertake forestry operations including access road construction, harvesting of timber and fuel management, in Compartments 180, 198 and 200, Chaelundi State Forest.

Operations are necessary in this small key part of the unlogged forest in Dorrigo Forest Management Area to provide continued supply of a suitable mix of hardwood sawlogs to sawmilling industries dependent upon it, until preparation in 1991 of an EIS for the whole Area in accordance with the Commission's announced strategy for increased public involvement in forest management planning.

An Environmental Impact Statement covering these activities has been prepared for operations proposed to commence in December 1990.

The EIS may be inspected during normal office hours in the period Tuesday 2 October, 1990 to November 1, 1990 at the following locations:

Forestry Commission of NSW,
6th Floor,
95-99 York Street,
Sydney, 2000.

Forestry Commission of NSW,
Regional Office,
Corner Hood and High Streets,
Coffs Harbour Jetty, 2450.

Forestry Commission of NSW,
District Office,
1 Cudgery Street,
Dorrigo, 2453

Forestry Commission of NSW,
District Office
NSW Government Offices,
49 Victoria Street,
Grafton, 2460.

Department of Planning
Publications Desk,
Remington Centre,
175 Liverpool Street,
Sydney, 2000

N.S.W. Government
Information Centre,
55 Hunter Street,
Sydney, 2000.

N.S.W. Environment
Centre,
39 George Street,
Sydney, 2000.

Nymboida Shire Council,
Through Street,
South Grafton, 2460.

Copies of the Environmental Impact Statement may be purchased from the Forestry Commission Offices listed above, at a cost of $5.

Any person or organisation may make written representations with respect to the activity described in the Environmental Impact Statement to the Forestry Commission of N.S.W., Box 2667, G.P.O., Sydney, 2001. Submissions must be received by the Commission at its Head Office at 95 York Street, Sydney by 5 p.m. Thursday November 1, 1990.

Following the closing date for receipt of submissions, a decision will be made in relation to the proposals.

J.A. KING
Acting Secretary

Proposed Hardwood Operations
Compartments 180, 198, 200
Chaelundi State Forest
Environmental Impact Statement
September, 1990

E R R A T A

Page (vi) Table 33. "Cpts 178, 180, 181" should read "Cpts 178, 179, 181".

Page 26 Table 7. Delete note number 5, 3rd column, ie.206, not 206[5].

Page 44 4th paragraph. Alter "as a condition of licensees" To read "as a condition of licences".

Page 69 2nd paragraph. Alter "These 3 species ---" to read "these two species ---".

Page 70 Table 15. Alter "Tuggoloo" to read "Tuggolo".

Table 16

a) Moonpar SF diversity of species: 3 should read 8

b) Wild Cattle Creek SF Coffs District: 0.06 should read 0.66

c) Diversity, column 3. Delete "/ha".

Page 71 Table 18. New England Hardwood. (Relative density): Alter 296.0 to 269.0.

Page 73 Section 4.4.3 Paragraphs 1 and 2. Figure 13 should read Figure 14.

Page 74 Alter "Table 20" in last para to read "Table 21".

Page 79 Summary of results. Alter "Table 21" in paragraphs 1, 2 and 4 to "Table 20"

Page 79 Section 4.4.4, Fauna of Special Concern, D.maculatus:

Alter Forest types 162/163 to 142/163.

Page 80 Last paragraph, penultimate line: Add "180" after "Compartments"

Page 93 4.7.2 Last paragraph, second sentence. Alter to read "A further outside the region also draws part of its allocated sawlog quota this Area",

Page 95 4.7.3 First paragraph, first sentence: Alter to read "Dorrigo is main centre of population for the Dorrigo district part of the Shire. Second paragraph: Alter first sentence to read "There are few other centres of population in this part of the Shire".

Page 115 5.2.3 Wildfire. In the last sentence of the second paragraph, add "exists".

Page 116 5.3.1 Alter Floyd (Ref $$$) twice in this section, to Floyd (19

Page 118 Last sentence, "178, 180 and 181" should read "178, 179 and 181"

Page 119 Table 33. Alter Cpt number "180"to "179".

Page 135 First line. Alter "Permissive Occupancy lease" to "Occupation

27th September

Proposed Hardwood Operations

COMPARTMENTS 180, 198, 200
CHAELUNDI STATE FOREST

ENVIRONMENTAL IMPACT STATEMENT

Forestry Commission of New South Wales

September 1990

CERTIFICATE

(Clause 59, Environmental Planning and Assessment Regulation)

This Environmental Impact Statement has been prepared by and on behalf of the Forestry Commission of New South Wales in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

J.H. Drielsma
Commissioner for Forests
19 September 1990

STUDY TEAM

This EIS was produced by a study team coordinated by Margules and Partners on behalf of the Forestry Commission of New South Wales (FCNSW).

Site specific information on flora, fauna and soils used to compile the EIS has been provided in part by FCNSW staff together with data from other sources including sworn affidavits from researchers who have undertaken studies within the three compartments or adjacent areas. Information relating to industry's resource requirements and the implications arising from not having those requirements met were provided by the relevant sawmilling companies.

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Report Compilation	:	D.G. Parsonson, BSc (For.)
Socioeconomic	:	Diana M.H. Gibbs, BSc(Hons), MEnv.Stud.
Drafting	:	L.V. Opuls
Word Processing	:	R.L. Kennedy

ACKNOWLEDGEMENTS

The Study Team wishes to acknowledge the valuable assistance provided by the Forestry Commission of New South Wales staff at: Dorrigo District Office; Coff Harbour Regional Office; and the Division of Wood Technology and Research. In addition, we wish to acknowledge the valuable information and advice provided by Dr W. Braithwaite and staff at CSIRO Division of Wildlife and Ecology.

LIST OF TABLES

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APPENDICES

GLOSSARY

Crown sawmill:	A privately owned sawmill licensed under the Forestry Act, which has been allocated an annual quota, or nominated annual supply through a longer term wood supply agreement, for supply of sawlog timber from Crown timber lands, under the provisions of the Act.
Salvage sawmill:	A privately owned sawmill licensed under the Forestry Act for which no annual Crown timber allocation rights exist. Parcel sales of Crown land timber may be made on an ad-hoc basis to meet some forest management, marketing or land disposal requirement.
Quota:	An annual allocation of sawlog volume made from a management area to a Crown sawmill. Quotas have a continuing basis but are subject to annual review or, in the case of a wood supply agreement, at the completion of the agreement period.
Quota sawlog:	A log having equal or greater than specified minimum dimensions and quality, the volume of which forms part of a sawmill's annual sawlog allocation (quota).
Veneer log:	A solid straight section of harvested tree bole (subject to minimum and maximum specifications for size) of a select number of species suitable for peeling or slicing to produce thin sheets of wood suitable for veneer production.
Pole, pile and girder:	Straight, sound, bole sections of a tree which are processed in the round, generally six metres or more in length. As diameter increases in relation to length, industry terminology prefers the term pile and then girder for increasingly larger end – section timbers. All such timber pieces may subsequently receive further processing altering the basic form, for example pole dressing or girder squaring.
Ex-quota sawlog:	A sawlog which when utilised by the sawmill, does not form part of its quota allocation, for a variety of reasons. This category may include both logs that are compulsory, (of good quality but below size limits subject to a further minimum limit) or optional, for utilisation by the sawmiller.
Salvage sawlog:	A log by agreement not required to be utilised by a sawmill but is available at its discretion. Generally, such a log is of ex-quota quality and consequently either of very small size or is highly defective.
Minimum rate sawlog:	A sawlog with defect in excess of an agreed maximum or having dimensions less than a specified minimum. Royalty is assessed for such log material at the current minimum royalty rate for sawlogs in the areas. May be equivalent to a salvage log.
Small sawlog:	A log less than 40 cm centre diameter of specified minimum length and small end diameter of a minimum of 15 cm. By agreement, these logs are usually required to be utilised by a sawmill (i.e. are 'compulsory'), but do not form part of quota allocation.
Sleeper:	Squared sawn timber, either free or inclusive of heart, used in railway construction or maintenance or less frequently in landscape retaining walls etc. Larger end dimensions and longer lengths are referred to as transoms and junk and are used in rail cross over points and where large timber sections are required such as bridge and culvert construction.
Post:	A timber piece normally less than six metres in length, either split, sawn or natural round used in fencing, rails either sawn or natural round, span between the posts and sawn palings may provide the upright barrier between the upper and lower rails.

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1.0 INTRODUCTION

This Environmental Impact Statement (EIS) has been prepared to describe a proposal by the Forestry Commission of New South Wales (FCNSW) to authorise Timber Licensees to harvest forest products from, and undertake other associated works within, three compartments in the Chaelundi State Forest in the Dorrigo Management Area on the mid north coast of New South Wales. The proposal is an approval referred to in Section 112 (1) of the Environmental Planning and Assessment Act, 1979.

The proposal has been put forward to meet commitments by the FCNSW to maintain access to sawlogs of appropriate hardwood species in the short term (12 months). Harvesting these areas is required to sustain the regional sawmilling industry pending preparation of an EIS covering the forests in Dorrigo Management Area which will be released during 1991 (ref. Appendix 1). This document should therefore be viewed in the context that it assesses impacts resulting from activities occurring on a specific part of Chaelundi State Forest, viz. Compartments 180, 198 and 200, a total area of 561 ha (ref. Figure 1). The document does not address the wider regional impacts of forest management except where impacts arising specifically from the proposal could be of regional significance. The wider context will be provided by the subsequent regional EIS which will cover areas of forest shown by Figure 2.

1.1 THE PROPONENT

The proponent for this proposal is the FCNSW which is charged with the responsibility for managing the State Forests in question. Whilst the FCNSW has responsibility for management, planning and of roading; the harvesting work would be undertaken by the sawmilling industry or contractors operating under their licences.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

This section of the study sets out the reasons why the FCNSW is proposing to harvest sawlogs and other forest produce from these three compartments. The section details the recent injunction taken out against continuing forest operations within a large proportion of the remaining unharvested areas within State Forests in the Dorrigo Management Area, and the effects this has had on the ability of the FCNSW to meet sawlog supply commitments to dependent industries.

1.2.1 Commitments

The Dorrigo Management Plan provides for sustainable forest production. The Quota Sawlog component of this yield is 40 000 m^3 nett per annum through the remainder of the first cutting cycle (CC1) to the year 2010 and through the second cutting cycle (CC2), years 2010-2040.

The realisation of this yield depends upon the harvesting of 'old growth' stands, particularly through the remainder of CC1 where such stands have an assessed yield of 983 000 m^3, i.e. 40 958 m^3 net per annum for 24 years from 1985 to 2010. This yield has been maintained although the method for assessing the allocation to sawmills has changed as detailed below.

There are three sawmills dependent upon Dorrigo Management Area for supplies of hardwood sawlogs. Allen Taylor & Co. Ltd has entered into a 20 year timber supply agreement from 1.1.88 for its nominated allocation. The other two mills have their allocation renewed annually.

Sawmill	Location	Annual allocation (m^3 gross)
Allen Taylor & Co. Ltd	Bostobrick	22 780
G.L. Briggs and Sons Pty Ltd	Briggsvale	18 180
Duncan's Holdings Ltd	Grafton	17 160
		58 120

The total allocation of 58 120 m^3 gross is equivalent to 40 000 m^3 net as spelt out in the Management Plan. This reflects changes that have occurred following adoption of compulsory utilisation standards, including additions of some ex-quota logs and adoption of a flat rate gross log sales system from 1.1.90. Harvesting operations to meet these commitments are currently underway in the following compartments of Chaelundi State Forest:

Duncan's Holdings	Compartments 265, 177 and 194
Allen Taylor & Co. Ltd	Compartments 170, 171, 234 and 206
G.L. Briggs and Sons Pty Ltd	Compartment 190

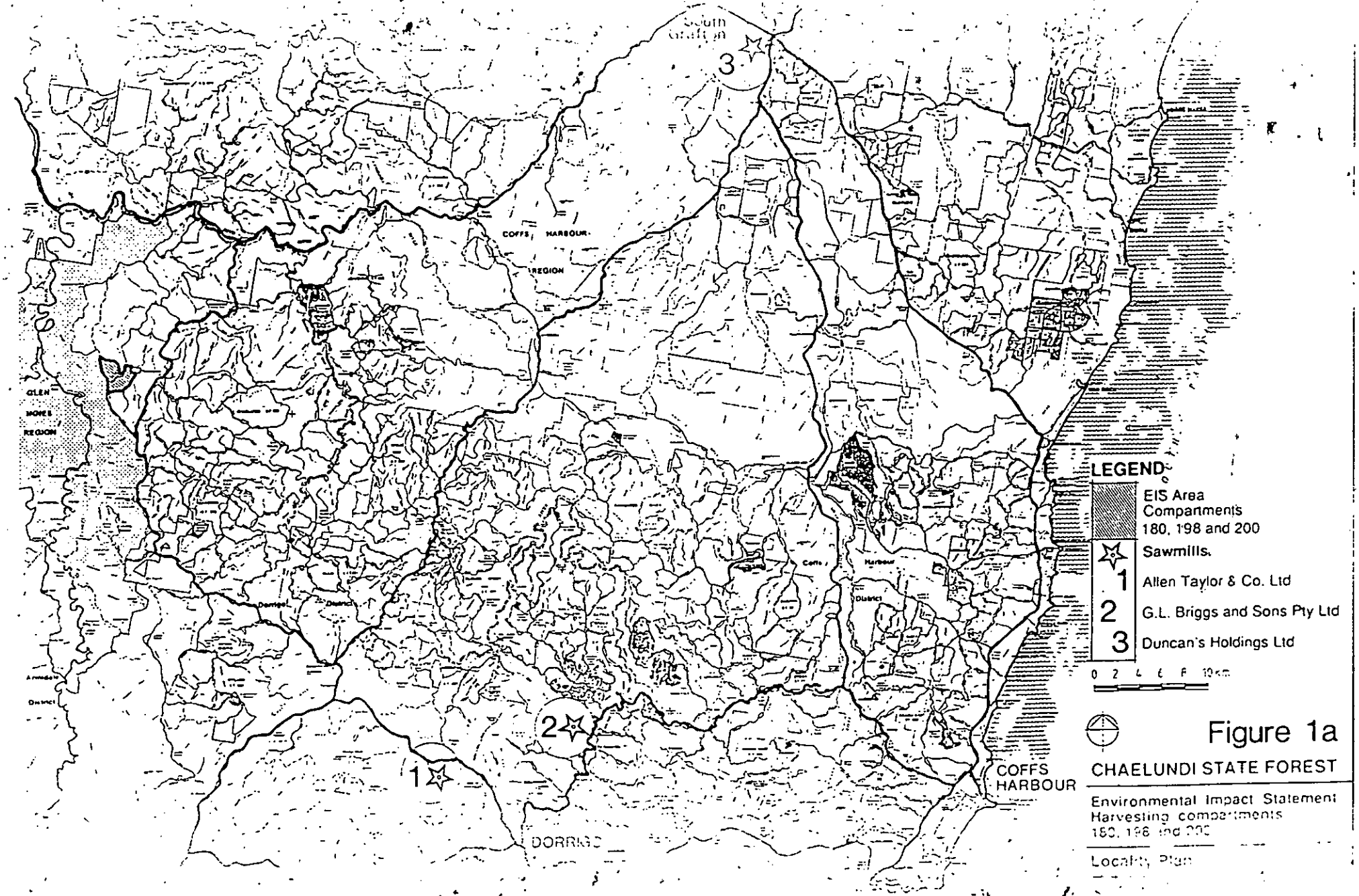
Forest products from these compartments are expected to sustain industry until towards the end of the year.

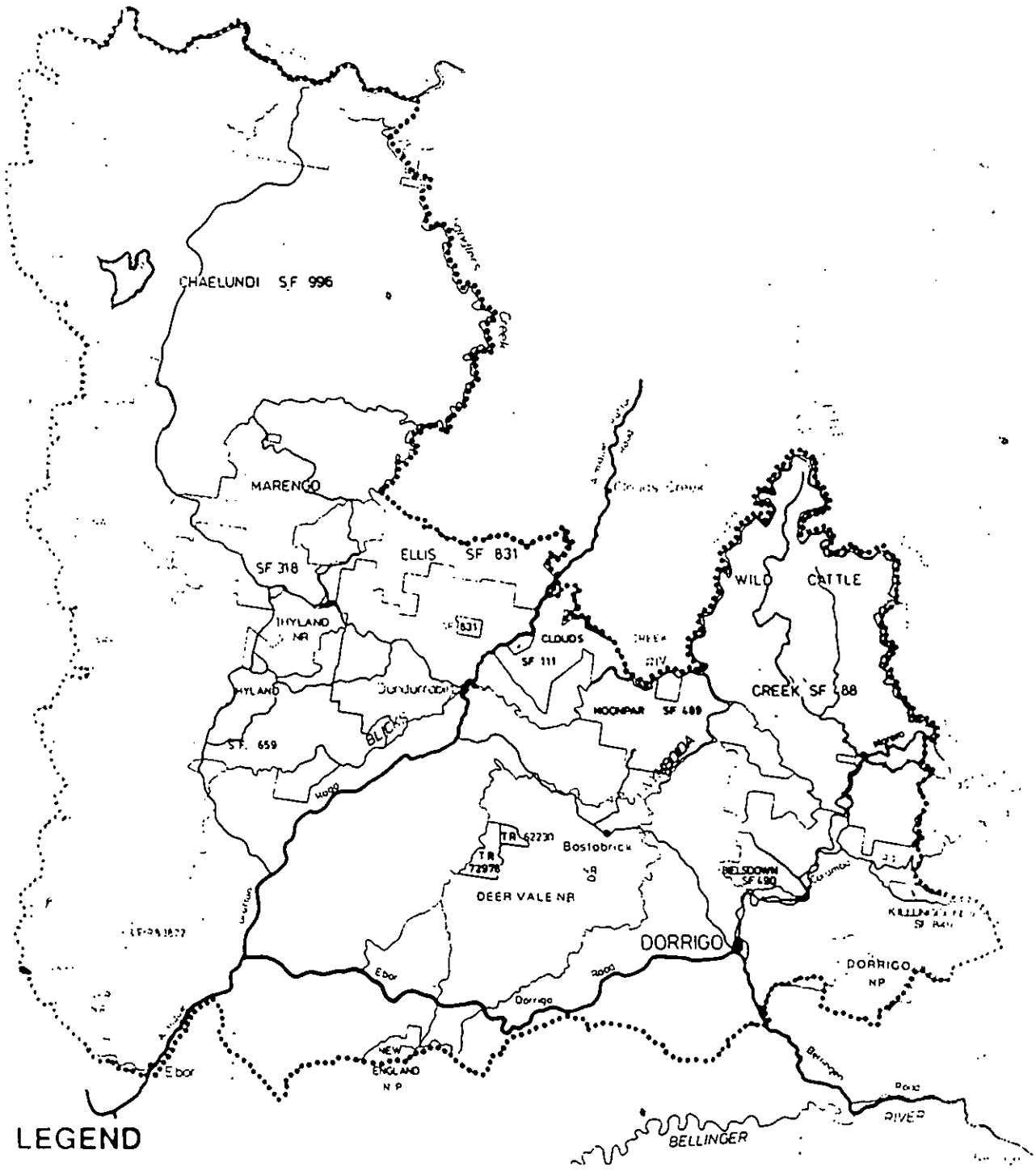
The District Forester allocates compartments for each sawmill. At any one time the sawmills will have two or more harvesting operations taking place. Compartments are allocated in both the high quality moist hardwood forest and the lower quality dry hardwood forest.

The percentages of quota drawn from each broad forest type have been held at roughly the same levels over time. The objective has been to balance the rate of harvesting within each of the two broad forest types. Table 1 shows the estimated volumes remaining in the Chaelundi North and East, and Chaelundi South and West zones which broadly correspond to the dry hardwood supply area and moist hardwood supply area respectively. Table 2 indicates the species/size class distribution as percentages of the total yield for the respective supply zones based on records of previous yields.

Table 1. Estimated nominal volume remaining in dry and moist hardwood types in Chaelundi group

Supply zone	Volume estimate as at 30.6.89 (m^3 nominal)
Chaelundi North and East (predominantly dry hardwood types)	260 000
Chaelundi South and West (predominantly moist hardwood types)	330 000


3
2
1
COFFS HARBOUR
REGION
GLEN INNES REGION
DORRIGO
COFFS HARBOUR
LEGEND
EIS Area
Compartments
180, 198 and 200
Sawmills.
1 Allen Taylor & Co. Ltd
2 G.L. Briggs and Sons Pty Ltd
3 Duncan's Holdings Ltd
0 2 4 6 8 10km
Figure 1a
CHAELUNDI STATE FOREST
Environmental Impact Statement
Harvesting compartments
180, 198 and 200
Locality Plan



LEGEND

- EIS Area Compartments 180, 198 and 200
- Management Area Limits
- Major Public Access Road
- Minor Public Road
- Major Forestry Access Road
- State Forest Timber Reserve

0 4 8 12 16 20 km.

Figure

CHAELUNDI STATE FORES

Environmental Impact State
Harvesting compartments
180, 198 and 200

Dorrigo Management Are

MARGULES PARTNERS PTY LTD

Date

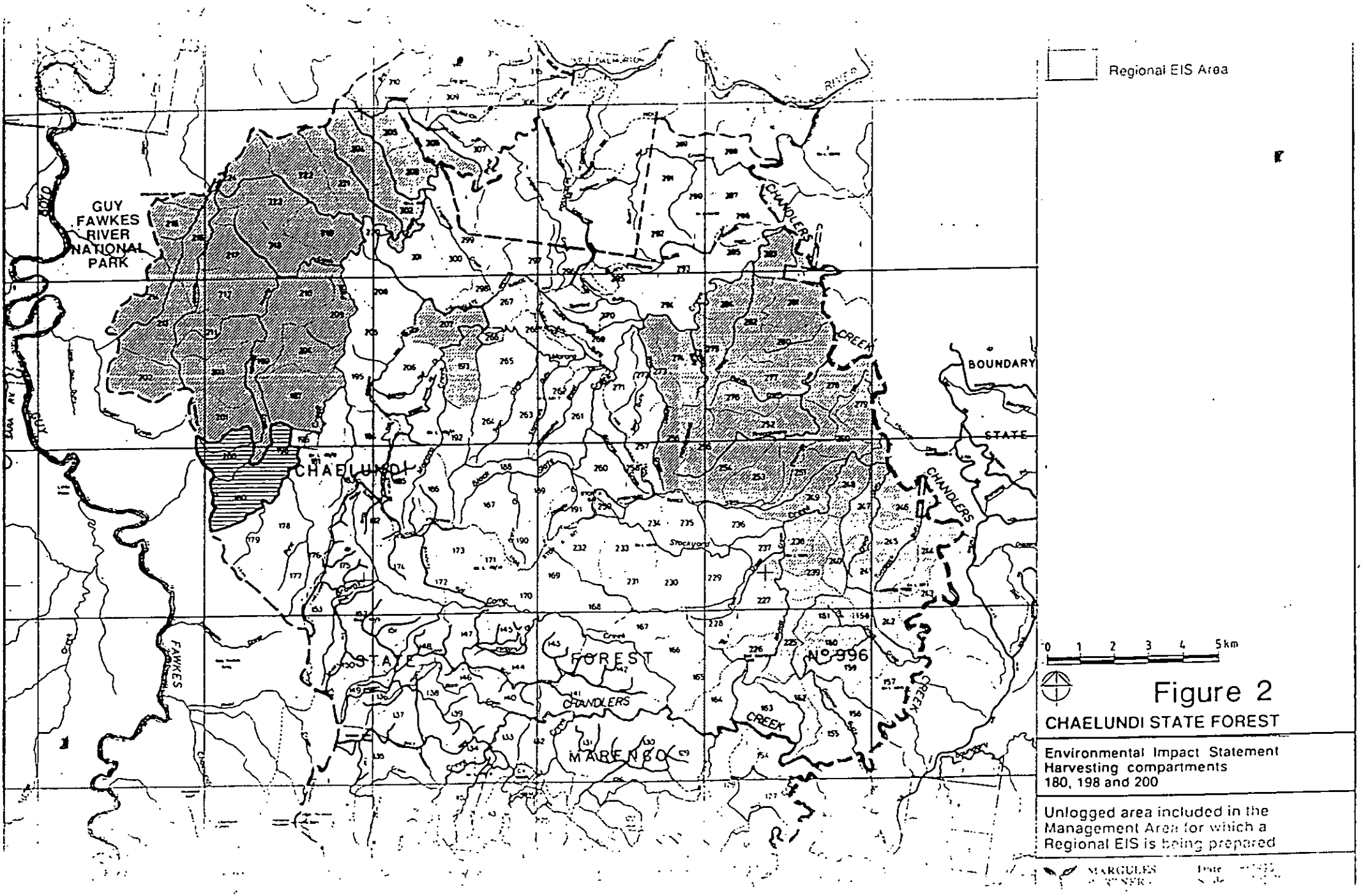


Figure 2

CHAELUNDI STATE FOREST

Environmental Impact Statement
Harvesting compartments
180, 198 and 200

Unlogged area included in the Management Area for which a Regional EIS is being prepared

Table 2. Historical yield (in percentages) by species and log size from Chaelundi supply zones

Supply zone	Log size class	Species (see key below) A	B+	B	C	D
Chaelundi North and East (predominantly dry hardwood types)	Large (80cm cdub)	-	-	2.7	-	0.2
	Medium (60-79cm cdub)	0.9	-	22.7	2.3	0.7
	Intermediate (40-59cm cdub)	5.9	-	53.9	9.7	1.0
Chaelundi South and West (predominantly moist hardwood types)	Large (80cm cdub)	16.4	5.5	6.6	0.2	1.6
	Medium (60-79cm cdub)	15.7	7.3	12.4	1.4	2.9
	Intermediate (40-59cm cdub)	6.2	5.5	13.3	2.9	2.1

cdub = centre diameter under bark

Species Groups

A = Tallowwood, Ironbark, Boxes
B+ = Blackbutt
B = New England BBT, Blue Gum, Red Mahogany, various Stringybarks-Spotted Gum
C = Grey Gum, White Mahogany, Round-leaved Gum, Ribbon Gum, Dichard Stringybark
D = Brush Box

Table 2 clearly shows the fundamental differences between the type of log from the two supply zones both in terms of the species being cut and in the size and quality of log being processed. The higher quality forest yields a bigger proportion of large (average 3.2-4.0 m^3 gross), high quality logs including Tallowwood. The dryer, low quality forest yields, generally smaller (average 1.8-2.2 m^3 gross), lower quality logs of less desirable species.

1.2.2 Compliance with EPA Act 1979

As discussed in Section 1, the FCNSW has undertaken to prepare EISs covering a number of old growth forests on the North Coast. The following excerpt from the FCNSW's document meeting the Environmental Challenge – A Forestry Strategy (ref. Appendix 1) sets out the context within which these EISs are being prepared.

> "The Environmental Planning and Assessment Act, enacted in 1979, requires an Environmental Impact Statement (EIS) for any activity likely to significantly affect the environment. It does not require an EIS for logging per se. It was not envisaged at the time, nor did the then Minister or the Department of Planning suggest, that an EIS would be required for all logging activities. In fact consultations with the Department led to the development of a system of internal environmental review designed to meet the requirements of the Act and identify those cases where EIS preparation might be required.
>
> Since the Act came into force in 1980, the Forestry Commission has completed five EISs for operations within areas seen to have particular sensitivity. However, interpretation of a Land and Environment Court ruling in 1989 suggests that EISs could be required for a considerably broader range of logging operations than previously thought, and particularly in respect of 'old growth' forest. In fact there is considerable doubt as to when an EIS might be held not to be required. This ruling, which has been successfully exploited by anti-logging groups, is the cause of the current crisis facing the Forestry Commission and the timber industry, particularly on the North Coast.
>
> This situation, coupled with perceived community concerns, gives additional impetus to the need to implement a strategy for the management of old growth forest."

As a result of an application for an interlocutory injunction by the Land and Environment Court, the Commission has undertaken not to proceed with harvesting operations over 6957 ha of Chaelundi State Forest pending completion of the EIS process. The undertaking covers the majority of old growth forests that contain high proportions of Tallowwood, the preferred species (ref. Section 1.2.4) remaining available to industry.

This EIS is being prepared as an alternative to seeking the Land and Environment Court to exercise its discretionary powers to permit harvesting to maintain supplies of forest products pending preparation of the regional EIS.

1.2.3 Areas available for harvesting to meet commitments

Yields to meet the commitments in the Dorrigo Management Plan for the present cutting cycle (CC1 to yr 2010) are sourced in old growth forests.

It is predicted that old growth forest not reserved for conservation in the general working circle (ref. Section 2.1.2) in the Management Plan Area, will be harvested by year 2010. The second cutting cycle will commence in the oldest cutover areas commencing in year 2011 or 2012, and the calculation of sustainable yield for this cycle is based on harvesting overstorey trees left during the first cut, plus regrowth trees which have grown to their maximum size since the first cut, plus some plantation and regrowth thinning timber. This calculation embraces a volume increment over time for the yields to be realised and consequently the resource sustainability is predicated upon the second cut not commencing before year 2011.

As previously discussed, current harvesting operations will meet industry commitments until the end of this year. At this time the Timber Licensees will be authorised to undertake harvesting and ancillary works in new compartments within areas of old growth forest capable of meeting industry requirements. These new compartments will only be available if there is access of a standard capable of handling log traffic loads generated by harvesting operations is constructed.

Access is an important criterion as it takes an average 8-12 months to survey, design and construct a road (of 4-5 km length). Therefore it will not be possible to initiate a totally new road project in the time remaining before harvesting in the current compartments is completed.

There are areas which do have suitable access available. This is shown by Figure 3. Two groups of unharvested compartments with suitable access are: Compartments 180, 198 and 200; and Compartments 189, 191 and 259. The latter group of compartments support forests with a low proportion of Tallowwood and would therefore not meet the objective of meeting industries requirements over the period. Aside from these areas there are some compartments that require additional roading that could possibly be undertaken in the time remaining before the current harvesting operations are completed. The survey and design work have been completed for the Grasstrees Road which could be constructed to provide access to compartments 232, 233 and 168 within the time frame. The extent to which these compartments are able to meet industry requirements is assessed under Alternatives (ref. Section 6.3). These areas are also shown by Figure 3.

1.2.4 Industry requirements for log size and species mix

Two companies, Allen Taylor & Co. Ltd and G.L. Briggs and Sons Pty Ltd have provided evidence concerning their special requirements for their log intake. This is appended as Appendices 2A and 2B. These requirements relate to both species mix and log size. The relationship between these factors and forest type (moist and dry) were discussed in Section 1.2.1.

Both companies indicate the importance of substantial proportion (22-30%) of good quality Tallowwood (*Eucalyptus microcorys*) in their log intake. This species is used to produce a range of high value products that contribute significantly to the financial viability of both mills. The proportions of this species in the mill intake for the three sawmills drawing quota logs from Dorrigo Management Area are provided as Table 3.

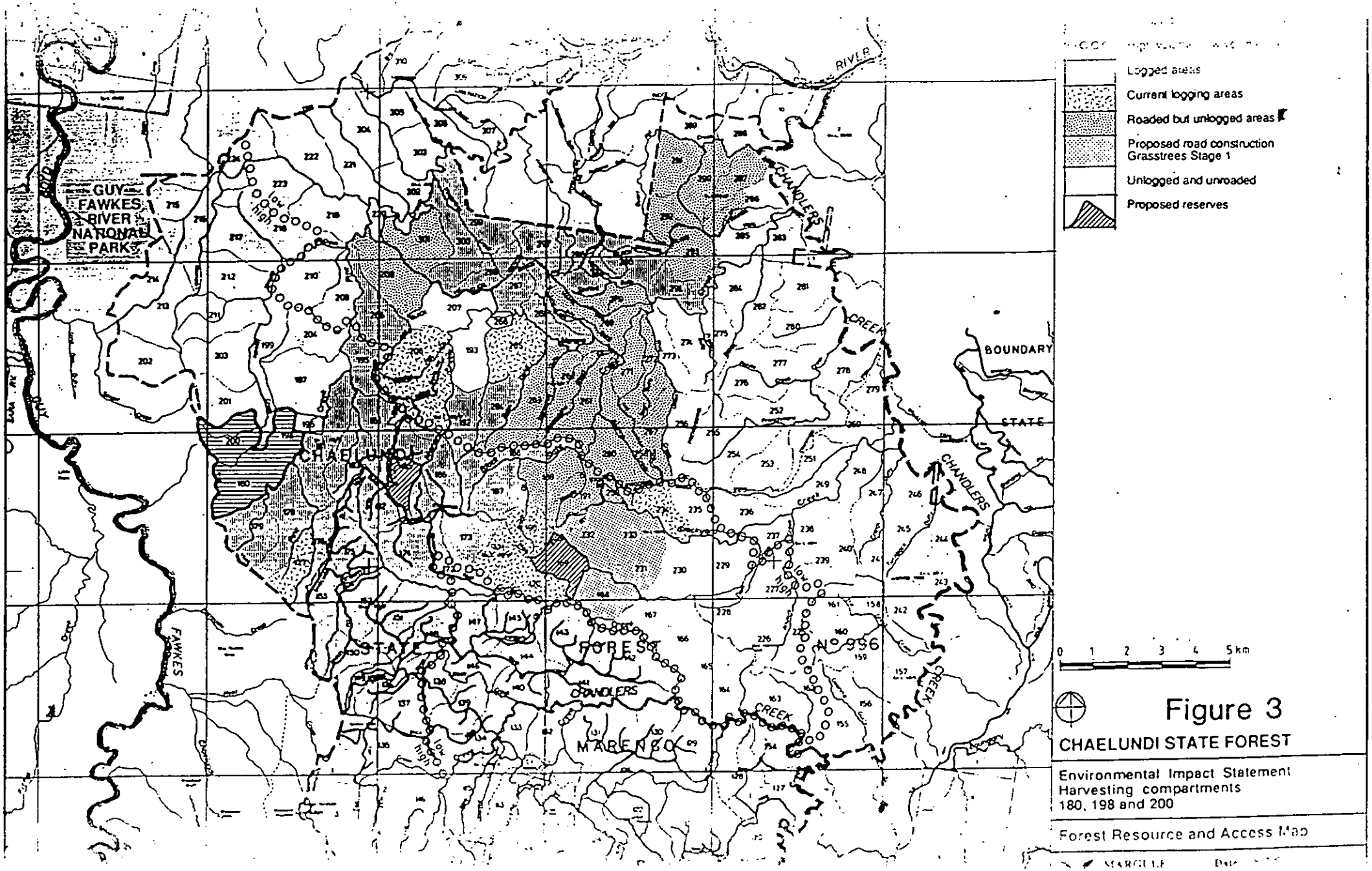


Figure 3

CHAELUNDI STATE FOREST

Environmental Impact Statement
Harvesting compartments
180, 198 and 200

Forest Resource and Access Map

Table 3. **Proportion of Tallowwood logs in total log intake for the Allen Taylor & Co. Ltd, the G.L. Briggs and Sons Pty Ltd Sawmills and Duncan's Holdings Ltd 1986-1989**

SAWMILL	YEAR 1986	1987	1988	1989	Average
Allen Taylor & Co. Ltd	31%	35%	38%	42.0%	36.5%
G.L. Briggs and Sons Pty Ltd	42%	41%	36%	20.0%	35.0%
Duncan's Holdings Ltd	35%	7%	11%	21.7%	18.7%

The significance of the difference between the 22-30% of good Tallowwood required and the 35-36% of Tallowwood log intake is that a percentage of the intake is not good, i.e. will not cut large sound lengths of sawn product. Also as the mills draw from both the moist hardwood resource and the dry hardwood resource some of the Tallowwood log intake is from the dry resource areas and is of inferior quality.

The importance of Tallowwood to these sawmills is evidenced by data provided in Appendix 2. G.L. Briggs and Sons Pty Ltd annual turnover for Tallowwood products is about $757,000 which covers approximately 63% of the fixed costs of operating the sawmill. Allen Taylor & Co. Ltd has budgeted for Tallowwood to contribute 50% of the profit from its Bostobrick sawmill.

The range of products and price paid for sawn timber is linked to a number of factors. The key factors are: the size of individual pieces; species – based on inherent qualities such as durability, strength, colour, etc; and quality of the individual pieces of timber, i.e. presence or absence of visual or strength defects. The sawmills drawing timber from Dorrigo Management Area have had continuing access for many years to a source of large logs of a durable species (Tallowwood) and have developed markets that exploit the inherent qualities of these logs by producing products such as large dimensioned girders, wharf decking and electricity transmission line crossarms. By maintaining a consistent supply of these products, the sawmills have developed regular customers seeking these products. For example, G.L. Briggs and Sons Pty Ltd have supplied some customers for up to 40 years with these products.

As discussed, log size is another important element affecting the sawmill's ability to produce marketable products. Quota logs harvested from these mature forests vary in size from a minimum small end diameter of 30 cm up to ≥150 cm, with a bias toward the larger diameter logs. The sawmills can be used to process smaller diameter logs, however, this involves higher processing costs as the sawmills are not geared towards these smaller size classes. Under normal circumstances the bias towards larger logs in the mill input allows the sawmills to cover the higher processing costs of the smaller logs through the efficient sawing of larger logs. This enables them to produce competitively priced products.

The importance of species and log size is illustrated by reference to comparative price for the same product, unseasoned, sawn framing and engineering timber, in different size classes and for different species. This is given in Table 4.

Table 4. **Price differential based on species and size gradient**

Product size (mm) [width and thickness]	Comparative price ($m/³ above base value)	
	Northern structural hardwood	*Select Tallowwood*
75 to 150 x 25 to 50	Base	321
175 to 250 x 25 to 50	23	390
275 to 300 x 25 to 50	87	461
175 to 200 x 125 to 150	135	524

Source: Derived from Duncan's Sydney Merchant Price List, August 1989.

If the average log diameter were to suddenly shift towards the smaller log size class then a sawmill equipped to handle large size logs would be disadvantaged particularly during periods when markets for timber products are depressed and prices are discounted.

It is apparent that the sawmills would be significantly disadvantaged if their access to the larger size logs of the preferred species were to be cut off. This would move them down towards the commodity end of the product spectrum where the margins between cost and price are much smaller.

The key elements in the relationship between the sawmills and their customers are:

- consistent supply
- products that meet specified requirements (size, durability and strength)
- competitive price

The sawmills therefore argue that if their supply of large, high quality Tallowwood logs is interrupted, they will be unable to maintain the supply of products to their regular customers. If supplies of alternative species and or log qualities cannot be processed to meet their customers' product specifications, then the sawmills would lose these customers.

Given time, these sawmills could re-equip to handle smaller logs and/or other species and could develop markets for the products produced. G.L. Briggs and Sons Pty Ltd have estimated it would take approximately six months to re-equip the mill at a cost of between $150,000 and $250,000 (ref. Appendix 2A). A more significant cost and time delay would be incurred by the company in its efforts to develop new markets for the new range of products being produced. The company has estimated these costs at $300,000.

Clearly, these two mills are not in a position to quickly adapt to significant changes to either the species mix or average size of log to be processed. Such changes, if required, can be phased in over time to allow the companies to cope with changed circumstances.

Duncan's Holding Ltd is the third company that has a Crown quota allocation from the Dorrigo Management Area. The company's position differs from the other two sawmills with respect to its specific requirements for Tallowwood over the next 18 months. Duncan's Holdings Ltd has a number of hardwood sawmills drawing on

Crown forests in other forestry regions. Some of the company's other sawmills have access to high quality Tallowwood resources which are able to meet current and expected commitments during the period between now and the completion of the Regional EIS.

In addition, Tallowwood has not represented such a significant proportion of the throughput of the Duncan's mill. When compared with the other quota sawmills, the Duncan's sawmill has typically been allocated a higher proportion of the 'dry hardwood' forest types than the other two mills. When averaged out these forests yield approximately half the proportion of Tallowwood (ref. Table 3). This factor, combined with availability of Tallowwood from other sources has meant that the company as a whole would not be seriously disadvantaged by not having access to Tallowwood to supply its Grafton mill during the period between now and the completion of the Regional EIS. However this mill would be disadvantaged if access to Tallowwood logs was denied beyond the period envisaged for completion of the Regional EIS or if access to larger diameter logs was denied.

For the reasons set out above, the FCNSW have accepted the industry's position that the logs supplied, pending finalisation of the regional EIS process, should not change. Tallowwood of the size and quality required by these mills is only available from moist hardwood forests (ref. Section 1.2.1). Therefore the Commission sought to identify three compartments within the moist hardwood forest that could sustain industry pending preparation of the aforementioned Regional EIS. Based on this decision, the three compartments, 180, 198 and 200 Chaelundi State Forest were chosen.

These compartments were selected from those potentially available immediately. There is good road access reflecting the fact that compartments 180 and 200 had been scheduled for harvesting under the proposed order of working (FCNSW pers. comm.). The FCNSW had intended to put a case to the Land and Environment Court to exercise its discretionary powers in respect of harvesting in these three compartments. The FCNSW considered the Court may have felt less constrained in exercising these powers in view of the fact that the compartments could be harvested without requiring major roadworks. Compartment 198 was included in this proposal in lieu of compartment 2[illegible] which had also been scheduled for harvesting at this time because this consolidated the area being excluded from the harvesting suspension (ref. Appendix 1).

2.0 OVERVIEW DESCRIPTION OF THE PROPOSED ACTION AND POSSIBLE ALTERNATIVES

This section of the document briefly describes the main elements of the proposal. Because the proposal constitutes a comparatively small part of a wider operation, it is appropriate that this be preceded by a description of the FCNSW's state and regional forest policy and planning processes. This will provide the context within which the proposal can be considered. As discussed, readers of this document should note that an EIS examining these wider issues has been foreshadowed by the FCNSW and is expected for release in 1991.

The planning and policy documents set out the objectives for management of these forests. This permits the proposal to be tested against these objectives to determine the extent to which it meets them.

This section also provides an overview of possible alternatives to the proposal. These are assessed as to their potential to meet the stated objectives and also to determine if they are both prudent and feasible.

2.1 RELATIONSHIP TO FOREST POLICY AND PLANNING ISSUES

The Forestry Act of 1916 defines the power, duties and objectives of the Forestry Commission. Forest policies and Forestry Commission planning processes have been developed to meet these statutory obligations through appropriate management of State Forests and Timber Reserves.

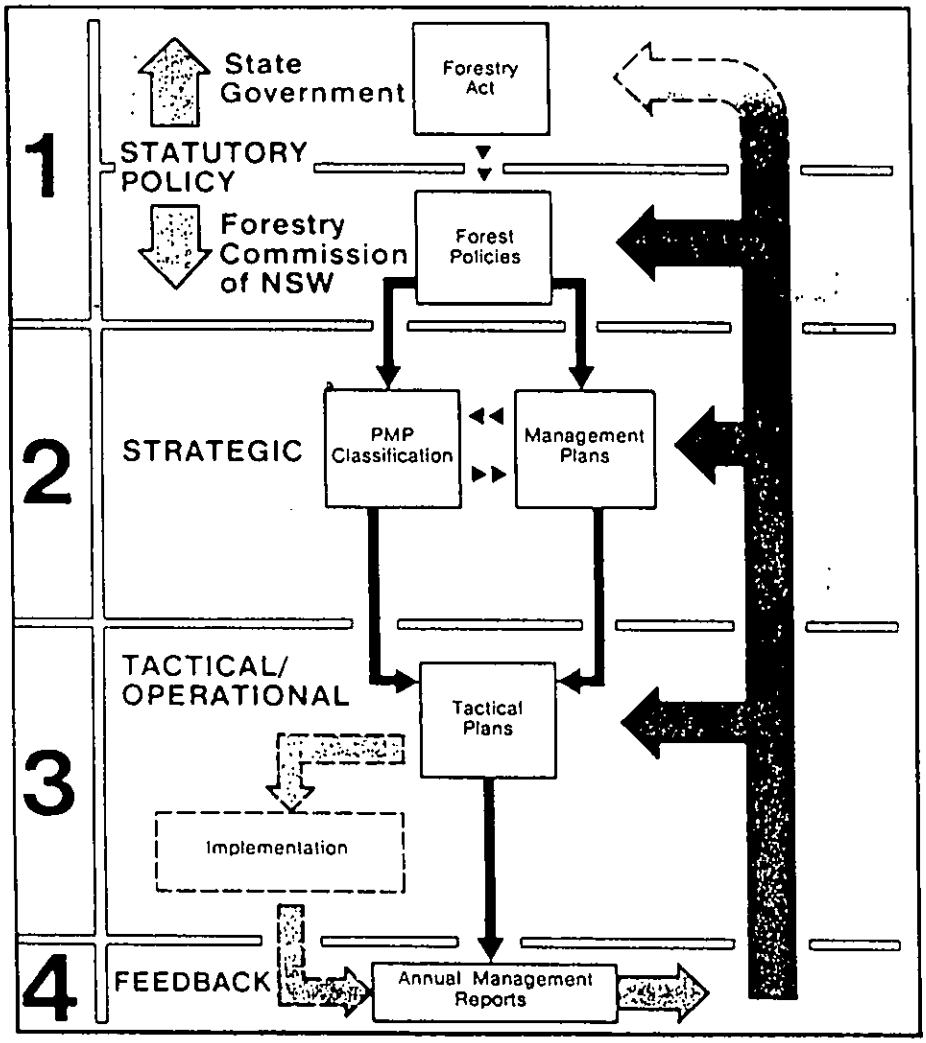
The levels of planning used by the FCNSW are illustrated by Figure 4. The following section describes the levels of planning that are of relevance to the proposal.

2.1.1 FCNSW indigenous forest policy

The indigenous forest policy defines the objectives of forest management on a state wide basis. The basic policy statements that guide forest management are:

> "• Indigenous forests have a continuing role in the production of forest products, principally sawlogs.
>
> • Indigenous forests have continuing and expanding roles in the fields of recreation and education, wildlife conservation, catchment protection and scientific research.
>
> • Development of these roles should be constrained so that future forest managers are not denied the opportunity to select from the widest possible range of forest uses.
>
> • The many and varied uses of the forest are inter-related, and each contributes to a socially desirable, economic and practical pattern of forest management."
>
> Source: FCNSW 1976

Other policy documents have been prepared that relate to specific aspects of forest management such as wildlife and fire fuel management.



Figure

CHAELUNDI STATE FOI

Environmental Impact Stat
Harvesting compartments
180, 198 and 200

Levels of Planning

MARGULES PARTNERS PTY LTD

Date

Table 5. Regulated maximum yield by product for Dorrigo Management Area

Product	Maximum annual yield (m^3)
• Quota sawlogs	40 000 (net)*
In addition, the following volumes of other products may be harvested:	
• Poles, piles and girders	2 500
• Hardwood veneer logs	10 000
• Small hardwood logs	19 500 - 30 000 (gross)
• Ex-quota sawlogs, salvage hardwood sawlogs, sleepers, posts and other timber and products	Variable, dependent on demand and availability

* The yield of quota sawlogs is now calculated on the basis of gross volumes as set out in Section 1.2.1.

The Plan describes the level of infrastructure development and management input that will be applied to particular areas within the Management Area. Road construction and maintenance standards will be limited to those required for effective harvesting, fire protection and public usage. Intensive management and protection will be concentrated on forests in the south east of the Management Area with low intensity long term future management in the more remote forests. The three compartments in question are in the latter area.

Ecological objectives

The Plan sets out the strategy being adopted to maintain an adequate natural forest vegetation cover and ecological viability and related objectives. Aspects of relevance to the proposal are reproduced below.

> "Maintenance of an adequate natural forest vegetation cover and ecological viability and related objectives will be met essentially by:
>
> - Retention of adequate stockings of unmerchantable trees and vigorous advance growth.
> - Natural regeneration following logging, supplemented by planting as outlined in the timber production strategy.
> - Protection from wildfire damage.
>
> Other measures will include:
>
> - The application of Standard Erosion Mitigation Conditions in harvesting, road design, road construction and maintenance.
> - Exclusion from or modification of logging in specific areas of particular visual sensitivity.
> - Retention of selected mature and overmature trees potentially suitable for wildlife habitat.
>
> Distinctive values will be maintained by continuation of existing reservations free from disturbance; investigation and appropriate designations under the PMP classification and, where appropriate, dedication as Flora Reserves, and exclusion from or modification of forest operations to protect such values.
>
> Provision for public recreation will be met by:
>
> - Maintenance of existing facilities.
> - Monitoring of usage and provision of facilities as justified by anticipated future usage.
> - Maintenance of aesthetic values of existing and potential recreation areas.
>
> Maximisation of net financial benefits will be achieved by continuing review of construction and maintenance programs, marketing strategies and operational procedures.
>
> Other objectives will be met incidentally to the above.
>
> Crown timber Lands other than State Forests will be managed according to expected future tenure."

Source: FCNSW 1985

The Management Plan specifies a range of prescriptions covering many of the activities and works that take place in the forest. Prescriptions define how the forest is to be harvested, roaded and regenerated. Other prescriptions define measures to protect wildlife and visual values. Prescriptions to prevent or minimise erosion during and after harvesting are also defined. Individual prescriptions have either been developed specifically for the Management Area or have state-wide application. The prescriptions relevant to this proposal are set out in Section 3.2. Prescriptions vary between parts of the forest reflecting differing management priorities.

2.1.3 Preferred Management Priority (PMP) classification system

The Preferred Management Priority (PMP) classification process operates in tandem with the Management Plan in defining the management strategy for the Management Area and is more responsive to change than the Management Plan.

PMP is a map-based system used to identify and define priority uses or special management emphasis for all forests under FCNSW management. Under the system areas of forest are assessed and grouped into broad classifications which denote the FCNSW's long term management objectives. PMP classification is an important tool that assists in achieving many of the objectives of management set out in the Management Plan. Non-timber production objectives are met in part or in whole by PMP classification.

PMP classification employs a three stage classification which progressively classifies the forest estate into one of thirteen categories. The hierarchy of PMP classification and a description of the management objectives for each of the thirteen categories is set out in Appendix 3. A description of PMP classifications for the three compartments is provided in Section 3.2.2.

2.1.4 Environmental review process

An environmental review (ER) is prepared by FCNSW officers prior to undertaking works that have the potential for significant impacts. This is an internal FCNSW document used to identify impacts and to plan appropriate measures to mitigate impacts.

An ER has been prepared to cover "the construction of Broadmeadows Road and associated subsidiary roads, and the harvesting, and protection of that part of Chaelundi State Forest served by those roads". The three compartments were included in the area studied;. The ER included specific prescriptions aimed at ameliorating impacts that were anticipated could occur. These included a range of measures to protect wildlife, both flora and fauna, including: use of wildlife movement corridors; reservation of rainforest; identification of rare and endangered species and their habitat preferences; and a reiteration of the minimum habitat tree retention prescriptions. Specific reference was made to design principles to be employed in the siting and construction of Broadmeadows Road with the aim of protecting visual and water quality values within the adjacent Guy Fawkes River National Park.

The ER also highlighted the importance of the resources within the study area to maintaining regional forest-based industries.

Relevant prescriptions identified in the ER have been picked up in the harvesting plans for the three compartments as instructions to both the harvesting contractor and FCNSW field supervisors.

2.1.5 Harvesting plans

Harvesting plans are the culmination of the forward planning process used by the FCNSW. The objective is to ensure that all the information necessary to mark out and conduct the harvesting operation are available. Plans are produced for each logging compartment.

The harvesting plan is in two sections:

- The first consists of a report which summarises the prescriptions to apply, together with an overview of the type of forest and anticipated yields.
- A map makes up the second part of the plan. This shows: the location of minor roads and log dumps, including wet and dry weather dumps; PMP special emphasis areas; filter strips protection strips; and other areas where harvesting is either modified or not permitted.

Harvesting plans represent the final and in many ways most important link in the execution of the FCNSW's policies and objectives. The proposal, as represented by the three appended harvesting plans, is therefore linked through the various levels of planning to the current policies and objectives of the FCNSW.

2.2 THE PROPOSAL

The proposal involves the FCNSW authorising Timber Licensees and their contractors to undertake harvesting operations and ancillary works in areas of State Forest in the Dorrigo Management Area which will yield sufficient quantities of sawlogs and other forest products from suitable species so as to meet, in the short term (until the end of 1991), commitments to local industries dependent on continuing supplies of these products.

2.2.1 Location of the works

In order to meet these commitments, areas of State Forest have been identified that contain sufficient supplies of appropriate species to supply industries for 12 months.

These areas, Compartments 180, 198 and 200 Chaelundi State Forest, are located about 50 km north west of Dorrigo township. The Chaelundi State Forest No. 996 is within the Dorrigo District of the Coffs Harbour Forestry Region. This area is within the Nymboida Shire Local Government boundary and is zoned 1(f) in the Nymboida Local Environment Plan. The location of the compartments is shown in Figure 1A.

2.2.2 Works required

The FCNSW proposes to permit authorised Timber Licensees, through their nominated contractors, to harvest all available merchantable timber from these compartments in accordance with the harvesting plans and other relevant prescriptions and instructions issued by the FCNSW.

Prior to harvesting, plans have been developed to enable harvesting operations to proceed in accordance with FCNSW policy and to meet specified standards. This has been completed. The major access road has also been built. Minor access roads will be marked out and constructed prior to the commencement of harvesting operations with these activities confined to within the compartment boundaries.

Harvesting operations, as proposed, will affect approximately 438 ha of the 561 ha within the compartment boundaries. Areas will be reserved from harvesting to meet FCNSW objectives concerning protection of visual, fauna, flora and water quality values. It is expected that timber production objective from these three compartments will be approximately 23 000 m^3 (gross) of quota sawlogs; 2600 m^3 (gross) of non-quota sawlogs and 300 m^3 (gross) of poles. This represents approximately 40% of the annual allocation for the three quota sawmills drawing from the Dorrigo District. Harvesting will be undertaken by three harvesting crews.

Logs and other forest products will go to seven local industries dependent on forest products from the Dorrigo Management Area. These include:

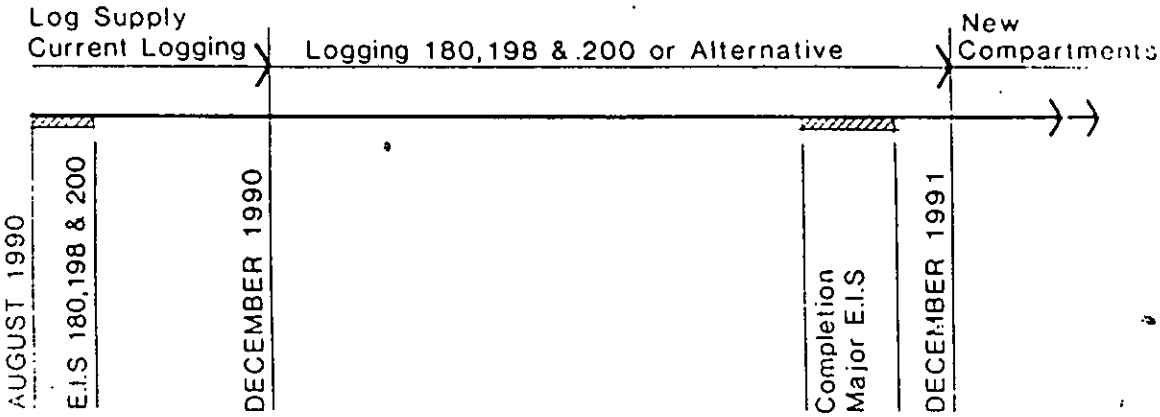
Quota sawlogs	• G.L. Briggs and Sons Pty Ltd • Allen Taylor & Co. Ltd • Duncan's Holdings Ltd
Poles and girders	• L.J. Williams
Other logs	• A. and F. Sawmill • F.M. Neaves Sawmilling • Mitchells Mill

At the completion of harvesting, soil conservation works and, if required, fire fuel hazard reduction, typically by burning, will take place in accordance with routine prescriptions. Logs will be transported by truck to the processing mills using conventional timber jinkers. Roads under various ownership categories will be used. No new haulage routes will be required.

2.2.3 Staging of works

The proposal is required to enable a continuation of log supplies in the short term pending preparation of the Regional EIS foreshadowed in Section 1.2. Harvesting of Compartments 180, 198 and 200 would be expected to commence as the harvesting operations in current areas are completed. This is expected to take place towards the end of 1990. Harvesting in Compartments 180, 198 and 200 would then continue pending completion of the EIS process. The timing of this process is shown by Figure 5.

E.I.S Time Line Figure 5



2.3 ALTERNATIVES TO THE PROPOSED ACTIVITY

The prudent and feasible alternatives are considered in the context of the perceive critical needs of two sawmills (as discussed previously in Section 1.2.4), for a 22-30 log intake in high quality, large Tallowwood logs and then for the overall quota sawlo allocations to be maintained.

Table 6 sets out this context for the next 12 months.

Table 6. Sawmills' annual requirement for Tallowwood logs

Sawmill	Annual sawlog quota (m^3G)	Average % of mill log intake in Tallowwood over past 3 years	Log supply required (m^3)	
			Tallowwood	Other spp.
Bostobrick	22 780	36	8 200	14 580
Briggsvale	18 180	35	6 363	11 817

The alternatives then are:

- Harvest Compartments 180, 198, 200 at reduced intensity; or
- Harvest Compartments 180, 198, 200 for Tallowwood species only; or
- Harvest elsewhere in similar high quality forest type; or
- Harvest elsewhere in a similar but low quality forest type; or
- Harvest elsewhere in dissimilar forest type; or
- Do nothing pending the outcome of the Regional EIS.

The resource options are set out in Table 7.

Table 7. Alternative resource areas – Chaelundi State Forest

Status	Area	Compartments	Loggable area by types (ha)	Estimated vol. (m³G)	Prog. cut to 31.7.90 (m³G)	Prog. Twd cut to 31.7.90 (m³G)	% Twd	Balance (m³G)
1. Moist hardwood – New England Hardwood								
Current	G.L.B.	190	169	6 000	3 080	1 240	40.2[1]	2 920
Current	A.T.D.	171	113	5 000	3 624	1 737	47.9[1]	1 376
Current	A.T.D.	170	165	7 000	2 127	356	16.7[1]	4 000
Current	A.T.D.	234	138	4000	825	228	27.6	1 175
					9 656	3 560	36.9	
Roaded	Stop a bit	189, 191, 259	423	13 000	-		10-15[2]	
Proposed roading	Grass trees	168, 231, 232, 233	741	45 000	-		<10[4]	BBT
Unroaded	Grasstrees Ext.	166, 167, 169, 228, 230, 235	1 278	64 000	-		10-15	BBT
2. Dry hardwood – Spotted Gum								
Current	A.T.D.	206	200	6 000	4 060	809	19.7[3]	2 000
					13 016	1 780	13.7	
Roaded	Various	208, 301, 257, 258, 260-263 269-272, 286, 287, 290-293	2 992	58 000	-		≤5	
Unroaded	Stopabit	236, 237	236	4 000	-		≤5	

Notes

1. Preference shown in logging Twd areas first distorts these yields – the final yield for Compartments 190, 171, 170 will be less % Twd.
2. Twd in alternative moist hardwood areas 189, 191, 259 and Grasstrees areas will be less than 15%.
3. Twd proportion from Compartment 206 is higher than can be expected for balance of dry hardwood areas – it is a borderline case and contains some moist hardwood stands. See also note [1] above.
4. Grasstrees Road surveyed, construction expected to commence September, 10 weeks construction following approval.

2.3.1 Harvest Compartments 180, 198, 200 at reduced intensity

This implies:

- Prejudicing the sustained yield basis of the Dorrigo Management Plan.
- Less timber yield per unit area leading to less revenue for other forest management activities.
- Revision of silvicultural management to ensure satisfactory restocking following harvest.
- Less disturbance so less impact on the natural environment.
- Increase in marketing costs leading to a reduction in net financial return.

This is a feasible alternative provided that a reduction in overall yield is accepted.

2.3.2 Harvest Compartments 180, 198, 200 for Tallowwood only

This implies:

- Prejudicing the sustained yield basis of the Dorrigo Management Plan.
- Less timber yield per unit area leading to less revenue for other forest management activities.
- Revision of silvicultural management to ensure adequate restocking of Tallowwood
- Increase in marketing costs leading to a reduction in net financial return.
- Less disturbance so less impact on the natural environment.

This is a feasible alternative provided a reduction in overall yield is accepted but it may disrupt the regrowth species mix and therefore impact adversely on future specie diversity.

2.3.3 Harvest elsewhere in a similar high quality forest type yielding large diameter Tallowwood logs

This implies:

That there is more high quality forest type within the region however most is within the largely unroaded northern and western areas of Chaelundi State Forest. The only available (i.e. roaded) alternative areas of high quality type are limited to parts of Compartments 189, 191 and 259. The areas currently being harvested in Compartments 170, 171 and 190 will supply sufficient high quality Tallowwood resource for four months (i.e. from July/August to October/November 1990). Compartments 189 and 191 may then supply one mill for 4-6 weeks with Tallowwood of medium to low quality. Thus the available resource elsewhere will provide about 40 mill weeks supply out of the 104 weeks supply required (i.e. about 40%). The impact on the natural environment would be the same but in a different location. This is not a feasible alternative as this would not maintain supplies of suitable logs to industry for the time needed to prepare the Regional EIS.

2.3.4 Harvest elsewhere in a similar but low quality forest type

An area in Chaelundi State Forest, comprising Compartments 166, 167, 168, 228, 229 and 230, is unharvested and unroaded and contains forest types expected to yield 10 15% Tallowwood in the log mix.

There is a current proposal to construct about 5 km of feeder road (Grasstrees Road) to access these compartments in Chaelundi State Forest. Road construction will take about 10 weeks following approval. (The road survey and design process has been completed.)

Because this type contains less than half the proportion of Tallowwood as a proportion of standing volume, it will require 2-3 times the harvested area to yield the volumes of Tallowwood needed, perhaps more depending on how it cuts.

There are also areas which have either been lightly harvested or unharvested in Wild Cattle Creek State Forest (Cascade) of moist hardwood types. The Tallowwood is of lower quality and called 'ringy', i.e. the wood tends to open and split along the annual rings. This makes it difficult to cut large sized clear timber which is an essential criterion for producing the range of products needed to meet existing customers' requirements.

This alternative implies:

- Prejudicing the sustained yield basis of the Dorrigo Management Plan.
- Disruption to planned harvesting operation.
- A variation in species mix in mill log intake
- A likely reduction in the quality and range of products produced.
- The impact on the natural environment would be similar, spread over a larger area.

This is a marginally feasible alternative for a short period of time. The area can be roaded in time and there is sufficient area from which to obtain Tallowwood provided the forest yields sufficient logs of the standard needed to meet the critical product criteria without prejudicing future quota sawlog allocation.

2.3.5 Harvest elsewhere in dissimilar forest type

There are areas of dissimilar forest type in Chaelundi State Forest roaded and available however none contain Tallowwood.

The dominant species in these areas is Spotted Gum which is often substituted for Tallowwood, but not in all the market areas into which these mills are selling. The use of Spotted Gum in most other markets requires the product to be treated to prevent Lyctus attack. Neither mill has this equipment and in the short term could not be expected to install such equipment.

The impact on the natural environment would be similar, spread over a larger area, but not such a diverse area as in the other forest types.

Therefore, this is not considered a feasible alternative.

2.3.6 Do nothing pending the outcome of the Regional EIS

The mills concerned are currently harvesting Compartments 170, 171, 177, 190, 194, 206 and 265. When these compartments cut out they will move to Compartments 189 and 191.

The available (i.e. roaded and outside the injunction area) Tallowwood resource is then finished. This is expected to occur some time during December/January assuming normal harvesting operations.

This would:

- Disrupt mill log supplies, harvesting operations and sawmill operations.
- Disrupt mill marketing strategies which may lead to retrenchment of mill and field staff.
- Create local unemployment leading to hardship socially and economically.
- Reduce the extent of environmental disturbance within the Chaelundi State Forest.

This is not a prudent and feasible alternative.

3.0 DETAILED DESCRIPTION OF THE PROPOSED WORKS

This section of the report describes the individual elements of the proposal. The section is subdivided into five subsections with each describing a different element.

The first subsection describes the harvesting operation including the equipment and techniques used for roading, harvesting and transporting of logs.

The second section describes the prescriptions used to govern the way harvesting operations are conducted. This includes identification and demarcation of areas where harvesting is excluded or modified.

The third section details controls over the harvesting operation with particular reference to the role of the harvesting plan and field supervision as a means of controlling operations in the field.

The fourth subsection provides an assessment of the likely extent of the operation in terms of net area harvested and in terms of proportion of standing trees removed.

The fifth subsection details future fire management.

3.1 DESCRIPTION OF OPERATIONS

This subsection details the works required to harvest the timber from the three compartments. The FCNSW proposes to permit three harvesting contractors to operate, one per compartment.

3.1.1 Volumes to be harvested

The FCNSW has assessed the volumes of products available from these three compartments as outlined in the Dorrigo Management Plan. These data have been updated periodically based on actual volumes cut from similar forest types.

The projected yield by product by compartment is set out as Table 8.

Table 8. Projected yield by product by compartment

Product	Specification	COMPARTMENT 180 Est. volume	Licensee	COMPARTMENT 198 Est. volume	Licensee	COMPARTMENT 200 Est. volume	Licensee
Poles & Girders	Conforming with AS 2209 for poles and suitable for current orders.	100m³	L.J. Williams	100m³	L J Williams	100m³	L J Williams
Quota Logs	Minimum length 3.0m, Minimum Small End diameter of 30cm. Maximum defect levels specified in Schedule of Compulsory Utilisation Limits for Dorrigo District.	10 000m³	Allen Taylor Co. Ltd	6 000m³	Duncan's Holdings Ltd	7 000m³	G L Briggs and Sons
Other	Logs not meeting specifications above.	1 000m³	Mitchells Mill	600m³	A & F Sawmill F M Neaves Sawmilling	1 000m³	F M Neave Sawmilling

Note: All figures gross

Based on the projected yields, these compartments are expected to maintain Tallowwood supplies to industry for a period of approximately 12 months.

3.1.2 Roading works

The three Compartments 180, 198 and 200 can be harvested without any further extension to Broadmeadows Road which has been constructed to the northern boundary of Compartment 200. Some gravelling would be required to provide a suitable pavement for heavy haulage. Gravel would be imported from an existing quarry 12 kilometres south of the area. A fire trail (Pine Creek Trail) runs along the ridge separating Compartments 200 and 180 and forming the western boundary of Compartment 198. This fire trail, approximately 2.5 km in length, would require construction of two short deviations to remove sections that don't meet grade criteria. In addition, minor widening and straightening of the existing trail will be required. Construction of approximately 6 kilometres of short term logging tracks is also required. These will be sited and constructed in accordance with the standard erosion mitigation conditions (ref. Section 3.2.3). Logging tracks are generally located near ridge tops, thereby minimising earthworks and drainage requirements. One track in Compartment 200 crosses a creek and construction of a bridge will be necessary. These tracks would be closed and cross-drained at the completion of harvesting. Road locations are shown in Appendices 4A, B, and C.

3.1.3 Tree marking

Trees are marked by FCNSW marketing foremen under supervision from a professional forester as an explicit instruction to either take or retain the marked tree and to mark boundaries or alignments. Trees for retention are marked with yellow paint. Where an area has had individual trees marked for retention the faller is required to cut all the remaining trees that meet utilisation criteria. Trees to be removed are marked with pink paint and/or an axe blaze. Most trees that are harvested are not marked as they obviously comply with utilisation standards.

The following categories of trees are marked for retention:

- wildlife habitat trees
- identified feeding trees for Yellow-bellied Gliders and nearby refuge trees
- trees which have the potential for "significant net merchantable timber value increment for economic harvesting in subsequent cutting cycles". In other words, trees that are growing vigorously with good form with the potential to yield premium sawlogs are retained.

Other broad zones are identified (but not necessarily marked) for retention, for example wildlife movement corridors. Within certain of these zones, individual trees can be removed subject to compliance with prescriptions. Where this occurs, individual trees to be removed are marked with the remainder to be retained.

The boundaries and alignments that are marked where necessary include: the compartment boundary; road and track alignments; and dump sites.

Boundaries are not fully marked, but only sufficient to identify geographic feature forming the boundary, e.g. gully etc. Tree marking is undertaken as a two stage process. The initial marking seeks to define the broad framework of roading, dump location, compartment boundaries and the initial tree retention marking. As harvesting

proceeds and access into the compartment improves, tree marking is extended. In addition, the FCNSW supervisor can mark trees for removal that have been passed over by the faller.

3.1.4 Tree felling and snigging of tree logs

Felling

Tree felling is undertaken by 'fallers' using large capacity chainsaws. Fallers must demonstrate competence in chainsaw operation prior to being issued with a certificate of chainsaw proficiency which is a prerequisite for working as a faller in State Forests.

The faller makes the decision to cut or not cut those trees not marked specifically for retention or removal outside of reserved areas. This decision is made on the basis of utilisation standards, i.e. whether or not the tree will yield a log that meets the minimum standards. FCNSW supervisors monitor the level of utilisation and can instruct fallers to cut trees that have been passed over by the faller.

Having cut the tree, the faller is responsible for trimming branches and cutting the log to length ready for snigging to the log dump. The tree crown and unsuitable parts of the trunk are left on the forest floor.

The faller has the responsibility to both select trees for harvesting and to maximise the yield of merchantable logs from those trees. The faller has some control over the direction the tree will fall which is of benefit in reducing damage to retained stems. There are specific prescriptions that preclude harvesting trees that if felled would damage retained areas of rainforest.

Snigging

A crawler tractor of D6-D7 size fitted with a blade and winch is used to transport or 'snig' logs from the forest to the log dump. The tractor is used to create an access route from the log dump to the area where falling is occurring. This is termed a snig track. Logs are normally snigged uphill reflecting the predominantly ridge top roading pattern. Typically snig tracks follow the fall line with little or no side cutting. The typical pattern is for snig tracks to radiate from the log dump.

Logs are attached to the rear of the tractor using a wire rope fitted to a drum winch. Larger logs are transported singly, smaller logs can be bunched and transported together. Logs are dragged behind the crawler up to the log dump where they are processed prior to loading.

Snig tracks typically carry from few to many passes of a tractor. As such they represent some of the most intensively disturbed areas of the compartment. There are restrictions placed on the movement of equipment within the compartment. These are set out in the: Standard Erosion Mitigation Conditions; and Code of Logging Practices – Coffs Harbour Region (FCNSW 1988a). These cover a range of practices that seek to reduce or eliminate impacts. These are discussed in Section 3.2. Key elements of relevance to snigging operations include: procedures to minimise damage to retained trees; avoiding snigging through drainage lines and other wet areas which is likely to impact adversely on water quality; procedures to minimise the number of snig tracks open at any one

...me, thereby reducing the risk of erosion; use of 'walk over' techniques where debris is ...etained on the snig tracks to spread the weight of the tractor.

...1.5 Log dumps and loading

...og dumps are located in comparatively flat sites along the ridges that are specified in ...e harvesting plans. Log dump establishment involves: clearing vegetation from an ...ea of approximately 1200 m^2; stripping and stockpiling of topsoil; and construction of ...n earth and log loading ramp.

...ogs are processed; branded and measured and recorded; and stockpiled prior to ...oading and dispatch. Logs are loaded by using the tractor to push the logs up the ramp ...nd onto the truck.

Log dumps are typically highly compacted following completion of harvesting and require rehabilitation works including removal of the loading ramp (levelling), draining ...nd respreading topsoil.

Where logs are debarked (this applies only to Allen Taylor & Co. Ltd operations), or a ...ild-up of debris occurs on the dump the crawler tractor is used to redistribute the bark ...nd debris back through the area.

3.1.6 Transport of logs

Logs are transported on heavy timber jinkers which typically carry a net load of 22 tonnes. Each truckload of logs is tallied and entered on a delivery docket that is carried by the truck driver.

Before leaving the log dump truck drivers are required to ensure their load is properly secured to comply with provisions of the Code of Logging Practice and the Timber Industry (Health and Safety) Regulation 1982.

Haulage routes from the three compartments to the respective sawmills are:

Duncan's Holdings Ltd:	Broadmeadows Forest Road, thence northward on Chaelundi Forest Road to Dalmorton and then Old Glen Innes Road (Shire) to Gwydir Highway (RTA) and then to Grafton.
Allen Taylor & Co. Ltd:	Broadmeadows Forest Road, thence southward on Chaelundi Forest Road, Sheep Station Creek Road via Chaelundi Road (Shire), Grafton-Armidale Road (RTA) and Tyringham-Dorrigo Road (RTA) to Bostobrick.
G.L. Briggs and Sons Pty Ltd:	As for Allen Taylor except that the route continues to Dorrigo, then Dorrigo-Coramba Road (RTA) and then a small section of shire road and forestry roads to Briggsvale.

The length of the haul on roads under various ownership categories are set out in Table 9.

Table 9. Length (km) of haul by road ownership category

	Forestry Commission	RTA	Shire
Duncan's Holdings Ltd	36	10	58
Allen Taylor & Co. Ltd	38	15	6
G.L. Briggs and Sons Pty Ltd	42	44	7

3.1.7 Post harvesting debris disposal

Following completion of harvesting operations fire may be used to reduce the amount of debris such as tree heads and flattened understorey that remain on the harvested area. Fires are lit during mild conditions resulting in the occurrence of some running fire. Generally 70% of the area harvested is 'burnt' with the actual area burnt closer to 50% leaving a mosaic of burnt and unburnt patches, (FCNSW pers. comm). The Dorrigo Management Plan prescribes that burning can be undertaken subject to provision being made for the protection of existing regeneration, advance growth and trees retained for further growth. In practice, this involves ensuring that debris does not accumulate in close proximity to areas of retained vegetation.

3.1.8 Silvicultural/regeneration requirements

Silvicultural/regeneration needs for the various forest types are described in the Dorrigo Management Plan (pages 22-23). The following sets out the requirements for the relevant forest types.

No specific silvicultural treatment, other than top disposal burning, has been undertaken in the Chaelundi group forests. This is because post harvesting regeneration has generally been adequate.

New England hardwood

The unharvested stands of this type are generally composed of mature or overmature trees with little regeneration or advance growth. This is particularly so in the drier, poorer sites which have been subject to frequent occurrence of fires perpetuating an understorey of xerophytic shrubs and grasses.

Considerable site variation occurs in this type depending mainly on soil depth and fertility and on rainfall.

Prolific regeneration develops as a result of significant disturbance and extensive openings of the overstorey canopy by harvesting or natural disturbance. Burning of logging slash may aid regeneration establishment but exclusion of fire thereafter for a period of three to five years is necessary to ensure successful development of regeneration.

After harvesting to maximum utilisation standards of trees not marked for retention in this type, trees, scattered or in clumps, may occupy about 50% of the area on poorer

sites. On more productive sites, such trees may occupy only about 20-30% of the harvested area. The occurrence and development of regeneration is usually adequate for future timber production.

Dry hardwood
In the main these types are relatively shade tolerant and slow growing. They regenerate well from seedlings, lignotubers and coppice following harvesting or other significant disturbance. Unharvested stands usually have an uneven-aged structure and carry a high proportion of pole size trees. The generally uneven-aged condition is typical of the type and readily perpetuated by selective harvesting.

These types typically have an open grassy or xeric understorey and despite frequent burning (particularly on the areas dominated by spotted gum) adequate regeneration is obtained by lignotubers or seedlings.

Extensive areas of unharvested stands of this type occur in the northern and eastern sections of the Chaelundi Group.

Moist hardwood
Unharvested stands, mainly in the north west section of the Chaelundi Group, are mostly mature or overmature with little or no sclerophyllous regrowth present, except in occasional large gaps created by major natural disturbance.

On the Chaelundi Group where the type is generally drier than other parts of Dorrigo M A, the understorey development following disturbance is not heavy and regeneration of desirable species is readily achieved following harvesting and top disposal burning.

3.2 PRESCRIPTIONS COVERING FOREST OPERATIONS

The FCNSW has developed general and special harvesting prescriptions that apply to areas to be harvested. The prescriptions that are to apply to the proposed operations in the three compartments are set out below.

3.2.1 Harvesting prescriptions for Dorrigo Management Area

These prescriptions are set out in the DMA Plan of Management under Section 2.2.3 on pages 56-60 of that document. The following prescriptions are of relevance to this proposal.

"**Special prescription areas**
Harvesting operations shall be excluded from or modified in specific areas designated as PMP Special Emphasis as necessary to protect the values designated and in other such areas as considered desirable by the District Forester to maintain specific aesthetic values or to protect any distinctive values as they are identified, either in or adjacent to the harvesting area. These areas shall include those in the visual vicinity of:

- Existing or potential recreation sites (PMP 1.1.2).
- Selected parts of major roads regularly used by the public (PMP 1.1.6)
- Within known habitat of the Hastings River Mouse, designated as PMP 1.1.7 Special Emphasis Flora and Fauna Protection.

Harvesting operations in hardwood areas adjoining rainforest stands on State Forests shall be modified as far as practicable to minimise avoidable damage to rainforest structure.

General prescriptions

- Erosion control prescriptions, as defined in the Standard Erosion Mitigation Conditions for Logging and Clearing in NSW, shall be applied.
- Tree marking for removal or retention shall be carried out as necessary to ensure the proper implementation of the harvesting prescriptions of this Plan.
- Supervision should ensure that all trees removed are harvested for the most economic end use for which markets are economically and practically available, and should aim at maximum economic utilisation of all trees designated for removal.
- Tree marking and supervision of felling and extraction operations shall aim at minimising damage to retained trees and soil disturbance in excess of that required for adequate regeneration.
- Trees judged capable of significant net merchantable timber-value increment for economic harvesting in subsequent cutting cycles shall be retained except where their removal would result in a more valuable increase in the increment on preferred retained trees.
- Where not already retained in harvesting, including incorporated unlogged areas, additional mature and overmature trees of value for wildlife habitat, shall be retained to provide an average frequency of one per hectare. These should be preferably in clumps of up to five trees scattered throughout the harvesting area. Additional trees of potential habitat value should be retained as necessary for future recruitment and continuity.

Trees identified as being used for feeding by yellow-bellied gliders, and one or two nearby refuge trees, shall be retained.

In those limited areas of the Moist Hardwood stands where regeneration at sawlog stocking (125 stems/ha) is not expected following logging, and regeneration treatments are not proposed, sufficient spaced mature trees shall be retained to provide an average residual basal area of at least 5 m^2/ha.

Consistent with the previous prescriptions harvesting should thus aim towards:

- Maximum economic quota yield from trees not required for retention.
- Production of increment on retained trees, or development of regeneration.
- Maximum economic utilisation in overmature stands on sites of moderate topography, favourable site quality and economic location.

Harvesting of ex-quota logs other than thinnings should be undertaken where practicable and economic in conjunction with or closely following Crown quota operations to the extent required to achieve these aims.

All practical steps should be taken to avoid damaging trees in rainforest stands by road construction, and hardwood logging in adjoining areas. Any damaged trees should be salvaged by harvesting.

Harvesting of timber and forest products other than sawlogs, veneer logs, or poles; shall be restricted to trees or parts of trees which are neither suitable nor potentially suitable for higher value products, and are not trees required for retention under the provisions of the plan.

The order of working for sawlog and pole operations shall be determined by the District Forester and approved by the Regional Forester each year for the following two years.

As far as practicable, pole operations shall precede sawlog operations, but follow access road construction.

In general, harvesting areas should be allocated so as to avoid relative economic disadvantage to any licensee and to give a reasonable mix of log quality, size and species in relation to the overall availability of timber product yield.

Where practicable, areas suitable for wet weather logging should be set aside for that purpose.

Logging shall proceed in an orderly fashion and, as far as practicable, each logging area shall be completed to the satisfaction of the supervising forester before operations commence on a new area.

The area shall be logged in an order that as far as practicable maximises the net return on roading expenditure.

The order of working for other timber and products shall be determined by the District Forester on the basis of demand and availability under the harvesting prescriptions of this plan."

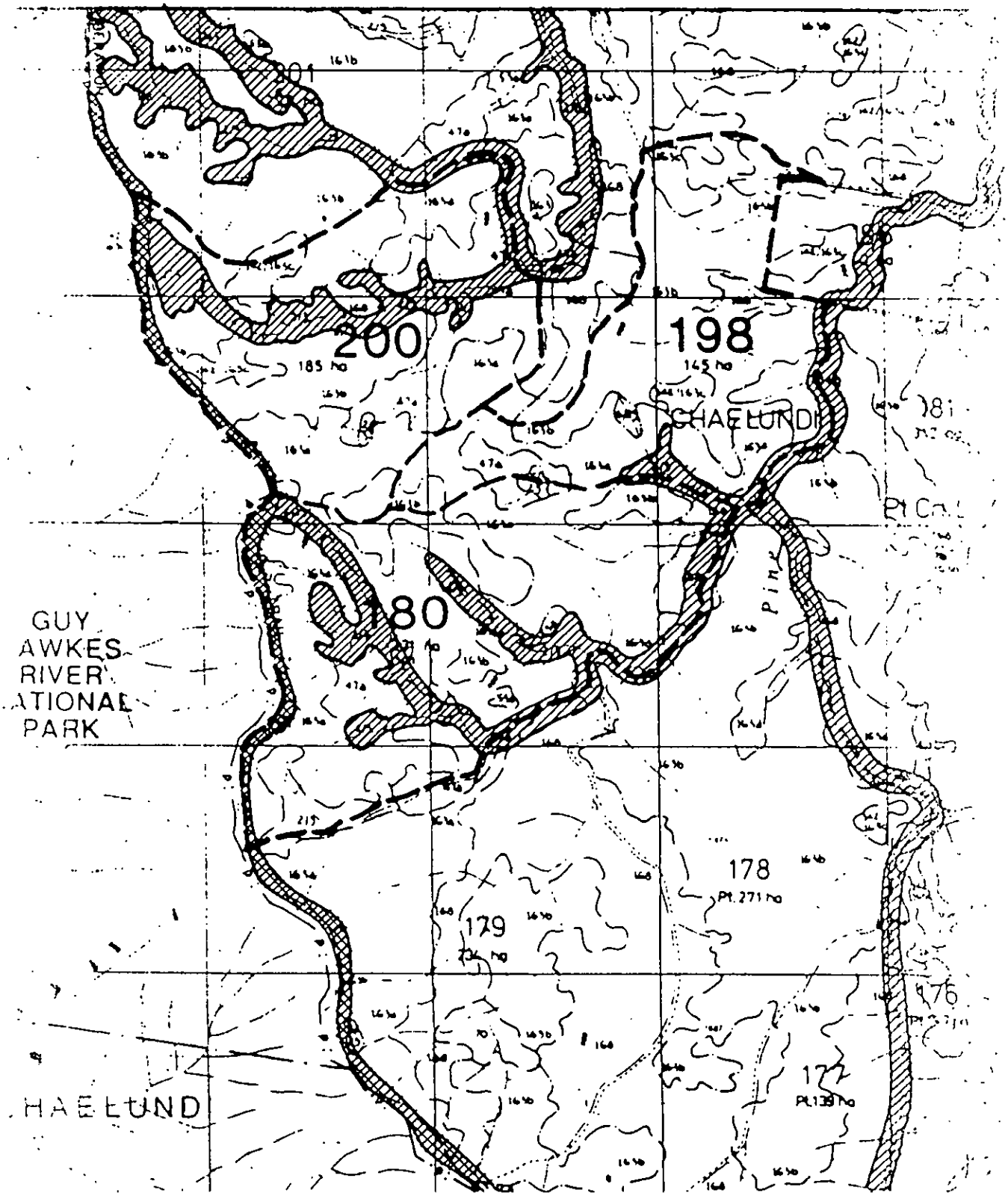


Figure 6

CHAELUNDI STATE FOR

Environmental Impact State
Harvesting compartments
180, 198 and 200

P.M.P. Classification

LEGEND

EIS Area
Compartments 180, 198 and 200

Visual Resource Protection Areas

Flora and Fauna Protection Areas

0 0·5 1·0 1·5 km

MARGULES PARTNERS PTY LTD

Date
Scale 1:25

Table 10. Erosion protection measures

Forest operation	Prescription	Environment protection benefit
Roading	Road network kept to ridges where practicable.	Keeps road away from streams except at crossing points. Less interception of groundwater hence less overland flow.
	Properly formed and drained. Maximum road grade below 10 degrees.	Maintains control over water. Allows dissipation of collected water. Minimises erosion.
Minor Roads	Minimum number in use – remainder decommissioned by crossbanks.	Reduces potential sites for erosion caused by major storm events. Greatly reduces maintenance requirements.
	Crossfall drainage	Maintains control over water. Allows dissipation of collected water. Minimises erosion.
	Structures to be constructed for stream crossings – to be removed when road decommissioned.	Minimise damage to stream bed.
	Use minimised in wet weather.	Reduced risk of physical damage to soils.
Stream Protection	Filter strips are strips of retained vegetation of 20 m width each side of streams with catchment 30 ha or more.	Buffer to protect water quality (also wildlife, landscape amenity etc.) Traps sediment moving off harvested area.
	Protection strips, width 10 m each side, may be specified for streams with catchments less than 30 ha.	
	No machine within 10 metres of protection strips.	Protects potentially unstable and boggy areas. Disturbance of such sites could initiate erosion.
	Drainage line or gully crossing points must be approved by the supervising officer.	Ensures crossings are made at sites that will minimise impacts and that these are constructed to an approved standard.
Falling	No falling into streams.	Minimises disturbance to stream flow, bed and banks.
Snigging	Snig uphill as far as practicable.	Snig tracks radiating from ridgetop dumps spread water rather than concentrate it (as with downhill snigging).
	Draining snig tracks as soon as works completed. Spacing in accordance with slope and erosion hazard rating.	Diverts water off compacted soil on snig track to stable vegetation where it is dissipated.
	No snig tracks over 25 degrees unless specifically authorised.	Minimise risk of erosion on steep areas.
Log dumps	Located as far from drainage line as possible. Minimum distance 10m from filter strip or drainage line.	Log dumps are heavily compacted hence are a source of overland flow and erosion. By keeping the maximum distance away the possibility of sediment from these sources entering the stream is minimised.

3.3 CONTROL OVER HARVESTING OPERATIONS

The FCNSW ensures that harvesting operations are conducted in accordance with the plans and prescriptions as set out previously. This is achieved through a system of licences and operational plans with penalties specified for non-compliance. Operations are supervised and monitored for compliance.

Controls are also maintained over the utilisation of logs for particular purposes and to ensure accurate records are kept of where logs are being sent for accounting purposes.

3.3.1 Licences

Control of harvesting operations is maintained through provisions of the Forestry Act 1916 and Forestry Regulations 1983. Harvesting operations are authorised by the Commission through the issue of a three-tiered structure of licences.

The primary licence is the Timber Licence which is issued to the sawmills. This licence gives authority to the wood using industry to harvest timber. The licence sets out the period of the licence, the volume of wood, the area it is to be harvested from and the royalties payable.

The second level of licensing is the Contractor's Licence. This is issued to contractors nominated by the holder of the Timber Licence as being contracted to remove timber from the forest.

The third level of licensing is the Operator's Licence. This is issued to employees of either the contractor or the licensee, who are engaged in obtaining and removal of timber from forests. In the Dorrigo Management Area, fallers are required to have a current Certificate of Proficiency for Chainsaw Usage.

Licences specify the basic requirements for conducting a harvesting operation and invoke the general harvesting prescriptions set out above as well as other FCNSW documents including the Code of Logging practices for Coffs Harbour Region and harvesting plans. In addition the provisions of other relevant legislation such as the Occupational Health and Safety Act 1983; the Timber Industry (Health and Safety) Regulation 1982; the Motor Traffic Act 1909; the State Roads Act 1986; and the Local Government Act 1919 are also invoked.

The licence specifies requirements for branding of timber to be taken. It also specifies provision of guarantees for payment of royalty and for the FCNSW to be indemnified against any loss or damage or injury arising from the activity being undertaken.

The Act provides the FCNSW with powers to suspend or penalise licensees. The level at which the suspension or penalty is issued depends on who is held to be responsible for the breach of the Act, regulations or forester's instructions.

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The Act provides the FCNSW with powers to suspend or penalise licensees. The level at which the suspension or penalty is issued depends on who is held to be responsible for the breach of the Act, regulations or forester's instructions.

Depending on the seriousness of the breach one of the following courses of action is taken.

1. Warning letter. This details the nature of the breach and the possible penalties for committing further breaches.
2. For more serious breaches the licensee can be suspended immediately or issued with a penalty notice (under the Forestry Act) which gives 21 days to pay.

In the case of a suspension, the licensee is prevented from operating and the District Forester is notified. The licensee is given 24 hours to put his/her case which is then forwarded together with the statement from the FCNSW officer who witnessed the breach to the FCNSW head office. The decision to suspend or cancel the licence or impose a penalty is made at this level.

The implications of a suspension or cancellation of licences depend on the level of licence affected. Operators who have their licence suspended or cancelled are barred from working in State Forests in NSW for the period nominated. If a contractor's licence is suspended all operators working for the contractor are suspended for that period. If the Timber Licence is suspended all contractors and all operators working under the licensee are suspended for the period nominated.

3.3.2 Harvesting plan

The format and objectives of a harvesting plan were discussed previously in Section 2.1.5 in the context of the FCNSW planning hierarchy.

As the last level of planning, the harvesting plan is used to plan and prescribe how the

Table 10. Erosion protection measures

Forest operation	Prescription	Environment protection benefit
Roading	Road network kept to ridges where practicable.	Keeps road away from streams except at crossing points. Less interception of groundwater hence less overland flow.
	Properly formed and drained. Maximum road grade below 10 degrees.	Maintains control over water. Allows dissipation of collected water. Minimises erosion.
Minor Roads	Minimum number in use – remainder decommissioned by crossbanks.	Reduces potential sites for erosion caused by major storm events. Greatly reduces maintenance requirements.
	Crossfall drainage	Maintains control over water. Allows dissipation of collected water. Minimises erosion.
	Structures to be constructed for stream crossings – to be removed when road decommissioned.	Minimise damage to stream bed.
	Use minimised in wet weather.	Reduced risk of physical damage to soils.
Stream	Filter strips and zones of restricted	Buffers to protect water quality (also

Other aspects included are:

- An assessment of the product specification and estimated yields from the compartment.
- A description of the forest types and stand condition.
- A schedule of areas with modified prescriptions and special emphasis requirements such as wildlife habitat tree retention, and controls over harvesting in and adjacent to reserved areas.

Finally, the plan draws attention to the provisions of the Code of Logging Practices and Conditions of the Timber/Contractors/Operators Licences.

Harvesting plans are provided to all parties involved in the harvesting operation – the timber licensee, contractor and FCNSW supervisory staff.

Timber licensees, contractors and operators are all required, as a condition of licensees, to carry out all operations in accordance with the harvesting plan.

The harvesting plans for the three compartments are included as Appendices 4A,B,C.

3.3.3 Field supervision

Field supervision of harvesting operations by the FCNSW is undertaken by marketing foremen who are in turn supervised by a professional forester in charge of marketing.

The foreman maintains day-to-day control over the harvesting operation. The actual frequency of visits can vary. Under most circumstances, there is a maximum interval of one working day between inspections for any operation. The foreman completes a fortnightly logging report which provides a checklist for all aspects of field supervision.

In addition to the duties of tree marking set out in Section 3.1.3, the FCNSW marketing supervisors also have responsibilities to ensure the relevant prescriptions and regulations are implemented.

The supervisor is responsible for the following:

1. Breaches of logging discipline such as any unapproved deviation from the harvesting plan, including trespass into reserved areas, falling of habitat trees etc.
2. Ensures that specifications covering erosion control and water quality protection are adhered to.
3. Advises on wet weather operations and enforces closure of the roads during wet weather.
4. Looks for unsafe acts in the forest, for example, felling technique, speeding trucks, non-compliance with FCNSW directives and signs on forestry roads.
5. Makes log sorting decisions on the log dump
6. Any breach of the Forestry Act 1916 and associated regulations or of a forester's instructions.

3.3.4 Log measurement

Logs are measured and marked by logging contractor, with all dimensions marked on butts of logs. Removals of all logs from bush are covered by approved delivery dockets completed by the truck driver. Forestry personnel check dimensions on 2% of logs at dump or millyard, and 5% delivery dockets are checked for correctness.

Delivery dockets are used as the basis of account with respect of logs supplied to Allen Taylor & Co. Ltd and Duncan's Holdings Ltd. Logs are tallied by FCNSW foremen at millyard for G.L. Briggs and Sons Pty Ltd. Poles and girders are usually harvested as an advance operation with poles tallied on dump by FCNSW. Logs not meeting quota sawlog specifications which are sold to alternative buyers are tallied by FCNSW foremen.

3.4 FIRE CONTROL MEASURES

Fire control measures apply during and after harvesting operations.

Measures that apply during harvesting operations are designed to reduce the risk of fire caused by the actions of the harvesting crew and operation of their equipment.

Contractors and operators are bound by provisions of the Forestry Regulation 21-35 which states that fires may not be lit in State Forests and timber reserves without the approval of a forestry officer. In addition, other more specific controls over the use of fire and equipment with the potential to start fires are set out. This includes storage of flammable liquids and maintenance of appropriate spark arresters on equipment.

The FCNSW is also empowered to suspend harvesting operations when the fire danger is high to extreme.

Licensees are required to assist with fire suppression if required. Crews are required to maintain minimum fire fighting equipment on site.

Measures that are to apply post harvesting are aimed at protecting the regenerating forest and to reduce the regional fire hazard.

Measures typically include the post harvesting debris removal burn described in Section 3.1.7. Following these burns it is normally a requirement to exclude fire from the site for a minimum period of 3-5 years to ensure successful establishment of regeneration.

4.0 DESCRIPTION OF THE ENVIRONMENT

4.1 PHYSICAL

4.1.1 Topography

The three compartments comprise moderate to steep hill slopes at an elevation rising from 710 m to 1080 m. They form a small part of the Chaelundi plateau (ref. Figure 7). Slope classes for the study area are shown Figure 8.

The aspect is mostly easterly swinging from northeast through east to southeast.

4.1.2 Geology

The most recent geological mapping covering Chaelundi State Forest and the three compartments was done by Landenberger (1988). This mapping updates that available in the Grafton 1:250 000 Sheet (SH56 6). Landenberger (1988) was mainly concerned with the granitoid intrusions associated with Chaelundi Mountain to the south of the study area and so the coverage of the study area would be of less intensity and limited by access from Liberation Fire Trail.

Landenberger (1988) mapped the study area as being situated on two components of the sedimentary Coffs Harbour Block; the Moombil and Brooklana Beds. The Coffs Harbour Block is a thick sequence of turbidite sediments of Carboniferous age (Korsch 1978) which covers some 5000 km^2 of northern coastal NSW. The lithological differences between the two component beds are minimal.

1. Moombil Beds – massive argillite with rare sandstones and siliceous siltstones.
2. Brooklana Beds – a sequence of interbedded greywacke, siltstones, mudstones and siliceous rocks.

As Korsch (1978) states: "The important feature of the greywackes is the abundance of volcanic-lithic fragments and plagioclase. The rocks are predominantly quartz-poor."

A detail from the map of Landenberger (1988) is given in Figure 9. It is important to note three geological features pertinent to the study area:

1. Adamellite of the Chaelundi Complex is inferred to be directly west of the study (<1 km) and it is the differential erosion of this granitoid body together with the presence of the Demon Fault that has produced the Guy Fawkes Valley system.
2. Adjacent to the adamellite intrusion is a contact aureole of metamorphosed country rock (mainly hornfels) and it is the indurated nature of this contact aureole that has produced the ridgeline-escarpment with the Guy Fawkes River (Liberation Fire Trail and Broadmeadows Road run along this ridgeline in part).
3. The boundary between the older Moombil and the overlying Brooklana Beds has been inferred to run northwest-southeast through the southwest corner of Compartment 180 and the individual strata within the Brooklana Beds strike northwest-southeast with a near vertical dip. Some of these strata are more indurated than others and have therefore produced characteristic 'hard', rocky, northwest-southeast ridgelines through the study area and to the north. Moombil

Brooklana Beds boundary has been mapped as being coincident with a series of 'felsic dyke rocks'.

The construction of Broadmeadows Road and the boundary fire trail between compartments 180, 200 and 198 has allowed greater access to the area than was available to Landenberger (1988). Extra detail and modifications can now be made to the geological map (Figure 9). The main modifications relate to the location of the 'felsic dyke rocks' and the occurrence of a small intrusion of granitoid rock east of the main Chaelundi Complex.

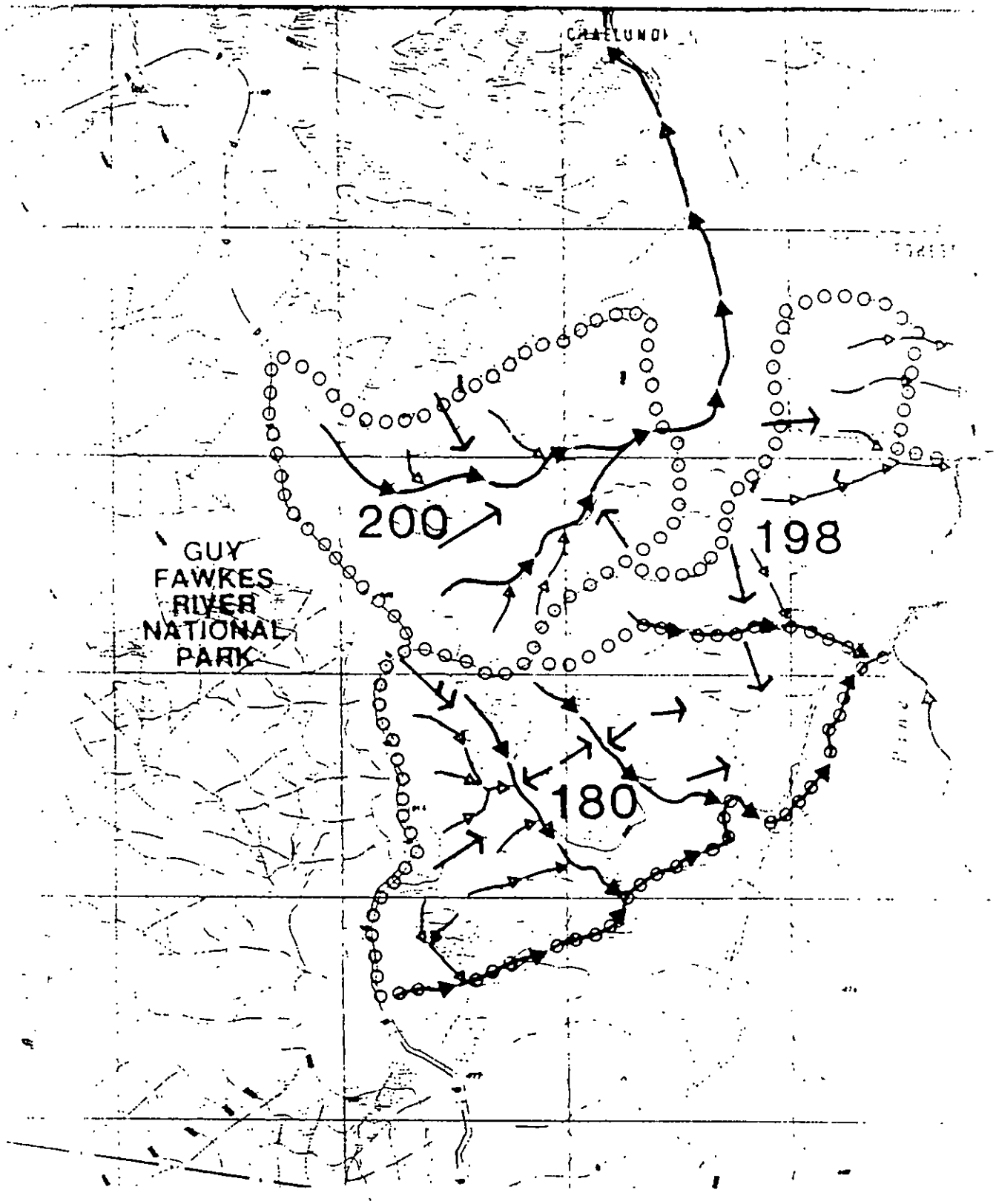
There are outcroppings of an acid intermediate rock intruding the greywacke along Broadmeadows Road, on the western boundary of compartment 180 and into the southwestern corner of compartment 200. There is another small outcrop along the boundary trail between compartments 200 and 198. South of compartment 180 there are two main outcrops along Broadmeadows Road, both occurring as rocky ridges. The rock consists of quartz, and occasionally feldspar, phenocrysts in a fine felspathic groundmass and is probably rhyolitic or dacitic in composition. The outcrops could either be a swarm of dykes or a single dyke, associated with western ridgeline boundary of compartment 180, radiating out from the Chaelundi Complex adamellite further to the west. The location of the dykes do not support an association with the Moombil-Brooklana Beds boundary as proposed by Landenberger (1988).

At the junction of the three compartments there is a small intrusion of adamellite. It is uncertain whether this body is related to the dykes or represents an outlier of the main Chaelundi Complex. Both the dykes and the granitoid outcrop are characterised by plentiful large surface boulders.

4.1.3 Soils

The soils derived from the Coffs Harbour Block sediments east of the study area have been described by Atkinson and Veness (1981) and Ryan and McGarity (1983) while McArthur (1964) described soils formed from sedimentary rocks south of Chaelundi State Forest (Moombil and Brooklana Beds) as the Gangara Association (red and yellow podzolics).

Soils within the study area formed from greywacke parent materials have morphology in common with that described in the above studies. The greywacke is fine-grained, iron-rich, and easily weatherable (at least where it hasn't been indurated or metamorphosed to hornfels) due to its volcanic origin (Korsch 1978). These features of the parent material produce acid, silty clay loam to silty clay soils with orange-red to red pedal subsoils. The organic-rich surface soils have high soil faunal activities which produce moderate to strongly structured horizons with poorly defined boundaries. On the indurated ridgelines and within the contact aureole, gravel content increases and soil depth decreases. The soils here vary from lithosols to minimal yellow or red podzolics. Away from these latter areas the soils are deeper and vary from red podzolics to euchrozems.



LEGEND

EIS Area
Compartments 180, 198 and 200

Catchment

Aspect

0·5 1·0 1·5km

Figure 7

CHAELUNDI STATE FORE

Environmental Impact Statem
Harvesting compartments
180, 198 and 200

Topography

MARGULES
PARTNERS
PTY LTD

Date
Scale

LEGEND

EIS Area
Compartments 180, 198 and 200

Slope Classes

0 - 10°

10 - 20°

> 20°

0·5 1·0 1·5 km

Figure 8

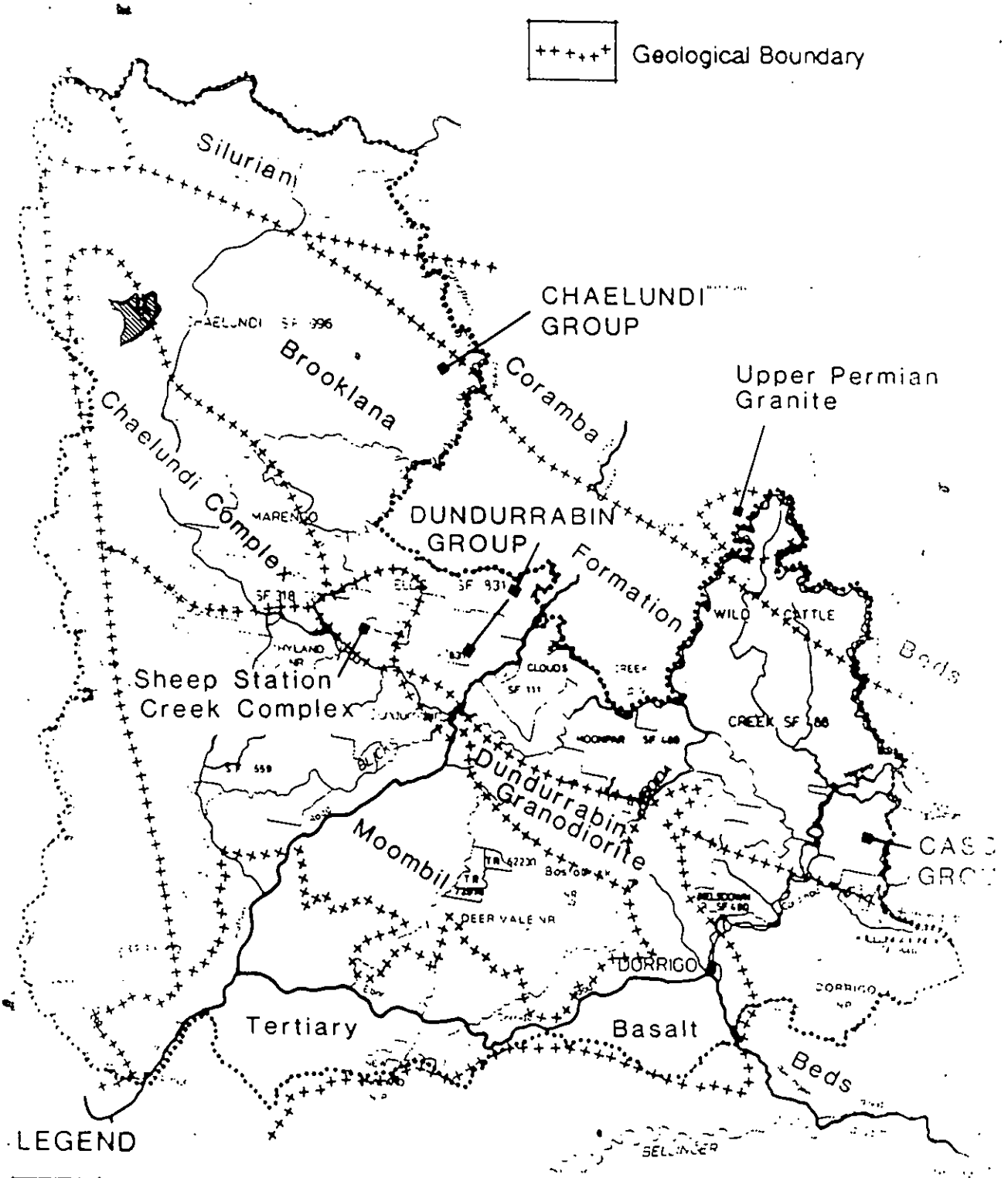
CHAELUNDI STATE FORE

Environmental Impact Statem
Harvesting compartments
180, 198 and 200

Slope Classes

MARGULES
PARTNERS
PTY LTD

Date 8-199
Scale 1:25



Figure

CHAELUNDI STATE FO

Environmental Impact Str
Harvesting compartments
180, 198 and 200

Geology

MARGULES PARTNERS PTY LTD

Date

Associated with the acid volcanic dykes are shallow lithosols or yellow earths with dark organic A horizons. The pale subsoils have poor structure and can be dispersive Gravel content in these soils is very high.

The small outcrop of adamellite is very gravelly and produces soils varying from sandy lithosols to deeper, sandy clay loam textured, yellow earths.

Soil profile descriptions of one profile on the greywacke and one on the acid volcanic dyke are presented in Appendix 5. Location of the profiles described plus other auger sites are shown on Figure 9.

4.1.4 Climate

There is no site specific climatic data however the compartments are within a warm temperate region having maximum rainfall during summer and autumn.

The following weather summary is for Clouds Creek State Forest Headquarters, 22 km southeast of the site and is taken from the ER prepared by FCNSW referenced to above in Section 2.1.4.

Month	Temperature (°C)		Rainfall (mm)
	Max.	Min.	
January	26.9	14.8	228
February	26.4	15.2	168
March	25.4	11.8	172
April	23.6	8.7	83
May	19.8	5.0	62
June	17.5	2.3	89
July	16.4	-0.3	62
August	17.3	2.7	68
September	20.5	4.8	49
October	23.8	9.0	109
November	26.2	11.0	122
December	26.7	12.9	165
Mean	22.5	8.2	Total 1397

Frosts occur on an average of 62 days per year at Clouds Creek. The lowest recorded temperature at Clouds Creek is minus 9.4°C.

Spring weather is characterised by strong westerly winds which are often accompanied by increasing temperatures and generally dry conditions. These conditions give high fire danger ratings.

4.1.5 Hydrology

The area proposed for harvesting is located in the headwaters of Pine Creek and Needle Creek. Both are perennial streams that are tributaries of the Boyd River which joins the Nymboida River at Buccarumbi some 20 kilometres downstream from Dalmorton. The Nymboida River flows northwards for 35 kilometres before joining the Mann River. The Mann in turn also flows northward for 40 kilometres before joining the Clarence River. There are no significant developments of the water resources downstream

Water usage is limited to private domestic farm and irrigation purposes and supplies to a number of small villages.

Oyster farming, professional and recreational fishing occurs towards and within the estuary, while recreational pursuits such as freshwater angling and canoeing occur in the extensive middle and upper reaches of the river system.

The catchments of Pine Creek and Needle Creek are shown by Figure 10. The catchments of both creeks are entirely forested within the Chaelundi State Forest.

Table 11. **Proportion of catchments harvested and unharvested**

Catchment	Harvested	Unharvested	Total
Needle Creek	-	2252	2252
Pine Creek	2847	4608	7455

In view of the area's remote location and the fact that these creeks are not utilised for any formalised water supplies, there are no data available on streamflow or water quality (Water Resources Commission pers. comm.). Water quality could be expected to be high in view of the largely undisturbed status of the creeks, the moderate slopes and low erodibility of the soil types.

4.1.6 Visual

Seen area

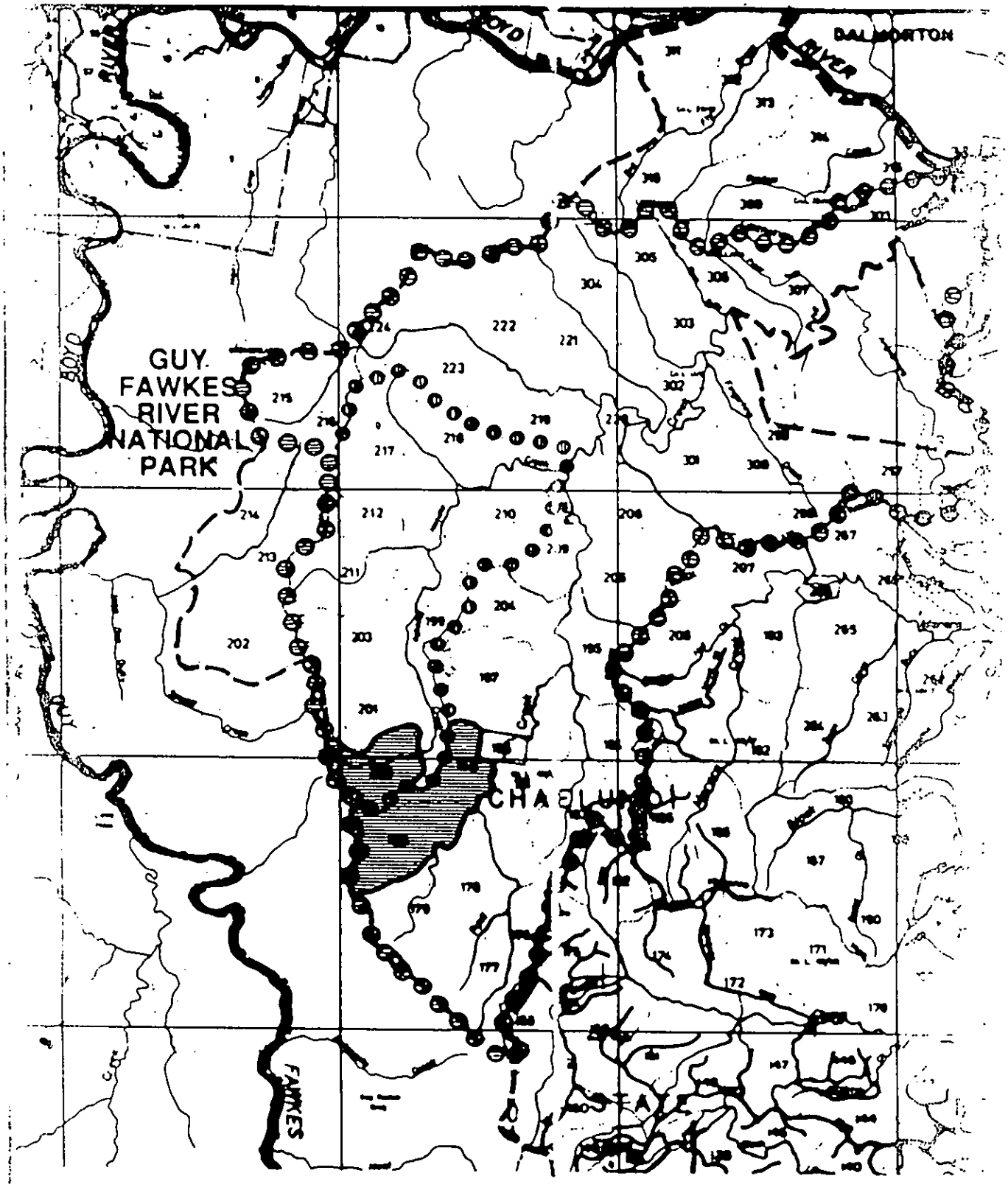
Forest cover over a hill and valley topography exists for over 20 km in all directions so it is not possible to see the site from any remote surface point.

The area is not seen from any road except Broadmeadows Road which runs through the western edge of the area exposing the vegetation edge to the observer.

The area is not seen from Guy Fawkes River National Park as it is screened by Liberation Spur and Broadmeadows road has been located on the eastern fall of the ridge to avoid any visual impact of road clearing on the path (Figure 11).

Landscape features

The area does not contain any landscape features. It is part of a regional landscape of timbered hills which present a continuity of uniform landscape when viewed from a lookout site (viz. Vista Point Lookout).



Figure

CHAELUNDI STATE FOR

Environmental Impact Stat
Harvesting compartments
180, 198 and 200

Needle and Pine Creek Catch

LEGEND

- EIS Area
  Compartments 180, 198 and 200
- Needle Creek Catchment
- Pine Creek Catchment

0 1 2 3 4 5km

MARGULES PARTNERS PTY LTD

Date
Scale

4.2 FIRE

Fire has been a component of the environment of the region over time, firstly, hunting burns by Aborigines and, more recently, broadscale burning by graziers and forestry. Wildfires have burnt over the region in the past but the fire history appears to be more a series of repeated regular fires than severe wildfire occurrence (FCNSW 1988b). Graziers seek to burn in the spring to ensure maintenance of winter fodder for the following winter. Forest management prefers autumn burns so strategic burning plans are developed in concert which permits some spring burning by graziers. The use of fire in resource management is now coordinated by the District Forester. The aim is to maintain the fire regime which has been applied to the area in the past.

Fuel management practices will be carried out from time to time as a means of protecting the forest and neighbours from wildfires, and promoting growth of palatable grasses for the significant livestock industry which leases most of the area.

Fuel reduction burning is the major component of fuel management and consists of;

Strategic burning – Strips of forest adjacent to roads and boundaries are burnt to reduce the amount of fire fuels. The strategic burns serve as low fuel zones reducing the potential damage from wildfire and providing areas where the control of wildfire may be more readily achieved.

Top disposal burning – This type of burning involves the lighting of logging debris under mild conditions. Some running fire occurs but generally only about 70% of the logging area is burnt.

Broad area hazard reduction burning – Broad area burning is undertaken when only about 50% of the area proposed for burning will burn with a low intensity of fire. This operation produces a mosaic of burnt and unburnt areas. This type of burning is used in the dry hardwood forests. It is rarely possible to run such a fire in the moist hardwoods.

There is visual evidence in these three compartments of fires having burnt over the area in the past.

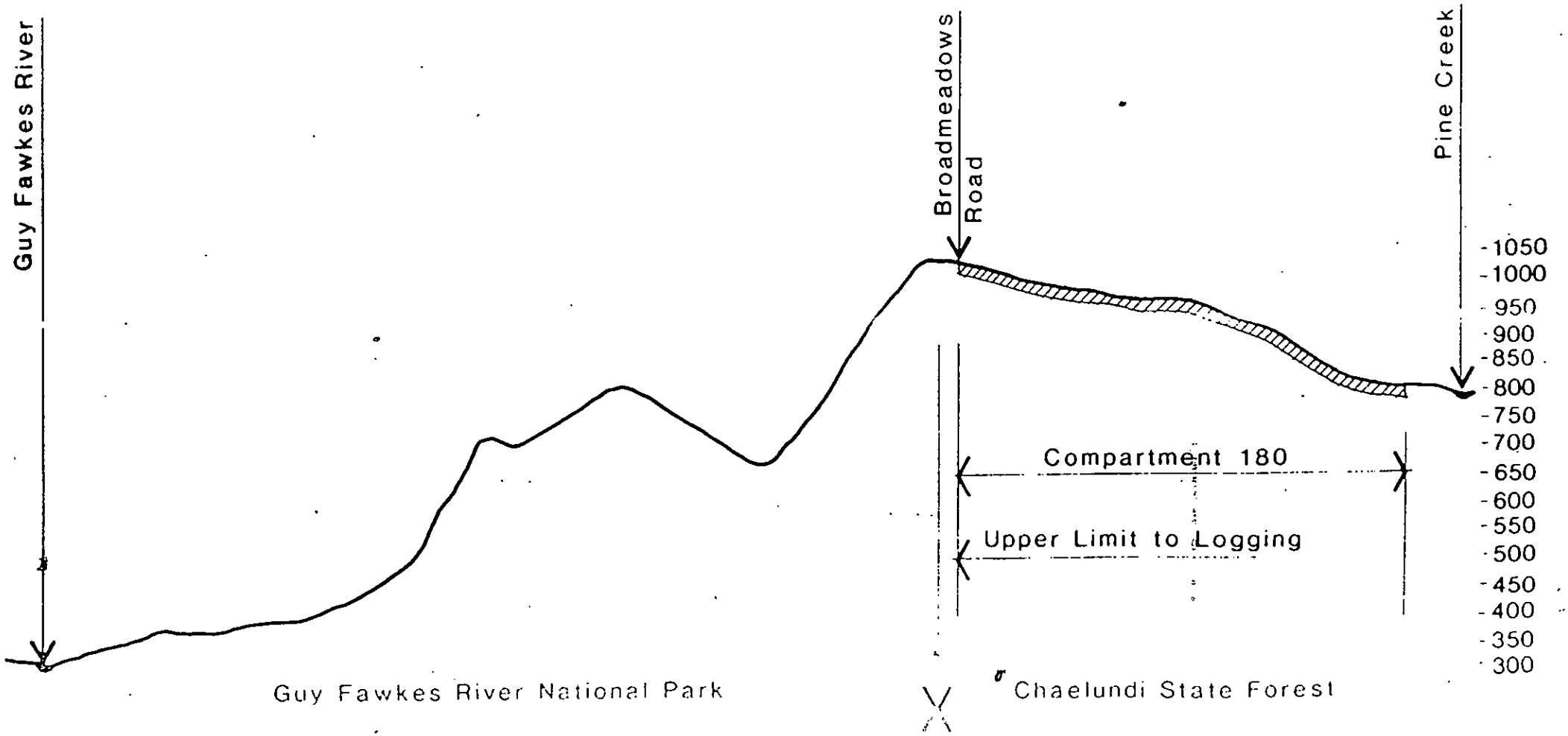
The moist hardwood type is not a high fire danger fuel type, but can be burnt from time to time, mildly, for hazard reduction burns, and is occasionally burnt by fierce wildfire under extreme fire danger conditions.

4.3 FLORA

4.3.1 Forest types

The vegetation was mapped by the FCNSW into 'forest types' in 1963. The 1963 typing boundaries were transferred to the 1:25 000 map base. The 1963 types were converted to types, as described in FCNSW Research Note 17, with the notation that there may be anomalies and sundry errors within the converted types. This mapping is the basis for this vegetation assessment.

SECTION ALONG GRIDLINE 66.84 EXTENDING FROM GUY FAWKES RIVER NATIONAL PARK OVER THE PROPOSED HARVEST AREA



Two site surveys have been carried out: one by a joint FCNSW-Earthwatch Flora and Fauna Study Group; and the other by Gilmour, submitted in his affidavit, in June 1990. Both surveys can be related to the forest typing. Details of Gilmour's survey is contained in Appendix 6 and the FCNSW-Earthwatch survey is contained in Appendix 7.

A forest type is a stand of vegetation (usually trees) which possess a general similarity in composition and character. Similar types are expected to occur under the influence of relatively uniform environmental conditions of climate, soil and past history.

The types are named from the occurrence of one or more indicator species which achieve a degree of predominance in the relevant stands. In rainforest stands species predominance may not exist, so distinctive and characteristic species are used to name the type.

The type mapping for these three compartments, shows a type '142/163c', i.e. a stand type including New England Peppermint (*Eucalyptus nova-anglica*)

This species is in the Snow Gum league, i.e. cold exposed sites – has not been recorded in or near the area and is very unlikely to occur in this vicinity. (See also Gilmour's notes, Appendix 6, para. 36, 37, 38). This type has been amended to type '163c' for this assessment.

Forest types on Compartments 180, 198, 200 – a brief description
The distribution of these types is shown on Figure 12.

Rainforest types

Forest type	Characteristic species	
2/3	*Sloanea woollsii*	Yellow Carabeen
	Schizomeria ovata	Crab Apple
	Doryphora sassafras	Sassafras
	Ceratopetalum apetalum	Coachwood
3/11	*Doryphora sassafras*	Sassafras
	Caldcluvia paniculosa	Corkwood
	Cryptocarya glaucescens	Silver Sycamore
	Ceratopetalum apetalum	Coachwood
	Schizomeria ovata	Crab Apple
6/23	*Ficus watkinsiana*	Strangler Fig
	Dendrocnide excelsa	Giant Stinger
	Doryphora sassafras	Sassafras
	Myrtaceae spp.	Myrtle

Moist hardwood types

Forest type	Predominant species	
47	*Eucalyptus microcorys*	Tallowwood
	Eucalyptus saligna	Sydney Blue Gum
53	*Lophostemon confertus*	Inland Brush Box
168	*Eucalyptus laevopinea*	Silvertop Stringybark
	Eucalyptus saligna	Sydney Blue Gum

New England Hardwood types

Forest type	Predominant species	
163	*Eucalyptus andrewsii* ssp. *campanulata*	New England Blackbutt

A full description of the typing and these forest types is given in FCNSW Research Note 17.

The suffix 'a', 'b' or 'c' following the numerals identifying the type indicate site quality by height.

a = high site quality usually > 45m
b = medium site quality usually 30-45m
c = low site quality usually < 30m

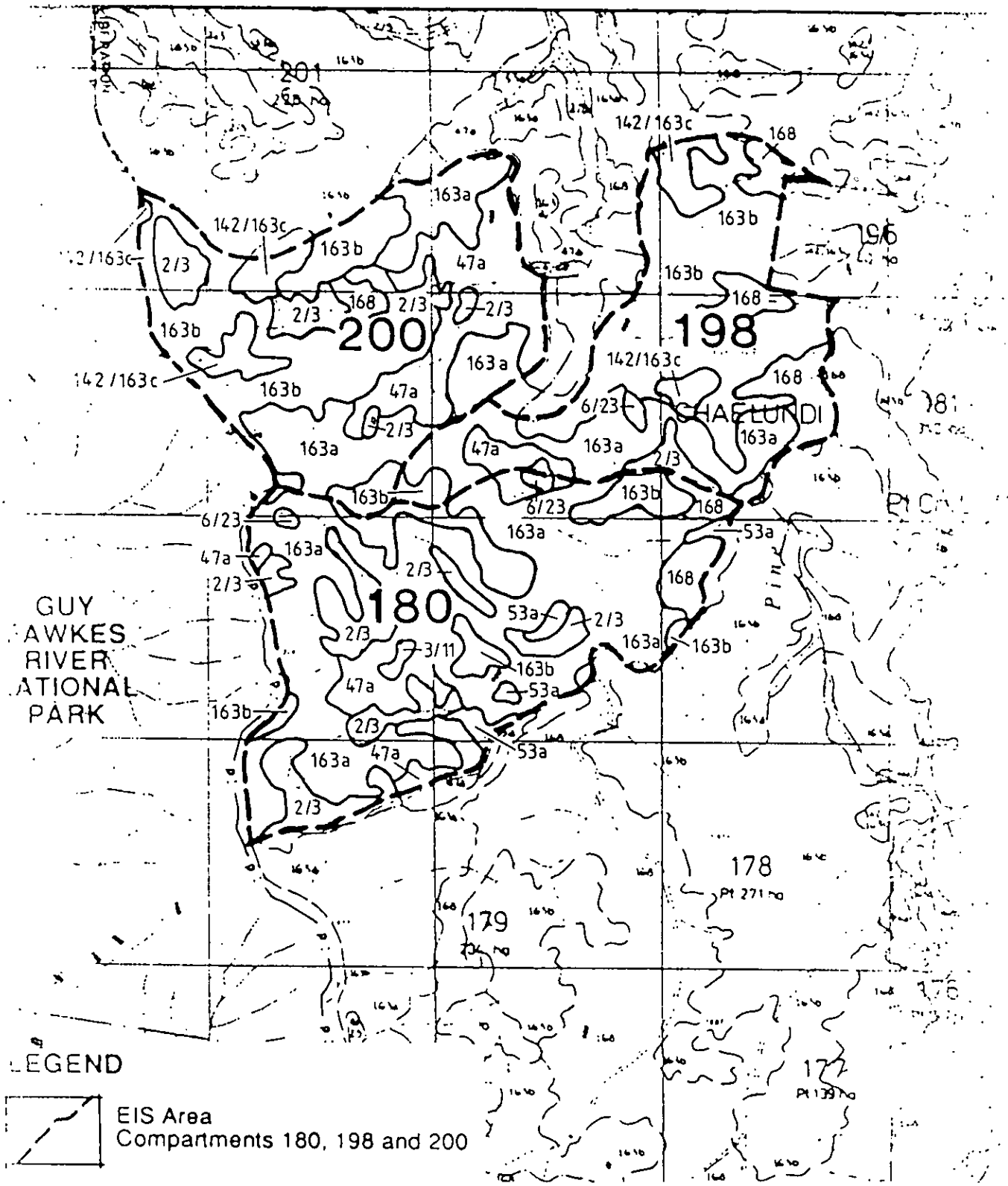
Each type has a number of associated species which occur within the stand, which sometimes may become so abundant as to justify a sub-type status. Briefly these associated species are:

Forest type	Associated species	
47	*Lophostemon confertus*	Inland Brush Box
	Eucalyptus laevopinea	Silvertop Stringybark
	Eucalyptus andrewsii ssp. *campanulata*	New England Blackbutt
53	*Eucalyptus microcorys*	Tallowwood
	Eucalyptus saligna	Sydney Blue Gum
168	*Eucalyptus microcorys*	Tallowwood
	Eucalyptus andrewsii ssp. *campanulata*	New England Blackbutt
163	*Eucalyptus microcorys*	Tallowwood
	Eucalyptus saligna	Sydney Blue Gum
	Eucalyptus laevopinea	Silvertop Stringybark
	Eucalyptus deaneii	Round-leaved Gum
	Eucalyptus cameronii	Diehard Stringybark

The relationship between the forest type, the Dorrigo Management Plan grouping and the Gilmour survey is as follows:

Forest type	Dorrigo Management Plan groups	Gilmour's survey grouping
2/3	Rainforest	Rainforest
3/11	Rainforest	Rainforest
6/23	Rainforest	Rainforest/Swamp forest
47a	Moist hardwoods	Tall open Tallowwood/Blue Gum forest
53a	Moist hardwoods	Tall open Tallowwood/Blue Gum forest
168	Moist hardwoods	Tall open Silvertop Stringybark/ Tallowwood
163	New England Hardwoods	Open Forest New England Blackbutt/ Diehard Stringybark forest

The area of each forest type within the three compartments is given in Table 12.



LEGEND

EIS Area
Compartments 180, 198 and 200

Forest Types

...ow Carabeen Crabapple Sassafras ...rnwood Silver Sycamore	2/3
...abeen Sassafras Cornwood Silver ...camore-Coachwood Crabapple	3/11
...assafras-Giant Stinger-Myrtle	6/23
...illowwood Sydney Blue Gum ...ite height > 36m	47a
...rand Brush Box height > 36m	53a
...ew England Blackbutt ...ite height > 45m	163a
...ew England Blackbutt ...ite height 30-45m	163b
...rvenop Stringybark Diehard ...ringybark Tallowwood	168
...ew England Peppermint New England ...anyhaut Site height < 30m	142/163c

0 0·5 1·0 1·5 km

Figure 1

CHAELUNDI STATE FOR...

Environmental Impact Statem...
Harvesting compartments
180, 198 and 200

Forest Type Vegetation

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Date ...
Scale 1:...

Table 12. Area of forest types in Compartments 180, 198 and 200

Forest type	Total area (ha)
2/3 3/4 6/23	59
47a	73
53a	8
168	36
163a 163b 163c	205 159 21
Total	561

The forest type description does not detail the understorey or ground vegetation. A recording of these species on the area surveyed by Gilmour (Appendix 6) is listed in Table 14.

The vegetation survey carried out during the "Earthwatch Flora and Fauna Study, Chaelundi S.F." July 1990 (Appendix 7) was aimed at describing the characteristic plant communities and determining their distribution in the study area; compiling a flora inventory; and identifying any sites of botanical significance.

Table 13 shows the species diversity, the most diverse types are the subtropical rainforest 6/23, and type 47, the Tallowwood/Blue Gum types. The ecotone between types 6/23 and 47 forms the most diverse habitat in the study area.

Table 13. Species diversity

Plot	Type	No. of species
1	74	35
2	163	54
3	47	64
4	163c[1]	47
5	168	43
6	6/23	64

[1] See comments 4.3.1 above re 142/163c Type.

A total of 163 plant species was recorded comprising: one moss species, one conifer, 15 pteridophytes, 25 monocotyledons and 121 dicotyledons. One species of introduced plant was observed and one species in type 47 *Hibbertia* sp. A (*villosa*) is listed in NPWS Rare Plant Database 1984. The composite plant species list appended shows habit, relative density and in which forest type the plant occurs.

A comprehensive list of plants recorded growing in Chaelundi State Forest is part of Appendix 6 to the Management Plan for Dorrigo Management Area (FCNSW 1985).

[illegible] 11. Correlation between canopy trees and understorey species

[illegible]ST TYPES WITHIN WHICH HARVESTING IS PROPOSED

Forest Types	CANOPY TREES: Predominant species	CANOPY TREES: Associated species	LOWER STOREY VEGETATION[1]: Small trees	LOWER STOREY VEGETATION[1]: Shrubs/groundcovers	LOWER STOREY VEGETATION[1]: Palms Vines Epiphytes
[illegible]	*Eucalyptus microcorys* *Eucalyptus saligna*	*Lophostemon confertus* *Eucalyptus laevopinea* *Eucalyptus andrewsii* ssp. *campanulata*	*Argyrodendron actinophyllum* *Caldcluvia paniculosa* *Shizomeria ovata* *Pennantia cunninghamii* *Cryptocarya rigida*	*Solanum inaequilaterum* *Lastreopsis* sp. *Lomandra spicata* *Adiantum formosum*	
[illegible]	*Lophostemon confertus*	*Eucalyptus microcorys* *Eucalyptus saligna*			
[illegible]	*Eucalyptus laevopinea* *Eucalyptus saligna*	*Eucalyptus microcorys* *Eucalyptus andrewsii* ssp. *campanulata*	*Acacia melanoxylon* *Acacia irrorata* *Daphnandra* sp. *Rhodamnia rubescens* *Caldcluvia paniculosa*	*Cryptocarya rigida* *Elaeocarpus reticulatus* *Synoum glandulosum* *Cassinia* sp. *Hedycarya angustifolia* *Polyscias sambucifolius* *Myoporum montanum* *Blechnum cartilagineum* *Culcita dubia* *Senecio* sp. *Drymophylla moorei*	[illegible]
[illegible]	*Eucalyptus andrewsii* ssp. *campanulata*	*Eucalyptus microcorys* *Eucalyptus saligna* *Eucalyptus laevopinea* *Eucalyptus deanei* *Eucalyptus cameronii*	*Allocasuarina torulosa* *Acacia melanoxylon* *Acacia binervata* *Elaeocarpus reticulatus*	*Persoonia attenua* *Pimelea ligustrina* *Trochocarpa laurina* *Leucopogon lanceolatus* *Goodia lotifolia* *Solanum* spp. *Pteridium esculentum* *Lomandra longifolia* *Gonocarpus teucrioides* *Synoum glandulosum*	

[illegible]ST TYPES WITHIN WHICH NO HARVESTING IS PROPOSED

Forest Types	CANOPY TREES: Characteristic species	CANOPY TREES: Associated species	LOWER STOREY VEGETATION[1]: Small trees	LOWER STOREY VEGETATION[1]: Shrubs/groundcovers	LOWER STOREY VEGETATION[1]: Palms Vines
[illegible]	*Sloanea woollsii* *Schizomeria ovata* *Doryphora sassafras* *Ceratopetalum apetalum* *Doryphora sassafras* *Caldcluvia paniculosa* *Cryptocarya glaucescens* *Ceratopetalum apetalum* *Schizomeria ovata* *Ficus watkinsiana* *Dendrocnide excelsa* *Doryphora sassafras* *Myrtaceae* spp.	*Argyrodendron actinophyllum* *Dysoxylum fraserianum* *Orites excelsa* *Diploglotis australis* *Brachychiton acerifolium* *Litsea reticulata* (*Eucalyptus deanei*)[2]	*Austrobuxus swainii* *Acronychia pubescens* *Polyosma cunninghamii* *Alangium villosum* ssp. *polyosmoides* (*Callistemon salignus*)[2]	*Aristotelia australasica* *Solanum inaequilaterum* *Lastreopsis* sp. *Pteris umbrosa* (*Blechnum nudum*)[2]	[illegible]

[illegible] [1] Species as listed by Gilmour (Appendix 6)   [2] Gilmour lists these species in Swamp Forest Type – *E. deanei* to be confirmed.

4.3.2 Rare and endangered species

Two plant species recorded growing on the area have a classification 3.R.C.a as defined in Rare or Threatened Australian Plants (ANPWS Special Publication No. 14). This means:

3 = A range over 100 km but occurs only in small populations mainly restricted to highly specific habitat.

R = Rare, but not considered currently endangered or vulnerable.

C = Known to be represented within a national park or other proclaimed reserve.

a = Considered adequately conserved.

The species are:

Austrobuxus swainii	Pink Cherry
Dodonaea megazyga	Winged Hop Bush

These ~~three~~ two species have been recorded growing elsewhere either in Chaelundi State Forest and/or Dorrigo Management Plan Area. They are represented in Flora Reserves. Pink Cherry in Norman Jolly and Black Bull Flora Reserves, and Winged Hop Bush in Middle Creek Flora Reserve.

Hibbertia sp. A (*villosa*) is listed in ANPWS Special Publication No. 14 as *Hibbertia* species 2. It has a conservation classification of 2RC at. This classification should be amended to 2RCa because the AT classification was given as a result of the author being unaware of additional sites of occurrence for the species (D. Binns pers. comm.). It is locally common along the escarpment from Gibraltar Range to Werrikimbe National Park and is adequately reserved.

There are no other recorded Rare or endangered species. Gilmour (Appendix 6) draws attention to the occurrence of Black Booyong (*Argyrodendron actinophyllum*) at elevations over 1000 m as a significant feature.

4.4 FAUNA

4.4.1 General comments

The rainforest, moist hardwood and New England hardwood forest types which cover these compartments, are known to be rich in fauna. These types combined with a moderate to steep sloping topography and having a south to south east aspect present good site factors for rich animal diversity and abundance.

Research and faunal survey work associated with this and nearby areas confirms this richness. Recently, June 1990, affidavits by experts, lodged with the Land and Environment Court all draw attention to the high conservation values of these stands.

These experts were:

Assoc. Professor H. Recher, University of New England
Dr Tony Norton, Australian National University
Mr H. Hines, Department of Conservation and Environment, Victoria (Appendix 10)
Dr L. W. Braithwaite, CSIRO Division of Wildlife and Ecology (Appendix 11)

These reports plus a joint survey by FCNSW-Earthwatch Fauna and Flora Study Group (Appendix 7) supply the site specific data on faunal diversity and abundance on these three compartments.

Comprehensive lists of native fauna positively identified within the Dorrigo Management Area appear in Appendix 7 of the Management Plan for the Dorrigo Management Area. These identifications have been made as a result of sightings by FCNSW staff, small mammal trapping, night transects, identification of road kills and work by research workers associated with FCNSW; CSIRO; and Universities. These lists record the habitat at the place of the sighting.

An examination of the sightings in various habitats also supports the relative faunal richness of the moist hardwood and New England hardwood forest types. The rich diversity and abundance of native fauna in these forests is not under dispute – it is supported by all concerned. The relative diversity and abundance of native fauna in a regional context may be gauged from a summary of internal FCNSW reports (ref. Appendices 8 and 9). Relevant data from these are presented below.

Table 15. **Comparisons of relative abundance and diversity of arboreal mammals in other areas of State Forest throughout NSW**

State Forest	Location	Faunal Species Diversity (no. of species)	Faunal Species Abundance (no. individuals/km²)
Coolangubra	Bombala	8	84
Bucclcuch	Albury	-	40-86
Hyland	Dorrigo	4	345
Marengo	Dorrigo	4	132
Chaclundi	Dorrigo	3	227
Tuggolo	Tamworth	-	303

The full summary is appended - Appendix 9.

Table 16. **Regional comparison of relative abundance and diversity of arboreal mammals**

State Forest	Forest district	Arboreal faunal species Diversity (no. of species)	Arboreal faunal species Abundance (mean no. of individuals/km)
Chaclundi	Dorrigo	3	4.72
Hyland	Dorrigo	4	10.41
Cascade	Dorrigo	6	1.28
Marengo	Dorrigo	4	4.01
Moonpar	Dorrigo	8	0.93
Wild Cattle Ck	Dorrigo	2	0.8
Wild Cattle Ck	Coffs Harbour	7	0.860
Washpool	Grafton	5	7.64

The full summary is appended - Appendix 9.

4.4.2 Arboreal mammals

A summary of FCNSW Arboreal Mammal Surveys in the Chaelundi Group of Forests provides the following data. See also Appendix 8.

Table 17. Summary of arboreal mammal survey in Chaelundi Group of Forests

Fauna species	Species abundance (number of individuals/km²) Hyland S.F.	Marengo S.F.	Chaelundi S.F.
Greater Glider	345	132	227
Yellow-bellied Glider	-	-	10
Koala	-	2	-
Mountain Brushtail Possum	8	2	-
Ring-tailed Possum	10	-	-
Sugar Glider	-	-	2.5
Common Brushtail Possum	-	2	-

This summary also provides the relative densities of arboreal mammals by forest type (Table 18).

Table 18. Relative density of arboreal mammals in forest types

Forest Type	Relative density (no. of individuals/km²) of arboreal mammals by forest types in Chaelundi Group of Forests
Rainforest	58.3
Moist Hardwood	192.0
New England Hardwood	~~296.0~~ 269.0
Dry Hardwood	71.0

The same summary recommends that ten habitat trees/ha (i.e. trees with hollows) be retained in sites favoured by Greater Gliders, i.e. New England Hardwood types on east to south east aspects with moderate 10-15° slopes and, in addition, mature and over-mature trees of value for wildlife habitat should be retained to provide an average frequency of one per hectare, preferably in groups of up to five trees scattered throughout the harvesting area.

The Environmental Review (ref. Section 2.1.4) reports on the CSIRO survey along Liberation fire trail past the western boundaries of these compartments as follows:

> "CSIRO Division of Wildlife and Rangelands Research have undertaken sampling on four nights in July 1987 and October 1987 within the southern part of this area along Liberation trail for arboreal mammals. Sightings of Greater Glider, Sugar Glider, Yellow-bellied Glider, Ring-tailed Possum and Koala have been made. Mean density (all species) recorded is 202 per 10 km transect, and this represents a density of about 40 times the density that this research unit has recorded in south coastal forests (L.W. Braithwaite pers. comm.).
>
> In general, moister forest types in and near gullies and watercourses tend to support a much richer and more diverse fauna than nearby drier ridges. There are two main contributing factors:
>
> - Higher nutrient levels of gully soils, often enriched by alluvium and leaching from higher ground, which leads to higher foliar nutrient levels in vegetation in turn supporting a higher population of herbivores and hence animals of other trophic levels (carnivores, parasites etc).

- Tendency for greater structural and floristic diversity of vegetation in gullies (probably due to more favourable nutrient and moisture status) which results in greater fauna species diversity.

Forests on richer soils, or in higher rainfall areas, tend to have similar characteristics to the moist gully forests, in terms of wildlife populations."

Data collected on the Earthwatch Flora and Fauna Study – Chaelundi State Forest July 1990, has been collated and analysed by the FCNSW and provides details on:

- The stand condition of the harvested forest sampled (ref. Section 5.3.2)
- The vegetation communities on the study area (ref. Section 4.3.1).
- The abundance and diversity of
  - Arboreal mammals
  - Small mammals
  - Other mammals
  - Birds

This information is summarised below:

The arboreal mammal assessment consists of a number of drive and walk transect surveys through both harvested and unharvested forest.

The location of these surveys in shown in Figure 13 and the key to the transects given in Table 19.

Table 19. **Key to arboreal transects in Figure 13**

Transect No.	Location	Walking/ driving	Logged/ unlogged	Forest types
1	Liberation Trail 2km-3.5km	drive	unlogged	New England hardwood
2	Un-Named Spur Road	walk	unlogged	New England hardwood
3	Liberation Trail 0km-2km	walk	unlogged	New England hardwood
4	Un-named Spur Road	walk	unlogged	New England hardwood and rainforest
5	Broadmeadows Road	drive	(L) unlogged (R) logged and unlogged	New England hardwood and rainforest
6	Pine Ck Trail (EIS Area)	drive	unlogged	New England hardwood and moist hardwood
7	Pine Ck Trail	drive	unlogged	New England hardwood and moist hardwood
8	Cpts 170 and 179	drive	recently logged	New England hardwood
9	Fellabindi Rd	drive	recently logged	New England hardwood and moist hardwood
10	Stopabit Road	drive	older logging	New England hardwood and moist hardwood

Survey details are appended (Appendix 7). Survey results indicate the following (G. Watts FCNSW pers. comm.).

Note: Estimates of relative faunal density, especially of arboreal marsupials, should be regarded as an approximate guide only and are not suitable for detailed comparison.

Unlogged forests (transects 1, 2, 3, 4, 5, 6 and 7)

The mean number of arboreal mammals overall observed in unlogged forests was:

- Drive transects 211.3/km^2
- Walk transects 525/km^2

Note: Driving transects in unlogged forest under estimate populations by 40%. The animals are harder to see in unlogged areas.

The unlogged surveys show that:

1. Relative density of arboreal mammals in the EIS compartments is 432/km^2 (10/km of transect). However, relative densities in adjacent unlogged areas in vicinity of the study area are lower, ranging from 56-117 km^2 (2-6/km of transect).
2. Populations of arboreal mammals are dominated by Greater Gliders.
3. Arboreal mammals predominantly occur in New England Blackbutt types, with a dbh range 35-100 cm.
4. Mean relative density unlogged
   - 211.3 + 40% (see walk vs drive results)
   - 295/km^2

Logged forests (transects 8, 9 and 10) – in vicinity of Compartments 180, 198 and 200.

These surveys show that:

1. Arboreal mammal relative density in logged areas in the vicinity of the EIS area range from 180-318 mammals/km^2 over 5-18/km of transect.
2. In logged areas arboreal mammals predominantly occur in New England Blackbutt with a dbh range of 20-150 cm.
3. Arboreal mammal populations are dominated by Greater Gliders.
4. Mean relative density logged = 234/km^2.

4.4.3 Small mammals

The Earthwatch Flora and Fauna Study July 1990, provides the following data on diversity and abundance of small mammal fauna in relation to plant communities. The trap sites are shown on Figure 14.

The location of the trap sites is shown in Figure 14. These sites were selected for Hastings River Mouse *Pseudomys oralis* habitat specification. Trapped mammals were identified, sexed, weighed and had general body condition recorded at each capture. On initial capture they were ear-marked for recapture identification.

Results

Five species of small mammal were trapped:

Antechinus stuartii	Brown Antechinus	(AS)
Antechinus flavipes	Yellow-footed Antechinus	(AF)
Rattus fuscipes	Bush Rat	(RF)
Melomys cervinipes	Fawn-footed Melomys	(MC)
Pseudomys oralis	Hastings River Mouse	(PO)

The distribution and abundance of the animals trapped is given in Table 20.

Table 20. **Distribution and abundance of small mammals trapped**

Sites	Forest type	Numbers trapped per 100 trapnights AS	AF	PO	MC	RF
A	74	1.5	0.02	-	-	-
B	163	1.3	-	-	1.5	-
C	163	7.9	-		1.4	2.8
D	74*	4.7	-	0.1	1.7	1.0
E	74	11.8	-	0.11	1.4	0.8
F	163	6.8	-	0.26	1.5	-

* Spotted Gum - Ironbark/Grey Gum

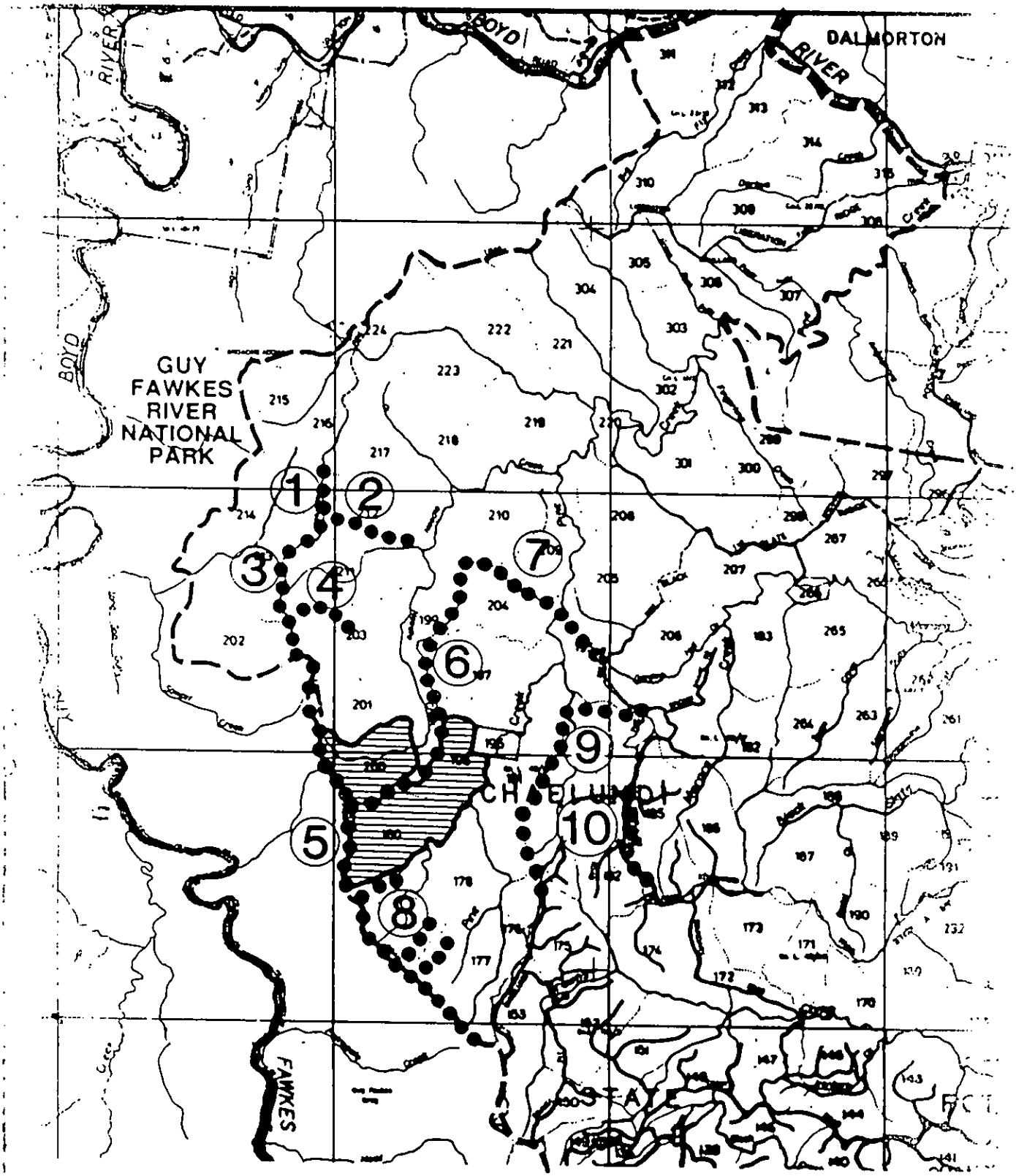
Sites BC only, have some relevance to the study area. See Figure 14.

Hastings River Mouse *Pseudomys oralis* was trapped at three new locations. The site D occurrence is significant because of the altitude of 410 m ASL – the lowest yet recorded. This brings the total number of known specimens of this species to 83. It was not trapped in or near these three compartments which are the subject of this EIS.

Other mammals trapped are common and widespread in the region. Table 20 & 21 summarises captures by site and species. Small mammal populations were dominated by *A. stuartii* (5.9/100 trapnight). Site E supported the highest relative density of small mammals (14.2/100 trapnight). Sites D & E were the most species diverse.

Table 21. **Trap record by species and site**

Species	Site A	B	C	D	E	F	Total	No. of individuals trapped /100 trapnights
AS	11	10	79	45	104	51	300	5.9
AF	1	0	0	0	0	0	1	0.02
MC	0	11	14	16	12	11	64	1.30
RF	0	0	28	10	7	0	45	0.90
PO	0	0	0	1	1	2	4	0.08
Total	12	21	121	72	124	64	414	8.15
Per 100 trapnights	1.6	2.8	12.1	7.6	14.2	8.5		



Figure

CHAELUNDI STATE FOR

Environmental Impact State
Harvesting compartments
180, 198 and 200

Arboreal Mammal Transect Loc

LEGEND

EIS Area
Compartments 180, 198 and 200

1 Transect Number
(Refer to key on following page)

0 1 2 3 4 5 km

MARGULES PARTNERS PTY LTD

Date: 8
Scale: 1

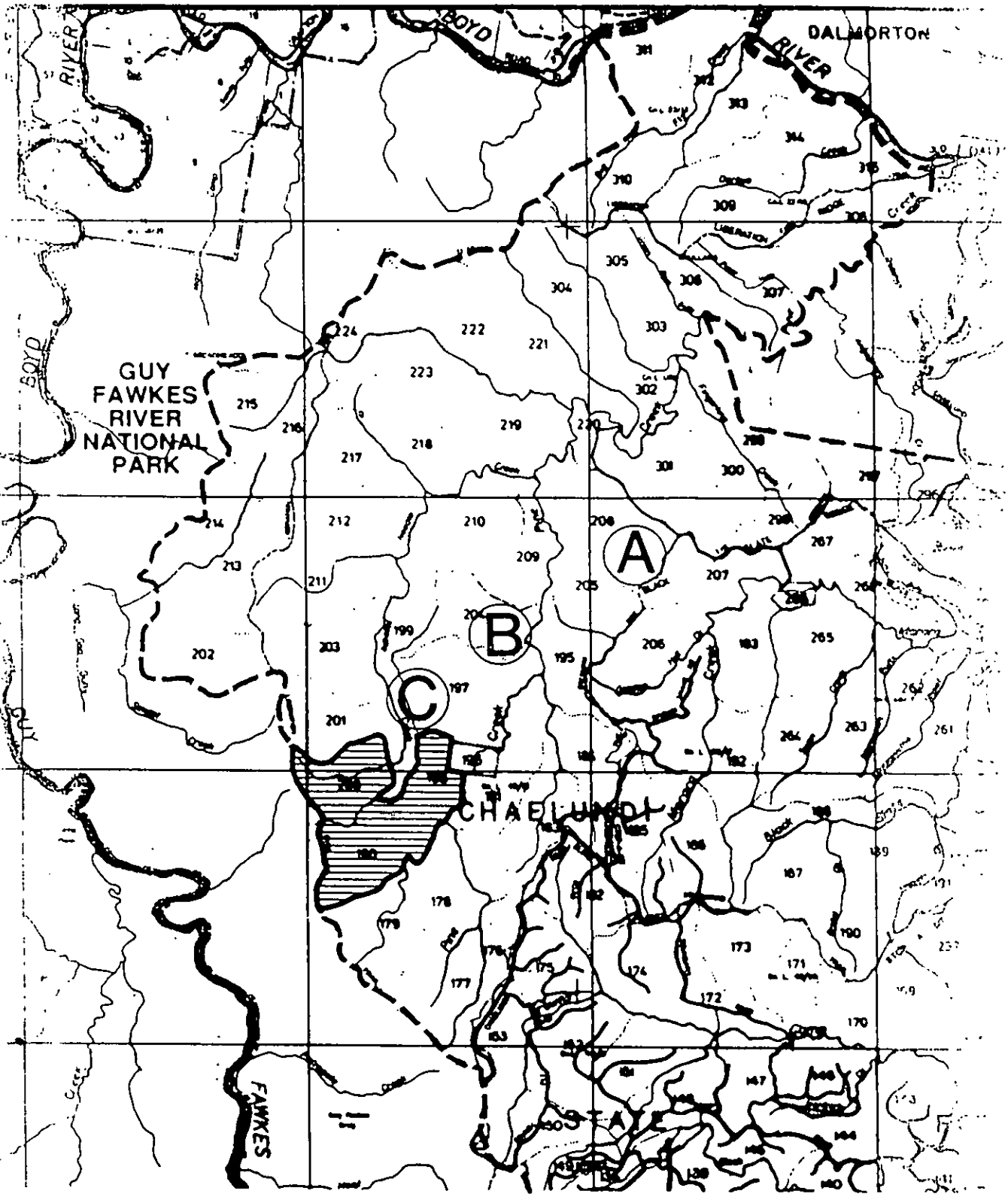


Figure 1

CHAELUNDI STATE FOR

Environmental Impact State
Harvesting compartments
180, 198 and 200

Small Mammal Trapping Loc

MARGULES PARTNERS PTY LTD

Date
Scale

LEGEND

EIS Area
Compartments 180, 198 and 200

A Trapping Site

0 1 2 3 4 5km

Summary of results

Antechinus stuartii (Brown Antechinus)

A. stuartii was the most abundant small mammal trapped at a relative density of 5.9/100 trapnights. Distribution by forest type is shown in Table 20. It occurred at all sites sampled, but was most commonly trapped at Sites E, C, and F. These sites were characterised by dense ground cover, and frequent fallen logs. *A. stuartii* is a widespread and common small mammal species found in forest and woodland throughout much of south eastern Australia.

Melomys cervinipes (Fawn-footed Melomys)

M. cervinipes was trapped at a relative density of 1.3/100 trapnights in the survey area. Distribution by forest type is shown in Table 20. It occurred at all sites, except Site A - a dry northerly facing ridge with open forest structure and recent fire history. Distribution over the sites was relatively even. Several of the females trapped were in breeding condition.

Comparative mean captures/100 trapnights at Chaelundi (1.3/100 trapnights) with other sites sampled in the Region (0.1-4.4/100 trapnights) indicate the occurrence of *M. cernivipes* at Chaelundi is not significant. The species has a common and widespread distribution in northeast NSW

Rattus fuscipes (Bush Rat)

R. fuscipes was trapped at a relative density of 0.9/100 trapnights. in the survey area. Distribution by forest type is shown in Table 20. It occurred on Sites C, D, and E only. Comparative mean captures/100 trapnights. 10.9/100 trapnights) with other sites sampled in the Region (0.1 - 21.7/100 trapnights) indicate the occurrence of *R. fuscipes* at Chaelundi is not significant.

4.4.4 Other mammals

A list of mammals observed during the course of the Earthwatch expedition is appended, together with data on habitat, occurrence and status (Appendix 7). These are summarised below.

A total of 16 species of mammal were observed. Two (2) of these species are listed in Schedule 12 of the NPWS Act, as follows:

Status	Species	Forest types
Fauna in imminent danger of extinction	*P. oralis*	74, 92, 163
Fauna of special concern	*D. maculatus*	163, ~~162/163~~ 142./143

Neither of these species was trapped in or near these compartment. Hines (Appendix 10) refers to detecting *Dasyurus maculatus* (Tiger Cat) in the area and it could reasonably be expected to occur. Its conservation status is common to rare depending on locality (Edgar 1983) and its habitat has been depleted by land clearance throughout the north coast.

Bats

Bats were not trapped during the Earthwatch program. There are no data on the species present on the site. Tidemann (1982) undertook a survey in the Washpool State Forest to the north of the study area. He recorded thirteen species of bats including one flying fox, one rhinolophid, one molossid and ten vespertilionids. Of these species, only one (*Myotis adversus*) is not dependent on forest for food, on roosting sites or both. All the bat species recorded are widely distributed elsewhere, and none is considered rare or endangered.

4.4.5 Birds

A list of birds observed during the course of the Earthwatch expedition is appended, (Appendix 7) together with data on habitat, occurrence and status. Several of the Earthwatch volunteers were keen amateur bird watchers. The list is reasonably definitive for the survey area at the time of the survey.

Results

A total of 47 bird species were observed. Five (5) of those species are listed in schedule 12 of the NPWS Act, as follows:

Status	Species	Forest types
Fauna of special concern	Grey-crowned Babbler	74[1]
	White's Thrush	74[1]
	Glossy Black Cockatoo	47, 142/163[2]
Vulnerable and rare	Powerful Owl	163
	Sooty Owl	163

1. This forest type does not occur in Cpts 180, 198 and 200
2. Recorded as 163C (ref. Section 4.3.1. above)

4.4.6 Reptiles, amphibians and invertebrates

Some data have been collected for areas to the north. A report to the NPWS describing the reptiles and amphibians of Gibraltar Range identified 15 species of reptiles and one species of frog from the wet sclerophyll forest habitat types.

Hines (Appendix 10) detected two species of amphibians and ten species of reptiles in the survey referred to in his affidavit. He qualifies this as a preliminary survey only, and no details of species is provided.

4.4.7 Invertebrates

There have been no specific studies undertaken to assess the invertebrate fauna of the study area. There is a lack of knowledge of the Australian invertebrate fauna in general. As at 1975 less than half of Australian insect species had been named and little is known of the ecology of most species, named or unnamed (Taylor 1979) Consequently, there is also little data that details the effects of forestry practices on invertebrates.

The types of insects expected to occur in the eucalypt forests can be classified by their feeding habits or exploitative behaviour. The following list is reproduced from Richards et al. (1990)

- Gall formers, e.g. Diptera (Cecidomyidae)
- Leaf miners, e.g. some Lepidoptera, (Yponomeutidae, Oecophoridae), Thysanoptera
- Sap-suckers, e.g. some Hemiptera (Aphidoidea, Psylloidea, Cicadellidae)
- Leaf chewers, e.g. some Phasmida, Coleoptera (Chrysomelidae, Scarabaeidae), Hymenoptera (*Perga* sawflies), Lepidoptera (Notodontidae, Eupterotidae, Pyralidae, Oecophoridae)
- Nectar and pollen feeders, e.g. some Coleoptera (Buprestidae), Hymenoptera (Apoidea), Diptera (Calliphoridae)
- Seed and fruit eaters, e.g. some Coleoptera (Bruchidae, Curculionidae, Cerambycidae), Hemiptera (Lygaeidae), Hymenoptera (Formicidae, Torymidae?) Lepidoptera (Lycaenidae)
- Wood borers, e.g. some Coleoptera (Cerambycidae, Buprestidae, Scolytidae, Platypodidae, Curculionidae, Lyctidae, Anobiidae), Lepidoptera (Cossidae, Hepialidae, Xyloryctidae), Hymenoptera (Siricidae), Isoptera
- Root feeders, e.g. some Coleoptera (Cerambycidae), Lepidoptera (Hepialidae), Hemiptera (Cicadoidea, Coccoidea, Aphidoidea, Fulgoroidea, Pseudoccidae)
- Predators and parasitoids, e.g. some Coleoptera (Trogositidae, Cleridae, Cucujidae, Passandridae, Rhizophagidae, Colydiidae) Hymenoptera (Ichneumonidae, Braconidae, Megalyridae)

4.4.8 Aquatic ecosystems

The streams draining the study area are likely to support complex biological communities.

The upper reaches of forest streams are heavily shaded and therefore plant life is restricted. In these sections of the stream algae which are attached rather than free floating, are the main plants. Most freshwater algae in Australia appear to be cosmopolitan species (Bayly and Williams 1975; Williams 1983).

As a consequence of the lack of primary production due to shading the major source of energy comes from outside sources, primarily litter fall from the surrounding forest (Bayly and Williams 1975; Lake 1982). Eucalypt forests provide a year-round supply of litter to the streams. Blackburn and Petr (1979) found that in a Victorian forest, stream leaf litter was decomposed relatively rapidly. Bark and branch litter provided energy to the stream in a more slowly available form.

In the upper reaches, forest litter is broken down in the stream by leaching and microbial and invertebrate action (Peterson and Cummins 1974). Animals appear to colonise the litter primarily as a food source rather than as a refuge (Pidgeon and Cairns 1981).

Invertebrate species can be grouped according to their method of feeding. A proportion of the organic matter (leaves etc.) that fall into the stream is broken down by

'shredders'. The faecal pellets from this group together with small uneaten leaf fragments are utilised by the 'filter feeders' and 'collectors'.

Dissolved organic material enters the stream via groundwater. It becomes available to filter feeders where it flocculates or is taken up by microbes on solid surfaces. Solid surfaces are the feeding areas utilised by 'browsers' or 'scrapers'.

Up to 80% of the invertebrate fauna may occur at depth greater than 5 cm within the stream bed. This deeper substrate is termed the 'hyporheos'. The deeper layers of the substrate may be important for different stages in the life cycles of invertebrates and as a place of refuge in times of environmental stress. These layers also support many species that complete their entire life cycle there (Williams and Hynes 1974).

Vertebrate aquatic fauna

Fish recorded in the Washpool study include Long-finned Eel *Aguilla reinhardtii*, a species of *Galaxias* and a Gudgeon (Osborne 1982).

Rare and endangered species

The Management Plan identifies two rare and endangered species known to occur in the Clarence River catchment:

- the Eastern Murray Cod
- a large freshwater crayfish genus *Evasticus*

Both are likely to occur in major streams in the lower elevation forests and would therefore be remote from the proposed operations.

4.4.9 Rare or endangered fauna

Following is a listing of animal species observed in or nearby Compartments 180, 198 and 200 which require special conservation considerations.

Symbol 1. indicates recording by the Earthwatch survey and 2. indicates recorded by Hines (ref. Appendix 10).

	Name	Recorded by	Conservation status
1.	Mammals		
	Hastings River Mouse	1.	Imminent danger of extinction
	Tiger Cat	1.2.	Special concern
	Long-nosed Potoroo	2.	Threatened
	Fawn-footed Melomys	2.	Special concern
2.	Reptiles and amphibians		
	Fletcher's Frog	2.	Protected
	Beech Skink	2.	Vulnerable and rare
	Carpet python	2.	Special concern
3.	Birds		
	Glossy Black Cockatoo	1.2.	Special concern
	Powerful Owl	1	Vulnerable and rare
	Sooty Owl	1	Vulnerable and rare
	White's Thrush	2.	Special concern
	Cicada bird	2.	Special concern
	Crested Shrike-tit	2.	Special Concern
	Rufous Fantail	2.	Special Concern
	White-throated Needletail	2.	Special Concern

4.5 CULTURAL

4.5.1 Aboriginal sites

A limited number of systematic archaeological studies have been undertaken in the North Coast Forests of NSW. There have been no studies undertaken within the three nominated compartments.

Bowdler (1983), in her review of Aboriginal sites on Crown forest lands, has indicated that existing records of sites reveal a disproportionately low number of sites within a large area of Crown forest on the North Coast. The North Coast region was known to have supported a large Aboriginal population at the time of European settlement. She attributes the low number of recorded sites to a lack of survey work coupled with difficult survey conditions caused by a lack of surface visibility.

It is likely that a similar situation to that which occurred in the South Coast Forests will occur in the North Coast Forests. That is, additional sites within forested areas will be found when and if studies are undertaken.

Bowdler recommends a systematic research program to determine the general patterns of Aboriginal occupation of and exploitation of the region's environments (in particular rainforest). This would lead to development of a suitable predictive model to indicate possible site locations.

Those sites that have been found are predominantly in rainforest communities with comparatively fewer sites from hardwood forest as shown by Table 22.

Table 22. Aboriginal archaeological site categories by forest type

Site Category	Rainforest type	Hardwood	
		Hinterland	*Coast*
Occupation sites	8	3?	
Scarred tree sites		2	
Stone arrangement sites	1		6
Earth rings			3
Carved trees			5
Paintings in caves		1?	1
Rock engraving	1		

This table lists the categories of sites that have been found in the region's forests. Of these, one, a stone arrangement has been identified at Chaelundi Mountain. The site is a stone arrangement and due to its location relative to the three compartments will not be affected by the proposal.

Byrne (1987) has proposed an Aboriginal landuse model for the New South Wales rainforests and adjacent areas. The study area falls within the 'upland rainforest' type. The Dorrigo plateau would have been accessible to both the coastal tribes and also the tablelands tribes.

Byrne indicates that use is likely to have been "small scale and intermittent; small highly mobile groups travelling between overnight camps and operating from base camps in the river valleys or on the coast". The larger areas of rainforest on the Dorrigo plateau may have been exploited by the tableland tribes in a manner similar to the way coastal tribes utilised the large areas of rainforest in the lowland areas. However, because of the limited areas of rainforest in the study area, movement was more likely along ridges. The areas of ribbon rainforest would be exploited from these ridges. Campsites are likely to have been in the open or in rock shelters.

4.6 LANDUSE

4.6.1 Wilderness

In assessing wilderness values of the study area and adjacent regions, it is important to have some means by which such values can be recognised and if possible quantified. Whilst there are no universally accepted definitions of wilderness there are two key elements that are stated or implied in most definitions. They are a lack of 'substantial' human modification or 'primitiveness'; and distance from human modified areas or 'remoteness'.

The NSW Wilderness Act (1987) provides for the Director of the NPWS to declare an area as a wilderness. No explicit parameters are identified such as minimum dimensions, however, the Act does specify that three criteria must be met. These are:

> "6. (1) An area of land shall not be identified as wilderness by the Director unless the Director is of the opinion that–
>
> (a) the area is, together with its plant and animal communities, in a state that has not been substantially modified by humans and their works or is capable of being restored to such a state;
>
> (b) the area is of a sufficient size to make its maintenance in such a state feasible; and
>
> (c) the area is capable of providing opportunities for solitude and appropriate self-reliant recreation."

The NSW Act broadly defines the 'primitiveness' criterion in 6.(1)(a) above, but does not define the 'remoteness' criterion except in the broadest sense. This follows from the work of the Wilderness Working Group (1986) which avoided adopting more explicit definitions as this was seen as being too restrictive and would result in exclusion of some areas which 'closely approach a wilderness condition and which could revert to that condition with appropriate management'.

Other authors have defined appropriate physical parameters that enable an objective assessment of wilderness.

Helman et al. (1976) provided explicit criteria in their assessment of wilderness along the east coast of Australia.

These were:

i. a minimum core of 25 000 ha;

ii. a core free from major indentations;

iii. a core area of at least 10 km in width; and

iv a management (buffer) zone surrounding the core area of about 25 000 ha or more.

Other authors have provided methods for assessing 'remoteness' which is a product of distance from the nearest human intrusion and size. Three recognised methods are described below.

i. **Access remoteness** is a measure of the time needed to travel to the boundary of a wilderness area by non-mechanised means. The commencement point is the closest human engineers' intrusion such as a road, a waterway used by motorboats, an airstrip or a helipad. Hawes and Heatley (1985) put down the necessary access remoteness in Tasmania as being the distance covered in half a day's walking from the nearest major intrusion;

ii. **Direct remoteness** is a measure of the map-distance between a point on the boundary of the wilderness core and the nearest major intrusion. For Tasmanian conditions, Hawes and Heatley (1985) ascribed a minimum direct remoting distance of 8 km.

iii. **Apparent remoteness** is the lack of any sensory awareness of adjacent human-modified areas be it visual, e.g. roads or powerlines, or auditory (e.g. logging roads). The Wilderness Society believes that the view from a wilderness should be natural for at least 10 km (TAS EIS 1985).

Hawes and Heatley (1985) in their Remote Primitive Land (RPL) method technique used a combination of direct remoteness and access remoteness along with primitiveness to define wilderness areas in Tasmania.

Kirkpatrick and Haney (1980) in their "Quantification of Developmental Wilderness Loss" assumed zero wilderness value at an access remoteness under four hours and direct remoteness of 5 km. They also took into account an arc of visibility of disturbance as a measure of apparent remoteness.

All of these definitions of remoteness imply that a buffer or remoting zone is present around the wilderness core. The buffer zone has the same criterion of primitiveness as the core.

The study area forms part of past and current wilderness proposals. The original proposal was contained in the Helman Report 1976 as an area warranting further investigation for wilderness values. An interdepartmental committee investigated the wilderness values of the area in 1984 and the implications for management arising from this. The committee made nine recommendations. The following are of relevance to the proposed works:

- "Further consideration of the Guy Fawkes Wilderness Area should be limited to the areas of interest to the National Parks and Wildlife Service."

  In the vicinity of the three compartments, this area is defined by the boundary between the Guy Fawkes River National Park and Chaelundi State Forest.

- "The Forestry Commission should be requested to refrain from undertaking or authorising any operations not compatible with wilderness values on those areas of interest to NPWS (in both core and management zones), without prior consultation with the National Parks and Wildlife Service."

  This was directed towards management of the Pillar Creek catchment north of the study area.

- "Normal Forestry Commission operations should be permitted on existing State Forests and other Crown-timber lands which are not of interest to the National Parks and Wildlife Service."

  This meant that normal forestry operations could continue in the areas of Chaelundi State Forest not within the Pillar Creek catchment.

- "The Department of Environment and Planning should be requested to take account of wilderness values within the area of interest to National Parks and Wildlife Service when assessing any development proposal, or in related planning activities."

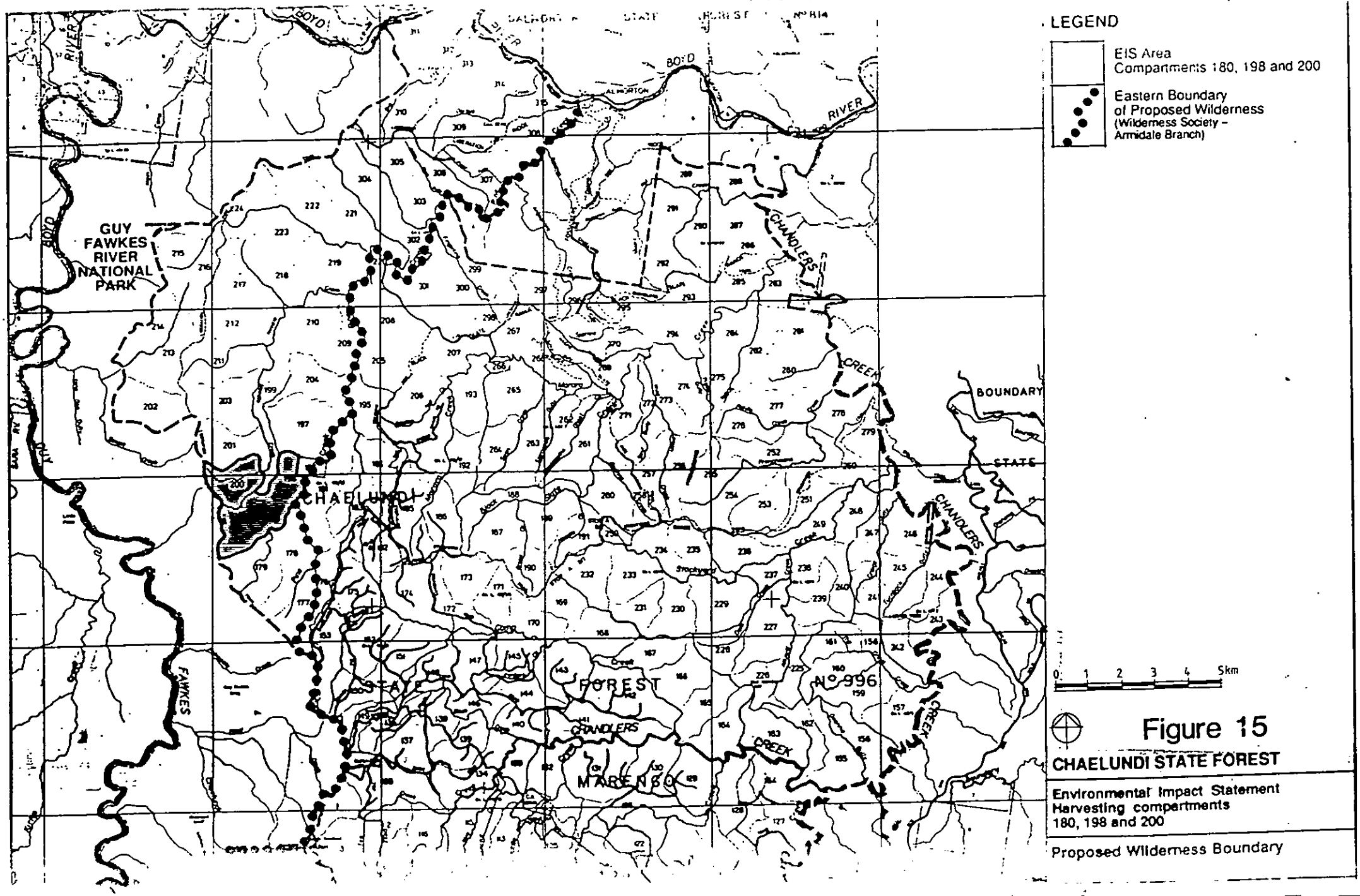
Forest management in the Chaelundi State Forest to date has been consistent with the recommendations of the interdepartmental committee. None of the 'area of interest' to the NPWS has been affected by harvesting or associated works. The FCNSW has recognised the need to avoid impacts affecting this area and has implemented measures to protect values within the adjacent Guy Fawkes River National Park. The alignment of Broadmeadows Road has been moved east off the ridge leaving an 80 m buffer between the park and the road. In addition, the road has been designed to drain away from the National Park. These measures will protect visual and catchment values.

More recently (16 March 1990) the Wilderness Society (Armidale) proposed that the land in and around Guy Fawkes River be identified and declared as wilderness. This proposal includes all the area west of Pine Creek including the three compartments and also Compartments 177, 178 and 179 which were harvested 1989 and 1990. Both groups of compartments form part of the eastern boundary of the nominated area as shown by Figure 15.

The proposal states that logging and roading activities are inappropriate for a wilderness area and requests that the Director (NPWS) "... take steps to have all logging and associated roadworks within the proposed wilderness area, stopped pending the outcome of this proposal". The proponents also indicated that some parts of the area were disturbed but that they could be restored with 'careful management applied'.

The total area proposed is 113 000 ha with no discrimination between 'core' and 'buffer' zones. The proposal acknowledges the close proximity of harvesting activities and the presence of fire trails. A number of existing land uses and activities within and around the proposed area were identified as seriously jeopardising its wilderness qualities. These included logging, cattle grazing, mining, use of recreational vehicles and horse riding. The Director of the NPWS is currently considering this proposal.

Existing activities and human engineered structures within the study area likely to affect wilderness values include: the newly constructed length of Broadmeadows Road separates the three compartments from the remainder of the nominated area; an existing formed fire trail that separates Compartments 198 and 200; grazing by lessees; 4WD driving; and the fire fuel hazard reduction burning.


LEGEND
EIS Area
Compartments 180, 198 and 200
Eastern Boundary
of Proposed Wilderness
(Wilderness Society –
Armidale Branch)
GUY
FAWKES
RIVER
NATIONAL
PARK
BOYD
RIVER
CHANDLERS
CREEK
BOUNDARY
STATE
FOREST
CHAELUNDI
MARENGO
No 996
FAWKES
RIVER
0 1 2 3 4 5km
Figure 15
CHAELUNDI STATE FOREST
Environmental Impact Statement
Harvesting compartments
180, 198 and 200
Proposed Wilderness Boundary

Using the assessment criteria defined previously, the wilderness values of the three compartments are:

- **Primitiveness**
  The study area is surrounded by obvious human development. This includes the Broadmeadows Road, fire trails and harvested areas in the adjacent compartments. Within the three compartments, some primitiveness values are present because of their unlogged status. These values are limited to comparatively small areas due to the presence of the aforementioned developments.
- **Remoteness**
  The three compartments have no 'remoteness' values again due to the presence of the existing developments. This area would not form part of any buffer or remoting zone for the main body of the nominated area due to the presence of Broadmeadows Road along the western boundary.
- **Grazing leases**
  The rights of existing lessees to graze cattle in the areas east of the park will continue to affect the wilderness values of the leased areas including the three compartments. The proponents of the wilderness nomination identify grazing as jeopardising the area's wilderness values. Grazing will continue unless the lessees can be persuaded to relinquish the leases.

On the basis of the above analysis the three compartments have no 'remoteness' values and have limited 'primitiveness' values. They are currently utilised for purposes which are incompatible with wilderness values.

4.6.2 Recreation

Compartments 180, 198 and 200 are remote and do not offer any unique recreation opportunities not already provided in forested areas closer to population centres. Existing use which is not monitored is largely confined to four-wheel drive enthusiasts.

In addition, Broadmeadows Road will provide access to locations along the eastern boundary of Guy Fawkes River National Park. This may generate some use by those seeking access to the Park.

4.6.3 Grazing

There is a long history of extensive grazing in the region and compartments 180 and 198 form part of Crown Lease 40/18 shown on Figure 16.

This lease was taken up in 1940 and has a 'perpetual' term. Chaelundi State Forest was dedicated over the lease in 1972 at which time the Forestry Commission took over the administration of the lease from the Lands Department. State Forest dedication did not, in effect, alter the terms or conditions of the lease. Shire rates are paid by the lessee.

The lessee is Doris Eileen Tibbett. The lease covers an area of 2586 ha and is not fenced along the boundary between compartments 180, 198 and 200.

The lessee is currently paid one third of net royalties received for timber harvested from the lease area and owns the grazing rights. The lessee grazes large stock (cattle) which being unfenced, are free to range over the three compartments.

Grazing will continue, and is continuing through this study period during which timber harvesting activities have stopped. It is compatible with the objectives of management for the forest.

The carrying capacity of harvested areas usually increases following harvesting. Stock browse many of the regenerating plants. Van Loon (1966) records that cattle and marsupials are attracted to the lush weed crop that emerges post harvesting, particularly on sites where fire has been used to prepare a seed bed for regeneration. In addition, grazing is facilitated through improved access from harvest roading.

4.7 SOCIOECONOMIC ENVIRONMENT

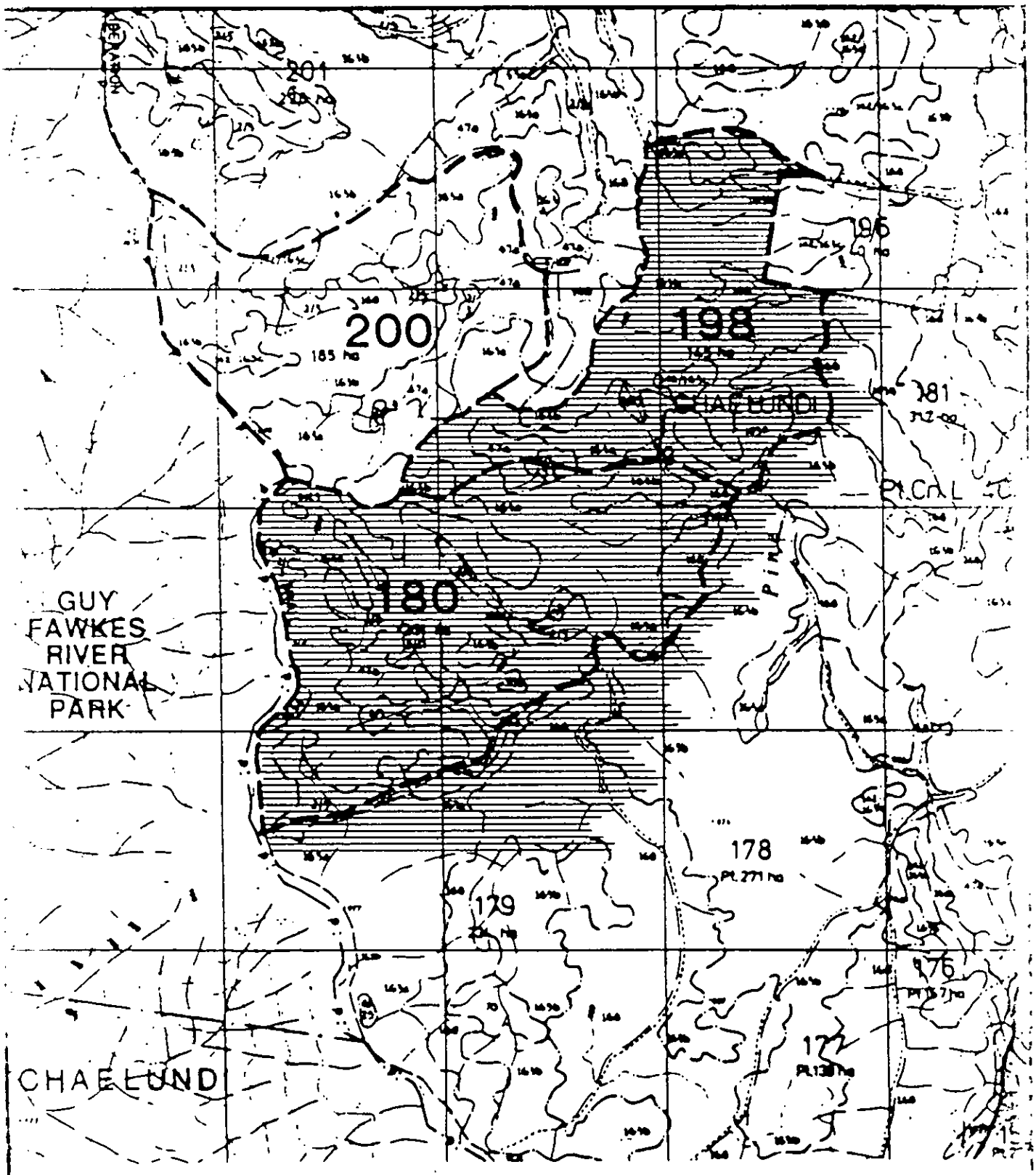
For the purposes of this analysis, the main region directly affected by operations based on the State Forests of the Dorrigo Management Area has been considered to be that covered by the Bellingen Shire area. In addition, the Nymboida Shire and the City of Grafton will also be affected as the proposed activity will take place within the former and the Duncan's Holdings sawmill is located in the latter.

The Bellingen Shire is centred around the town of Dorrigo. The Shire covers over 1600 sq. km, and (as at June 1988) was estimated by the Australian Bureau of Statistics to have a total resident population of 10 680. Over the inter-censal period from 1981 to 1986, the population of the Shire has increased at an average annual rate of 2.5%, which can be compared to an average population growth rate of 1.1% per annum for the State as a whole.

The timber industry has a long history in the region, and has formed part of the foundation for economic development and the growth of settlement in the area. The following section describes the socio-economic environment of the region, and outlines the role of the sawmilling industry (as currently operating) in this environment.

4.7.1 Economic characteristics

The economy of the region is heavily concentrated in the primary sector, with cattle grazing (both beef and dairy) and forest-based activities providing the major source of economic activity. The region has not shared in the strong growth in tourism that has been experienced in adjacent coastal areas (such as Coffs Harbour), but it is reported that some sub-division of rural properties has been associated with an influx of 'hobby farmers' and retired people. The relative proximity of Dorrigo to the large regional commercial centre of Coffs Harbour has also provided some part of the observed total population growth, but this increase is not associated with economic activity, and thus regional output, for the Shire.



LEGEND

EIS Area
Compartments 180, 198 and 200

Pastoral Lease 40/18

0 0·5 1·0 1·5 km

Figure 16

CHAELUNDI STATE FOREST

Environmental Impact Statement
Harvesting compartments
180, 198 and 200

Leased Area

MARGULES PARTNERS PTY LTD

Date 8-1990
Scale 1:25,000

A long-established timber industry has been based on the forest resources contained within the Dorrigo Management Area. This industry has experienced several phases of change, with Cedar, Hoop Pine, and other rainforest species being replaced with various Eucalypt species, including Tallowwood. The importance of forest-based activities for the economy of the region is demonstrated by the contribution of the 'agriculture' sector, which includes sawmilling, to total employment in the Shire. Examination of employment data, as illustrated in the statistics from the 1986 national Census that are presented in Table 23, indicates that the primary sector provides over 17% of regional employment, compared to just 4.8% of State-wide employment.

Table 23. Structure of regional economy

Industry Sector	Employment (1986)	Share of total (%)	State share of total (%)
Agriculture (incl. timber)	526	17.1	4.8
Mining	2	0.1	1.3
Manufacturing	447	14.5	15.4
Electricity, gas and water	23	0.7	2.1
Construction	191	6.2	6.3
Wholesale and retail trade	495	16.1	18.9
Transport and storage	127	4.1	5.7
Communication	71	2.3	2.2
Fin./Prop./Bus. Services	192	6.2	11.7
Public Admin./Defence	146	4.7	5.5
Community Services	503	16.3	16.4
Recreation/Pers. Services	237	7.7	6.3
Non-classified/Not stated	21	0.7	1.0
Total	3084	100.0	100.0

Source: Australian Bureau of Statistics, 1986 Census of Population and Dwellings

These data also suggest that the Shire is under-served (by comparison to State averages) with financial and business services, and public administrative services. The region is therefore more strongly based in the primary sector of the economy (which includes all timber-based activities), and less in the secondary and tertiary sectors, than is the State as a whole.

4.7.2 Timber industry

The forest resources of the area were responsible for the early development of the regional economy. Large areas of native forest were dedicated as State Forest, from 1914 until 1982. The total area of State Forest within the Dorrigo Management Area has also been reduced from 1974, as selected areas have been revoked for addition to National Parks in the region. Between 1974 and 1984, over 5500 ha of State Forest have been removed from logging activities and added to rainforest reserves and National Parks.

There are now two sawmills located within the area that draw their sawlog resource from the Dorrigo Management Area. A further ~~two~~ mills outside the region also draws part of ~~their~~ its allocated sawlog quota from this Area. For the purposes of this analysis, the timber industry based on the forest resources of the Dorrigo Management Area has been considered to comprise three mills, with a total quota allocation of nearly 74 000 m^3/yr. These are indicated in Table 24.

Table 24. **Estimated dimensions of regional timber industry**

Company	Location	Quota (m^3/yr)	Output $m/yr	Employment (no.)
G.L. Briggs and Sons Pty Ltd Boral Ltd (Allen Taylor)* Duncan's Holdings Ltd	Briggsvale Bostobrick Grafton	19 180 15 680 39 000	n.d.	n.d.
Total Regional Industry		73 860	12.0	280^

Source: Consultants' estimated based on industry information

n.d. Not disclosed for reasons of commercial confidentiality

* Logs from Dorrigo Management Area may also be sawn at this company's Coffs Harbour mill

^ Includes harvesting workforce, transport etc.

Around 30% to 35% of the volume of output from the industry consists of products made from Tallowwood with the balance comprising other hardwood species. Tallowwood is the preferred species for products requiring the qualities of strength and durability that are characteristic of this timber, including decking and flooring, various marine applications, and crossarms for utility poles. The wharves and promenade at Darling Harbour in Sydney are made from Tallowwood originating in the Dorrigo Management Area, as is the roller coaster at "Australia's Wonderland" outside Sydney. The unique qualities of Tallowwood make the contribution of this species to the value of industry output, and thus profitability, higher that the volume contribution would suggest. The three mills listed above all depend on the Dorrigo Management Area for their supplies of this important species. The two mills actually located within the region represent an investment of around $6 million by the companies concerned, although replacement values could now be expected to be considerably higher.

The operation of the timber industry based on the forest resource of the region is thus estimated to contribute around $12 million directly to the value of regional output. While it has been estimated that up to 50% of profits from one of the mills could be considered to be derived from Tallowwood, it is not possible to estimate the contribution of this single species to the total value of output. However, the industry considers that it is Tallowwood that provides the foundation for overall sawmilling activity in the region, as customers seeking its unique properties will then buy other products from the same source.

The total contribution of the timber industry to the regional economy is wider than this direct impact via industry output, as a result of the economic links that exist between the forest industries and other sectors of the regional economy. The nature of this 'flow-on' or multiplier effect, and its possible dimensions, have been described at length in other reports on economic aspects of the timber industry (HDA 1986; FCNSW 1988; Margules 1990). The similarities existing between the size and structural characteristics of the economy of this region, and that of the Eden region on the far south coast of NSW, indicate that the application of multipliers derived for the latter area, to the area examined in this analysis, can be considered realistic. The following values are thus taken to be appropriate for use as regional total multipliers to be applied to the timber industry of the Dorrigo area:

Output	1.58
Employment –	
mills	2.00
forest	2.32

Applying these multipliers to the direct output (and employment) values presented in Table 24 indicates that the total impact of the timber industry on the region could be much larger. Table 25 summarises the estimated total impact on the timber industry on the regional economy.

Table 25. Contribution of timber industry to regional economy

	Direct ($m/yr)	Total ($m/yr)
Output	12.0	19.0
Employment	280	600

The existing timber industry based on the forest resource of the Dorrigo Management Area is therefore estimated to contribute a total impact of around $19 million, per year, to the value of regional output. In other words, **this industry provides the basis for around $19 million of annual economic production generated by the region.** The magnitude of this contribution can be placed in perspective by comparison with an estimated gross value of agricultural commodities produced (1987-88 season) of $15 million (data from ABS, Catalogue No. 1304.1). In addition, **the total impact on regional employment of 600 positions** is significant when viewed against total regional employment (in 1986) of just over 3000 jobs. It can thus be demonstrated that the timber industry provides a fundamental component of the economic environment of the region.

4.7.3 Social characteristics

Dorrigo is the main centre of population for the Dorrigo district part of the Shire, and also provides the required commercial and other services for the surrounding district. The smaller villages in other areas of the Shire are associated with primary industry activities, such as sawmilling and pastoral enterprises, with all services increasingly being concentrated in Dorrigo.

There are few other centres of population in this part of the Shire. The villages of Briggsvale and Cascade were originally established to provide accommodation for employees of one of the sawmills, and the construction of dwellings within the confines of dedicated State Forest has been permitted under an occupation permit. Similarly, there is little activity in the village of Bostobrick other than the operation of the sawmill. The residents of outlying rural areas are provided with only limited community services, such as retail and education facilities, and must rely on travel to Dorrigo for access to these services.

The sawmills therefore provide an important source of employment for these rural areas, and there are few, if any, alternative opportunities for employment in these areas. Unemployment in the region is high, with the unemployment rate in August 1989 estimated by the ABS (Catalogue No. 1304.1) at 10.8% for the total of the Statistical Region (Richmond-Tweed and Mid-North Coast) which includes this region. This rate was the highest of any region of the State, and compares to an equivalent figure for the State as a whole of just 6.0%. Equivalent data available from the 1986 Census for the Bellingen Shire region alone is presented in Table 26.

Table 26. Social characteristics of the region

Indicator	Bellingen Shire (%)	State Total (%)
Unemployment rate ('86)	20.6	10.1
Participation rate ('86)	37.9	44.7
Aged share population ('87)	13.2	11.2

Note:

Unemployment rate – the number of unemployed expressed as a percentage of the labour force.

Participation rate – labour force (employed and unemployed) expressed as a percentage of the total population.

As indicated in the above data, the region also has a higher proportion of aged (those aged 65 years and over) than does the State as a whole. As indicated in data for 1987 provided by the ABS (Catalogue No. 1304.1), 13.2% of the population of the Bellingen Shire area is in this age-group, as compared to an average in the State population of 11.2% aged. This age-group consists of retirees, who are dependent on other economic activity (family, or tax-payers elsewhere via pensions) for their support.

5.0 INTERACTIONS WITH THE ENVIRONMENT AND MEASURES TO BE UNDERTAKEN TO MINIMISE IMPACT

This section describes potential impacts on the environment arising from implementation of the proposal. The interactions with the environment are twofold, i.e. those within the three compartments (internal) and those external to the three compartments (external). Impacts can be positive or negative, short or long term. In some circumstances there was insufficient data to determine likely impacts. These areas have been identified.

The main interaction is a transformation, i.e. timber harvesting from old growth moist hardwood forests transforms the forest from a stand comprised primarily of mature trees with vigorous understorey to a forest of residual large old trees interspersed with uneven stands of regeneration. This transformation is not uniform either in terms of the degree of change within harvested areas or in the area harvested as substantial areas are not affected. Assuming that these forests continue to be managed for wood production then they will stabilise as a relatively diverse multi-aged stand as selection harvesting takes place over time.

These forests, as with all eucalypt forests, are dynamic in that the structure and components that make up the forest change over time. In the absence of disturbance these changes take place gradually. However periodically these forests have been burnt by wildfire which has a dramatic impact on the forest ecosystem resulting in significant and rapid changes. These past fire events, typically at 300 to 400 year intervals, have shaped the forest and are an important determining factor responsible for the gross vegetation patterns within the study area (FCNSW 1982).

Therefore the proposal to harvest these forests must be viewed within the context of an ecosystem that has evolved mechanisms and processes to cope with both gradual, subtle change and more far-reaching, rapid change. The degree of disturbance that could be expected to occur as a result of harvesting these areas would remain within the levels of disturbance that have shaped the forest in the past. The processes and mechanisms referred to earlier can therefore be expected to operate to restore the structure and components of the forest. Past experience has shown this to occur where appropriate silvicultural techniques have been employed to regenerate the forest.

The transformation associated with harvesting shifts the forest from a slowly evolving well balanced ecosystem to an active unbalanced system in which the rate of change is increased, particularly in the period before canopy cover is restored. This is a long term significant change to the existing natural environment in that it represents an interruption to and, in many cases, a setback of the vegetation successional progression occuring in the forest prior to harvesting. This process may be repeated over time through subsequent harvesting operations. Under these circumstances humans, through management, would be holding the forest in a section of the natural spectrum of successional progression that could be expected to occur under natural conditions. This benefits those animals and plants that are favoured by the habitat associated with a diverse, multi-aged forest incorporating elements of the mature forest and regrowth forest.

This provides an alternative means of conserving these species to those preservation techniques employed in national parks and could prove to be of importance in the development of conservation strategies for particular species in the future. This interruption to the direction of change in the forest ecosystem can be released in part or completely at any time.

The art of native forest management is to manage this transformation optimising all values and without permanent loss of important environmental quality, for example populations of rare and endangered organisms. Native forest management is continuing to evolve as increasing understanding of the natural environment permits procedures to be amended to achieve this objective.

In some instances the changes resulting from the proposal will be more or less permanent. Road construction to access the resource is a permanent transformation to the environment. The existing Broadmeadows road is part of a road network which will remain for future forest management use. Feeder roads proposed for construction as part of this proposal would also be retained as part of the transformed landscape. Other tracks and roads would be closed down and allowed to regenerate as part of the modified forest resource.

External impacts are mainly positive and include those associated with maintenance of employment opportunities within the timber industry in the region. This industry is an important source of employment in a region typified by high levels of unemployment. Timber harvested as part of the proposal would contribute to the maintenance of employment opportunities. The economic activity generated by processing the logs sourced from these forests would form a significant part of regional output.

Impacts have been classified in accordance with the expected duration of effect or timing of occurrance:

- immediate, i.e. the impact during the proposed activity, e.g. noise, air quality, etc;
- short term, i.e. soil erosion, vegetation structure maintenance of industry and employment etc; and
- long term, i.e. changes in vegetation structure, changes in populations of animals etc.

5.1 IMPACTS ON THE PHYSICAL ENVIRONMENT

5.1.1 Soils

Forests which have achieved full canopy closure represent the most stable land use in terms of the maintenance of soil values.

Forest management practices, in particular roading and harvesting have the potential to cause significant impacts on forest soils. Soil physical structure, nutrient status and stability are the factors most likely to be affected.

Impacts on soil stability

The following factors affect the extent and rate of soil erosion.

Climate The occurrence of long duration, high intensity rainfall events has been described in Section 4.1.4. High intensity rain increases the risk of erosion occurring through increased overland flow of runoff water. The FCNSW has recognised this and applies prescriptions to minimise the number of potentially erodible areas. These include: the progressive restoration of snig tracks and access roads to minimise the number undrained at any time; wet weather closure of bush operations aimed at reducing impacts on soil physical structure while wet (ref. Application of Erosion Control Measures); design standards for roads and culverts capable of handling storm flows.

Slope and soil properties Compartments 180, 198 and 200 for Chaelundi State Forest are predominantly on fine-grained, dark sedimentary rocks of the Coffs Harbour Block. The soils derived from this parent material are common throughout the Coffs Harbour region. They are relatively stable soils and fit into the low to average erosion class in reference to the Standard Erosion Mitigation Conditions of the FCNSW. Adherence to these conditions especially the relevant slope restrictions on snig tracks and cross-banks will minimise any potential erosion due to harvesting operations planned in these compartments.

The limited areas of acid volcanic dykes and the small adamellite intrusion have produced soils of higher erodibility than the sedimentary soils but the overall erosion hazard is only moderate due to:

a. the limited areal extent of the soils;

b. the high gravel content of these soils; and

c. their occurrence on ridgelines and hillcrests.

Extent of area cleared, severity of clearing and rate of revegetation In the unharvested and unburnt forest, the soil surface is protected from erosion by: the forest canopy and the understorey which reduce the initial momentum of raindrops; the litter layer which further dissipates the energy of rain; and by the roots which assist in binding the soil together.

Forest canopy cover Harvesting partially removes the protective canopy which takes time to re-establish. The moist hardwood forests in the study area have multiple layers of vegetation which provide more cover. The selective harvesting techniques proposed for use in the three compartments will mean that a significant proportion of the canopy cover within harvested areas will be retained after harvesting (ref. Section 5.3.2).

Post harvesting revegetation restores this protective cover sometimes to levels above that which existed prior to harvesting. A rapid restoration of protective cover reduces the period the soil is exposed to erosive factors. This minimises the extent of erosion during the immediate post harvesting period when the risk of erosion is greatest. Vegetation cover protects the soil surface from the effects of sun and wind and generally makes the soil a more hospitable environment for soil flora and fauna to restore natural processes.

Degree of disturbance The extent and degree of disturbance to harvesting compartments has been reviewed by several authors: Cornish (pers. comm.); FCNSW (1966); Heyligers (1975). Estimates of disturbance levels are given by Table 27.

Table 27. Soil disturbance following harvesting and burning

Disturbance categories	% of soil surface exposed	FCNSW 1966	Cornish		Heyligers 1975
		Percentage in each category			
		(1)	(2)	(3)	(4)
Undisturbed		74.6	67.6	-	84
Disturbed					
- very light disturbance	comparable to unharvested	11.4	13.0	-	
- light disturbance	less than 25	8.3	7.0	-	
- snig tracks	25-75	3.3	5.3	25-30	16
- log dumps (landings) and minor roads	75-100	2.4	7.1	2.8	

(1) Based on assessment of disturbance in the Tallowwood-Blue Gum type.
(2) Based on assessment of disturbance at the Karuah Hydrology Research catchments, FCNSW.
(3) Based on Karuah area as for (2) above.
(4) Statement by Heyligers regarding general levels of disturbance from harvesting operations over Australian forests.

The litter layer in the undisturbed areas is largely intact. Lightly disturbed areas retain significant litter cover while snig tracks and log dumps have no litter cover. Post harvesting burns will remove additional litter and a proportion of tree crowns.

Post harvesting burns are typically patchy leaving a mosaic of burnt and unburnt areas. Cornish (pers. comm.) reports an assessment of the percentage of the Karuah experimental catchments affected by post harvesting burns and the intensity or class of burn. Data are provided in Table 28 for two catchments which were subjected to comparatively high intensity harvesting including removals of pulpwood as well as sawlogs.

Table 28. Extent and intensity of post harvesting burns

Catchment	Heavily burnt All material <150mm dia. burnt	Moderately burnt All material < 50mm dia. burnt	Lightly burnt Burning patchy, litter layer hardly consumed	Unburnt
Corkwood	23.9	3.8	6.5	65.9
Jackwood	31.4	26.2	5.0	37.4

Source: Cornish (pers. comm.)

Where burns have been deliberately undertaken as a method of creating a suitable seedbed between 73% and 87% of the net harvested area (as distinct from the total catchment area figures provided in Table 28) is burnt.

Impacts on soil physical structure Repeated passage of machinery and logs has the capacity to cause substantial changes to soils within harvested areas. Such changes include: soil compaction which can occur over a range of soil moisture contents; rutting and scouring caused by wheels passing through wet or soft soil; and puddling where machine movement and high soil moisture content can convert soil to a semi-fluid state (Cameron et al. 1979).

The degree and type of change is affected by many variables. They include: topography; soil type; soil depth; soil moisture content; amount and distribution of forest litter and slash; volume of timber extracted; type of harvesting system used, e.g. tractor harvesting; and the pattern of extraction, up hill or down.

Soil compaction on harvested areas is largely confined to the snig tracks, minor roads and log dumps. These areas represent less than 20% of the harvested area. Compacted soils have: increased soil strength and reduced total porosity through a reduction in large voids; and reduced aeration and water infiltration rates and saturated hydraulic conductivity.

Log dumps, minor roads and snig tracks when compacted generate overland flow of water which may in turn lead to increased erosion and transport of sediment. This may or may not result in increased erosion as compacted soils have increased strength which may enable them to sustain higher levels of runoff without erosion occurring (Greacen and Sands 1980).

The total area of compacted and exposed soil and the design and application of ameliorative measures will have a major influence on the extent of overland flow and subsequent sediment production. Overland flow can be collected and diverted to undisturbed vegetation where it will infiltrate reducing sediment production (Langford and O'Shaughnessy 1977).

The consequences of compaction on tree growth were examined by Greacen and Sands (1980) in their review of available literature. They found inconsistencies in the results from field experiments to test the effects of compaction on plant growth. Some studies indicated increased growth, others a reduction in growth, and some no change.

It appears that the relative availability of nutrients and water to the plant is an important factor in determining if compaction will affect root (and subsequently) shoot growth. Root growth through compacted soil is likely to be reduced in areas of significantly increased bulk density unless zones of weakness remain within the compacted soil. These zones if they exist, are preferentially exploited by plant roots (Sands et al. 1979).

Greacen and Sands (1980) recommended three types of preventative measures to reduce soil compaction viz. (a) management of natural soil factors, (b) traffic control and (c) mechanical loosening of soil.

a. Soils with high levels of organic matter such as those in the study area (ref. Section 4.1.3) are less susceptible to compaction and addition of organic matter to compacted soils reduced compaction and improved structure. Management of natural soil factors in the study area means maintenance of organic matter in soils by ensuring that organic matter is not removed by fierce slash burns.

b. The control of harvesting machinery during harvesting operations is used to minimise the extent of compacted and disturbed soil. The risk of compaction increases with increasing soil moisture levels. Hence, avoiding harvesting during periods of wet weather is of prime importance in reducing or preventing soil compaction. The FCNSW has implemented procedures for the automatic cessation of harvesting activities during wet weather.

c. The FCNSW has had a program of removal and subsequent replacement of topsoil on dumps to improve the prospects for revegetation of these areas.

In summary, the compacted area of a compartment may result in a drop in productivity from trees located on or adjacent to the compacted area. Snig tracks and access roads are the only areas left compacted following ripping of log dumps. Snig tracks would be likely to affect only part of a tree's root system and the impact on root growth would diminish as the distance between the track and the tree increased. It is not clear the extent to which compaction reduces the potential productivity from individual trees located adjacent to compacted areas hence causing a reduction in the total productivity from the site. As discussed above it is likely to depend on the extent to which soil nutrients and moisture levels are limiting growth. The question of possible drops in productivity, in terms of timber production, from areas within the compartment should be viewed in the context of the significant increases in overall site productivity from the regrowth and released future sawlog trees compared with the old growth forest.

Application of erosion control measures The FCNSW in conjunction with the Soil Conservation Service of NSW have drawn up comprehensive specifications for erosion control during and after harvesting operations in recognition of the erosion hazards associated with harvesting operations. These were discussed in Section 3.2.2

5.1.2 Impacts on site nutrient status

Nutrients within the forest ecosystem are contained within the living biomass, dead organic matter and soil. Nutrients enter and leave the ecosystem and there are transfers of nutrients between elements of the system. Nutrients bound in organic matter are released for subsequent uptake by other plants by the process of decomposition. There are three interconnected mineral flow pathways which together make up the overall nutrient cycling system in forest ecosystems. These are described in Richards et al. (1990).

> "• the geochemical cycle which links the external environment to the ecosystem by processes such as precipitation, rock weathering, leaching and groundwater flow
>
> • the biogeochemical cycle which concerns the circulation of nutrients within the soil-plant subsystem
>
> • the biochemical cycle involving the redistribution of nutrients within the plant biomass.
>
> Soil microbes are intimately involved in the second of these, viz. the biogeochemical cycle. The effect of organic matter decomposition processes on the supply of plant nutrients is entirely indirect, that is nutrients become available only as byproducts of microbial activity."

Forests in various stages of development differ in their requirements for and sources of nutrients. Nutrient cycling studies have identified three stages in a forest development viz.

1. Uptake stage – nutrients drawn from the soil reserves – corresponds to regenerating forest. All nutrient requirements are met from this soruce.
2. Internal cycling stage – physiologically active nutrients are recycled within the tree. Much of the trees requirements for P, N and K can be met from this 'source' although uptake is still significant. However, other nutrients such as Ca, M, Mn and Fe which are not physiologically active must come from the soil.
3. Maintenance phase – litter and mortality return nutrients to the soil (Attiwill 1980).

The old growth moist hardwood forests are in the maintenance phase reflecting the long periods between wildfires. Harvesting, especially of old growth trees, replaces the maintenance or internal cycling phase with the uptake phase. Nutrient removals in harvested biomass will have a minimal effect on the uptake phase of the regenerating forest. Nutrients removed from the site in the harvested biomass would not have become available for many years until broken down via the biogeochemical cycle. Nutrients contained in large logs are tied up for many decades and only become available once the logs have decayed. By the time nutrients from this source become available the regenerating forest will be relying predominantly on cycling within the biomass and from nutrients released from the breakdown of litter. For this reason, third and subsequent rotations are more likely to be susceptible to a lowering of the site nutrient status caused by forest operations (harvesting removals plus post harvesting burn) than the second rotation forest.

There are difficulties associated with any attempt to assess the proportion of the total store of 'available' nutrients within a site that are removed or lost as a result of harvesting.

A major difficulty lies with the definition of the quantity of 'available nutrients'. The soil is the major store of nutrients in the ecosystem. There are two factors that affect nutrient availability in the soil. Plant roots utilise only a proportion of the soil profile. Nutrients in soil below the depth explored by plant roots cannot be considered available. Some nutrients within the soil profile accessible to plants are in forms that are not available for absorption by plant roots. The form in which nutrients are held in the soil changes over time (eg for phosphorus see Crane 1978).

The quantities of available nutrients have not been assessed for the three compartments. The soils are of moderate fertility compared with forest soils in NSW generally (W.M. McArthur CSIRO Soils and Landuse Series No. 46, CSIRO 1964). In the absence of detailed information, it is possible to draw conclusions as to the likely significance of losses of nutrients due to harvesting by reference to the published literature.

Harvesting removes a proportion of the site's store of nutrients. Subsequent burning and runoff remove additional amounts. Lambert (1981) assessed the inorganic constituents of wood and bark of NSW forest tree species. the bulk of wood harvested is low nutrient heartwood (reflecting the eucalypts' capacity for internal cycling of nutrients). The amounts removed in wood is low compared with amounts in the remaining parts of the ecosystem (e.g. Stewart, Flinn, Hopmans 1985; Attiwill 1980, 1981; Turner and Lambert 1986).

Additional losses occur during the post harvesting top disposal burn and in any subsequent hazard reduction burns that may take place. Losses can occur from: volatilisation directly from the soil; from harvesting debris, litter and understorey components burnt in the fire; and from subsequent removal of nutrient rich ash and soil. Nutrients most likely to be affected include nitrogen, sulphur and phosphorus.

The magnitude and hence significance of nutrient losses from burning associated with forest management has been assessed for a number of forest types and types of burns. At one end of the scale intense burns such as occur during slash burning can result in substantial losses of some nutrients (eg Harwood and Jackson 1975). Whilst lower intensity hazard reduction burns have less pronounced effects (O'Connell, Grove and Lamb 1981). Data from studies conducted to date are contradictory in their findings concerning the significance of losses eg O'connell at al (1981); Raison (1980); Turner and Lambert (1986).

The combination of comparatively low intensity post harvesting burns and infrequent or no hazard reduction burning on the study area blocks indicates that the magnitude of losses attributable to these causes is likely to be small.

The long time periods between harvests associated with forestry in general, and native hardwood forests in particular, means that additional nutrients enter the ecosystem to replace the volumes lost from the system. Inputs occur via the geochemical cycle discussed earlier. Processes contributing to inputs of nutrients include weathering of bedrock and accessions from rainfall (e.g. see Hopmans, Flinn and Farrell 1987). In addition, atmospheric nitrogen is fixed to provide additional quantities of this nutrient (Attiwill, Baker and Adams 1980).

Based on an assessment of available information Richards et al. (1990) conclude that harvesting has its most pronounced effect on the biogeochemical cycle and that losses from this cycle incurred by harvesting under a conservative harvesting regime are small relative to the geochemical inputs.

In conclusion:

- The soils within the study area are of moderate fertility.
- A small proportion of the sites nutrient store will be removed or lost as a result of the proposed conservative harvesting operation.
- The regenerating forest will be substantially unaffected by these losses.
- Nutrients lost during harvesting will be replaced in the long interval that is planned before any subsequent harvest takes place.

5.1.3 Hydrology and water quality

Harvesting has the potential to affect both water yield and quality in streams draining the study area. Water yield is likely to increase coupled with the potential for a reduction in water quality caused by increased turbidity levels. The level of dissolved ions in the stream may also change. The magnitude of changes, if any, to both water yield and quality and the persistence of these changes are dependent on a range of

factors. This inlcudes: catchment characteristics; rainfall patterns; and the way in which the harvesting operation is undertaken.

Water yield

Removal of a proportion of the forest canopy during harvesting is likely to cause a rapid increase in water yield followed by a gradual return to levels existing pre harvesting. These changes result from a reduction in interception of precipitation and evapotranspiration which are linked to the level of canopy cover within the catchment.

The degree to which streamflow characteristics change is dependent on the intensity of harvesting and the proportion of the catchment affected by harvesting. Less intensive harvesting with a consequently high proportion of canopy retention can be expected to reduce both the magnitude of changes and the time taken to recover to pre harvesting levels. Studies to determine the effects of alternative silvicultural systems on catchment hydrology in the Ash forests in Victoria concluded that the effects of a partial cut (50% canopy removal) were muted compared with a clear cutting regime (O'Shaugnessy and Jayasuriya 1987).

Flood peaks

Harvesting can lead to increases in flood peaks. The magnitude of changes will vary in accordance with the two factors (extent and intensity of harvesting) described above and can also vary with changes in the moisture status of the soils within a catchment (Leitch and Flinn 1986). When a catchment's soils have high moisture levels during the wetter periods of the year, flood peaks from harvested areas will not be substantially different from unharvested catchments. Differences can be expected during dryer periods with harvested catchments yielding higher flood peaks. During these periods, water tables will be higher in the harvested catchment leading to faster groundwater recharge and transmission to the stream. This effect has an important influence in determining the volume of stormflow generated. The dryer soil has a higher recharge capacity enabling it to retain more water before contributing to streamflow during the storm event. Again, the proportion of canopy removed would be expected to affect the soil moisture status and therefore the degree to which flood peaks were increased during dryer periods of the year.

Studies of a small forested catchment in Victoria (Bren and Turner 1980) indicate that most streamflow response to rainfall was provided by the groundwater system. This response was continuous and slow. Areas of compacted soil generated more overland flow creating higher levels of peak discharges making the stream more 'flashy'. This effect was reduced with an increase in distance between the site of the activity and the stream. The study identified the importance of the riparian zone as a buffer. The authors of this study conclude that maintenance of a riparian filter strip of a minimum width of 20 m combined with simple structures to control overland flow and promote higher infiltration were effective ways of minimising the impact on catchment discharge.

Where these measures are applied to selectively harvested areas with 50% canopy retention, catchment discharge would show almost imperceptible change.

Water quality

Harvesting can affect water quality in a number of ways. The most obvious impacts are on physical water quality. This is measured through an assessment of suspended solids or turbidity.

Road construction has been identified as the principal source of suspended solids. Data from MMBW studies in Victoria indicated that turbidity in the stream increased following road construction and no separate effect on turbidity levels could be distinguished following subsequent selective harvesting (MMBW 1980). Detailed sampling showed that the increased levels of turbidity could be traced to stream crossings.

Similar increases in turbidity caused by machinery crossing the creek bed during harvesting of an area in the north coast of NSW was reported by Cornish (1980). This conclusion is supported by studies in the FCNSW Karuah catchment trials. These studies indicate that observed increases in turbidity levels were caused more by disturbance of major drainage lines that led directly into the mainstream rather than the proportion of the catchment disturbed. One catchment showed a decrease in turbidity levels following harvesting compared with its control area. In this catchment, there was a complete absence of disturbance of major drainage lines by either fire or machinery during harvesting and the catchment revegetated quickly. In contrast, another catchment showed significantly increased levels. In this treatment, snig tracks crossed numerous major and minor drainage lines that had been burnt severely (Cornish pers. comm.).

Over all, the Karuah trials show that turbidity values from a weekly sampling program resulted in small increases in turbidity for some catchments. The level of increases were not important to overall water quality. Similarly, turbidity values obtained from a large number of storms post harvesting in most cases were not significantly different from unharvested control catchments.

Increases in erosion and therefore potential increased levels of sedimentation and turbidity caused by the proposed harvesting will be of no significance to downstream water users. Any minor effects which may be apparent at the compartment boundaries would have been reduced to negligible proportions by the time the stream exits the State Forest boundary.

It is difficult to predict the consequences of harvesting on bedload and deposited sediment within the stream system because of measurement difficulties and the resulting dearth of investigations into this matter. Certainly, the amount and residence time of sediment deposited on the surface and subsurface of stream beds is more significant than suspended sediments in modifying the habitats of stream biota such as invertebrates and fish and modifying stream channel morphology.

It is equally difficult to predict how long deposited sediment remains on stream bed and banks and in the substratum. From the scientific literature, residence times prior to scouring by turbulent high flows range from a few months to decades. Finer sediment which penetrates into stream beds is likely to be extremely persistent.

Studies (Newbold et al. (1980); Graynoth (1979); Bren and Turner (1980) have identified the value of riparian buffer strips as a means of reducing, if not eliminating impacts on the stream environment.

Effects on nutrients and dissolved ions

Nutrients can enter the streamwater either as dissolved ions or adsorbed onto particles. Nutrient levels in Australian streams are typically low, reflecting the generally low (by overseas standards) nutrient status of the soils and the capacity for the Australian forest ecosystems to efficiently recycle nutrients held in organic forms. Harvesting disturbs these processes and, coupled with generation of overland flow, can increase the quantities of nutrients entering the streams.

Burning after harvesting can mobilise nutrients which can then be transported from the site through the mechanisms described previously. Additional quantities of organic matter entering the stream after harvesting can also contribute to heightened nutrient levels in the stream. Heightened nutrient levels can increase the amount of aquatic plant growth leading to changes in aquatic flora and fauna, both at the site and further downstream, particularly in water storages. The magnitude and hence significance of changes to these water quality parameters depends on the scale of disturbance.

Major impacts on all water quality parameters have been recorded following accelerated soil erosion associated with wildfires that have burnt forests over large catchments, e.g. Attiwell (1984). Whereas harvesting with normal soil conservation measures has been reported as causing only minor, if any, changes to streamwater chemistry, e.g. Hopmans, Flinn and Farrell (1987); MMBW (1980); and Cornish (pers. comm.).

A combination of selective harvesting, coupled with appropriate soil conservation techniques, including retention of riparian buffer zones, will significantly reduce the likelihood of any impacts on stream chemistry.

Other aspects of water quality of significance to aquatic organisms include water temperature, biochemical oxygen demand and pH. The network of retained vegetation will ensure that no changes to water temperature occur, by maintaining the pre-existing levels of shading over the stream. Water in the upper catchments of such streams is typically highly oxygenated. This would not change, as no signfiicant changes to concentrations of nutrients in the streamwater or to amounts of debris in the water are envisaged. Both these factors could cause depletion of oxygen through increased biological activity.

In summary

The proposal involves harvesting a maximum of 8% of the previously unharvested Needle Creek catchment and 5% of the Pine Creek catchment. This will increase the percentage of the Pine Creek catchment that has been harvested from approximately 38% to 43% (ref. Table 11 Section 4.1.5). These figures overstate the actual area affected because areas described as 'harvested' also include areas of unharvested forest such as filter and protection strips, rainforest and wildlife corridors.

Given the small areas involved and the comparatively low intensity of harvesting, changes to water yields resulting from the proposed harvesting operation will be within the limits of normal variability in streamflow in this region.

Short term, small increases in turbidity are likely, however, the magnitude of these increases can be controlled through careful siting, construction and maintenance of roads, particularly in the vicinity of stream crossing points.

Impacts on hydrology and water quality can be minimised through a combination of preventative and ameliorative measures. The research data presented indicate the important principles that, if applied, will minimise impacts on hydrology and water quality. These are:

- **Maximise the distance between sources of overland flow and streams**
- **Minimise the number of stream crossings**
- **Maintain effective riparian filter vegetation**
- **Intercept and divert overland flows to maximise infiltration**
- **Promote rapid revegetation of disturbed areas**
- **Keep machinery and fire out of riparian zones**

The harvesting plans and prescriptions applying to the three compartments that reflect these principles have been set out in Section 3.2.3, Table 10. The ridge top road network is of particular value in avoiding impacts on water quality. This has meant that roads will cross streams at only two crossing points. Particular care will be taken at these sites to divert sediment laden overland flow generated by the road into retained vegetation before it enters the stream.

Application of the measures set out in Table 10 will minimise impacts on catchment hydrology and water quality. Closure, draining and revegetation of unused roads will mean that impacts on water quality will be minor and short term.

5.1.4 Visual

Harvesting operations create a dramatic visual impact during the harvest and shortly following particularly when a top disposal burn is carried out. This is illustrated by reference to the following photographs.

Photograph 1 shows the visual impact in a neighbouring compartment (cpt 179) four months after harvesting without a top disposal burn. Photograph 2 shows the visual impact in a neighbouring compartment (cpt 183) nine months after harvesting and after a top disposal burn. Both photographs show the scene as seen from within the compartments. The scene reflects considerable vegetation removal and site disturbance. Site disturbance recovers in time provided soil erosion mitigation procedures are implemented and the vegetation also grows back as regrowth or regeneration or planted seedlings.

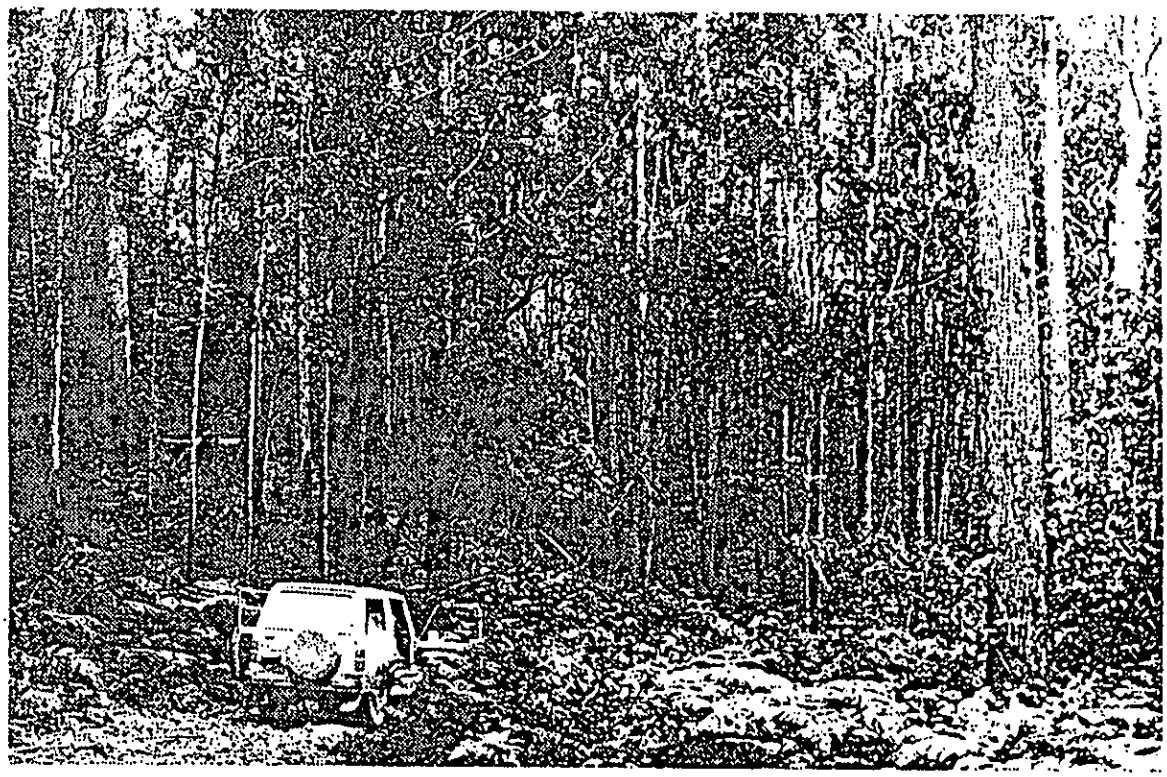
The severity of the impact declines over a two year period and diminishes to almost unnoticable over 15 to 20 years.

Photograph 3 shows the extent of recovery four and a half years following harvesting (Cpt 184). Photograph 4 shows the visual impact in a nearby compartment (cpt 18) nineteen years following harvest.

1. Compartment 179 – 4 months after harvesting – no top disposal burn

2. Compartment 183 – 9 months after harvesting and a top disposal burn

3. Compartment 184 – 4½ years following harvesting and top disposal burn



4. Compartment 18 – 19 years following harvesting

The harvest area is not seen from outside the compartments except along Broadmeadows Road. - lookout in NP, Chaelundi Road

Special provisions within the harvesting plan provide for a modified harvest within 40 m of the road edge eastwards into compartments 180 and 200 and for no disturbance on the western side of the road upto the border with Guy Fawkes River National Park. These provisions together with other unharvested areas within the compartments; i.e. 123 ha of special emphasis areas presents a mosaic of disturbed and undisturbed forest when seen whilst travelling along this road. This has less impact than a continuity of disturbed forest.

5.1.5 Noise

The harvesting operations will create noise from machinery, tractors, trucks and chainsaws. The location is remote, so only the operators will be aware of the noise. The ridge line between the operating area and the Guy Fawkes River National Park, combined with the normal attenuation of noise over distance, prevents the noise carrying to park users. unless they are in the vicinity

Noise arising from log haulage will have no nett increases over that which exists at present. All equipment operation, tractors, trucks and chainsaws are required to conform to the Noise Control Act 1975 which requires that a moving log truck under full throttle is restricted to a maximum noise level reading of 89 dBA at 7.5 m distant from the centre line of travel.

What about impact outside part 5F

5.1.6 Air quality

Dust will be raised by equipment working within the compartments and trucks hauling over unsealed roads, however, as the compartments are remote and the sections of roads through settled areas are sealed, the dust will be dissipated and have insignificant impact. Similarly, the remote location of the works renders engine emission gases insignificant. - what about on flora

Smoke from top disposal burning, if employed, will also be localised to the remote compartments. It is temporary and will be insignificant in impact.

contribute to air pollution, visual in vicinity

5.2 IMPACTS OF FIRE

Fire is used as a tool in natural resource management; it is also a threat as wildfire. In the context of fire as a tool, two types of forest management burning are used: broad area burning; and top disposal burning.

5.2.1 Broad area burning

Broad area burning is directed towards reducing the fire fuel accumulation in the forest. It may be carried out from the ground or air, generally in unharvested areas or where regeneration has developed to a height and bark thickness where low intensity burning

is unlikely to cause damage to the stand. Generally, less than 50% of the area is burnt, resulting in a mosaic of burnt and unburnt areas thereby providing refuges for fauna. This type of burning is carried out under conditions where gully lines, filter and protection strips remain moist and are unlikely to carry a running fire.

As mentioned previously (Section 4.2), the moist hardwood forest type is seldom burnt under this regime and then only mildly so the impact of this type of burning on the study area will either be minor or, if the area is not burnt, no impacts would occur.

No assessment, unqualifiable assumptions

If the proposal proceeds then the area would not be considered for the period necessary for the regrowth to meet the criteria set out above.

5.2.2 Top disposal burn

The disposal of harvesting debris, i.e. tree tops, branches and unusable log sections, by burning may or may not be carried out following harvesting. The decision to burn or not is made by the forest manager (District Forester) who is aware of the needs and the associated problems.

The need is to reduce fuel fire hazard to protect the residual stand from wildfire and provide a seed bed for natural regeneration if judged to be necessary.

The problems which arise are:

- Protection of advanced regeneration – young regeneration if burnt is often killed. Advanced regeneration needs to be 10-15 years old to survive.
- Danger to habitat trees. Habitat trees have hollows and may easily ignite so they may be lost and any existing animals killed.
- Danger to seed trees. If seed trees are killed the future seed source is threatened.
- Protection of rainforest patches. Harvesting up to rainforest margins leaves the fringes of these areas susceptible to fire during the top disposal burn. If fire did enter the rainforest it could penetrate up to a distance in the order of tens of metres into the rainforest (D.Binns pers. comm.). The risk of fire escaping into these areas is increased if the rainforest margin is damaged or dries out from increased exposure following harvesting.

  The risk of fire entering rainforest could be reduced by retaining a buffer around the rainforest both to protect the fringe from exposure and to reduce the likelihood of fire entering the rainforest area. Past experience has shown that the risk of damage to rainforest due to escapes from top disposal fires is negligible (FCNSW pers. comm.). This level of risk must be balanced against the considerable loss of timber resources within the areas that would be required for buffers because of the high edge to area ratio of the rainforest patches.
- Introduction of heavy fire weed infestations. Weed competition can be increased significantly if fire is used post harvesting. Fire weeds can be strong competition for regenerating hardwoods both in terms of regeneration success and subsequent growth rates. The faster growing Eucalypts can usually keep pace with the weeds. However, Tallowwood is disadvantaged by its slower growth rate, but because it is

more tolerant of competition is able to persist albeit with a lower growth rate (FCNSW 1982).

The impacts of top disposal burning are both positive and negative. The negative impacts can only be eliminated by not burning. Careful judgement to maintain low intensity fires will reduce these negative impacts, however to burn or not to burn remains a value judgement by the forest manager.

5.2.3 Wildfire

Severe wildfire burning through the moist hardwood forest type would defoliate the upper canopy stratum and destroy the shrub and ground flora. This would cause an immediate change to the micro climate of the remnant stand, in particular a change in light intensity at the forest floor.

Impact on rainforest patches

The pioneer species in the ecotone extending out from the rainforest patches into the moist hardwoods will be killed. Severe fire may cause considerable damage to the rainforest patches. However the integrity of the rainforest will be retained provided such fires are infrequent enough so as to allow the rainforest succession to proceed through to at least an early stage in the climax species. More frequent fires could lead to development of a dense groundcover of short lived species exists.

Impact on the moist hardwoods

The impact on the moist hardwoods is similar to the rainforest but less severe. The eucalypt tree species have the capacity to recover crowns through epicormic growth shortly following fire, however such fires will always create some degrade on timber values.

Forest management aims to reduce wildfire risk by following a regime of fuel reduction by controlled burning wherever possible which presents a mosaic of fuel reduced areas. This is usually sufficient to prevent a wildfire 'crowning' (i.e. burning in the crowns of the trees some distance ahead of the groundfire) and therefore avoids the severe damage created by wildfire.

5.3 IMPACTS ON FLORA

Harvesting operations as practiced in these forests result in the removal of a variable proportion of the mature overstorey trees, and damage to a variable proportion of the understorey. The degree of change experienced at any point within the harvested area varies in accordance with the proportion of overstorey trees that are harvested.

Application of the tree marking prescriptions discussed earlier (Section 3.1.3) coupled with retention of so called 'unmerchantable' trees means that typically something in the range between one and two thirds of the overstorey is removed with the remainder left to continue growing. In addition, not all the compartment area is harvested. Areas are retained unharvested to achieve a range of management objectives. These factors combine to create a mosaic of disturbed, partially disturbed and undisturbed areas

within the compartment following harvesting. Disturbance associated with the top disposal burn is superimposed over this mosaic.

In time,the holes created in the overstorey will be filled by regeneration which when grown, will lead to the creation of a multi-aged forest. This forest will be made up of the residual old trees, younger more vigorous retained sawlog trees and young regrowth. This will increase the level of diversity in terms of the proportion of the canopy represented by each 'age-class' of trees.

This section of the document assesses the range of possible impacts that are caused by this transformation

5.3.1 Impacts on rare and endangered or endemic species

Pink Cherry and Winged Hopbush are noted in Section 4.3.2 as rare or threatened plants which occur within these compartments.

Pink Cherry (*Austrobuxus swainii*) grows into a large tree 37 m high and 100 cm diameter, in rainforest types from Bellinger River, NSW to Tallebudgera Creek in eastern Queensland. Gilmour (Appendix 6) records several trees growing in and on the margin of the rainforest type 2/3 patch in the northwest corner of Compartment 200. It is rare but not endangered. Floyd (~~Ref. $$$~~ F 1989) lists a range of occurrences including nine other State Forests, Dorrigo and Border Ranges National Parks, and Bruxner Park, Black Bull, Big Scrub and Boomerang Falls Flora Reserves.

Winged Hopbush (*Dodonaea megazyga*) is a shrub found in the rainforest, grows to a height of 4 m with a spread of 2 m. It is rare but not endangered, commonly cultivated in ornamental horticulture. It is conserved in Chaelundi State Forest within Middle Creek Flora Reserve. Gilmour (Appendix 6) records it growing on the boundary between Compartments 180 and 200 and regenerating along Broadmeadows Road. It regenerates freely from seed and is unlikely to be at risk due to this proposed activity.

Black Booyong (*Argyrodendron actinophyllum*) is listed by Gilmour (Appendix 6) as significant due to the elevation of occurrence at over 1000 m. Floyd (~~ref. $$$~~ F 1989) states that it "prefers altitudes above 600 m on the north coast" and although it is common in occurrence, it is not common at or above this 1000 m elevation.

Potential adverse impact on these species will be minimised due to their location within rainforest patches that will remain unharvested.

There are no known species endemic to this area.

5.3.2 Impacts on flora within harvested areas

The extent of each forest type, the area to be harvested and the area which will remain undisturbed is given in Table 29.

Table 29. Extent of areas by forest type to be harvested and excluded from harvesting

Areas subject to harvesting
If type areas adjusted to gross area of compartments (561 ha) the area by type and cpt is as follows

Compartment	Forest type R/F	47a	53a	163a	163b	168	142/163	Total
Compartment 180	32	27	8	130	23	11	-	231
Compartment 198	6	5	-	28	75	22	9	145
Compartment 200	21	41	-	47	61	3	12	185
	59	73	8	205	159	36	21	561
Excluded from harvesting								
Wildlife corridors (inner 20m)	18	5	0.5	5	4	3	-	35.5
Other flora and fauna	26	-	-	-	-	-	-	26
Other rainforest excluded by prescription	15	-	-	-	-	-	-	15
Steep topography	-	-	-	6	-	-	-	6
Visual	-	-	-	8	6	-	1	15
Modified harvesting								
Wildlife corridors (outer 20m)	-	2	0.5	5	4	3	-	14.5
Filter strips	-	5	-	2	1	2	-	10
	59	12	1	27	15	8	1	123
Balance	-	61	7	178	144	28	20	438

There is no harvesting proposed in the rainforest type. In other types, harvesting will remove 40-50% of the existing canopy. The species removed will be approximately 46% New England hardwoods; 40% Tallowwood; 12% Blue Gum and 2% Brush Box. These percentages have been derived by examining the species mix actually removed from neighbouring Compartments 176, 177, 178 and 179 immediately to the south. The harvest will remove 35-40 stems per hectare 20, or more, of which will be top stratum canopy trees.

Stems remaining after harvest vary considerably. An indicative stocking is given from an assessment of 0.1 ha plots associated with two wildlife surveys along Fellabindi and Broadmeadows Roads shown in Table 30.

Table 30. Residual stocking following harvest by forest types

Forest type	dbhob range	Stocking stems/0.1 ha plot	Stocking stems/ha
1. Fellabindi Road			
47	12-85 cm	30	300
168	12-85 cm	18	180
163	12-85 cm	26	260
2. Broadmeadows			
47	12-135 cm	28	280
163	12-135 cm	29	290

A range of diameter classes is retained. Table 31 shows diameter frequency distribution for a variety of forest types. Frequency distribution is skewed towards smaller diameter classes, as would be expected in a timber production forest, however large diameter classes are still well represented.

Table 31. Stand condition of harvested forest sampled

Forest characteristics	Forest type 74	47	163	168
Stems/ha*	445	325	235	260
Basal area (m^2/ha)*	35.9	34.3	49.0a	24.9
# Species	8	9	5	7
Mean DBH	28.9	31.0	44.6	30.3
DBH Range	13.0 - 70.0	10.0 - 111.3	12.0 - 135.2	11.4 - 85.0
Mean HGT	20.4m	20.4m	25.4	18.2
Hollow trees/ha*	30	45	40	40
Hollow trees with animals	nil	10	30	nil

* probably maximum values for the type, i.e. not average
Source: Earthwatch survey refer appendix 7

what about unharvested figures

Change in canopy with harvesting is shown in Table 32. The percentage of canopy removed varies with forest type.

Table 32. Percentage of canopy by height class in harvested and unharvested forest — How much canopy left?

Height class	Type 74 H	U/H	Type 47 H	U/H	Type 163 H	U/H	Type 168 H	U/H
10-20m	33	65	40	45	41	53	50 →	49
20-40m	67	32	60	37	56	42	50 →	46
40+m	0	3	0	18	3	4	0	5
					100%	99	100	100

In all types the percent cover of tallest trees is reduced, excepting type 163 which retained 75% of the tallest trees. Much of the retained stand is in the 20-40 m height class, as confirmed by mean height values in Table 31. Canopy cover of small trees (10-20m) generally remains about the same, excepting type 74 which had a large number of small stems removed.

Table ... canopy ... rather ... were 40+m

Species frequency in the harvested forest remains diverse. Type species and non-merchantable species remain dominant.

Graphs of diameter and species distribution in the residual stand are included in Appendix 7.

An examination of recent (1990) vertical aerial photography of the adjacent harvested area in Compartments 178, 179 and 181 reveals the following percentages of crown removed in various forest types.

↑ 179

Table 33. Percent crown removal Cpts 178, ~~180~~ 179, 181 by forest type

	Forest type	% Crown removed	
		mean	*range*
163a	New England Blackbutt > 45 m	65	55-80
163b	New England Blackbutt 35-45 m	22	10-40
168	Silvertop Stringybark Diehard Stringybark and Tallowwood	35	30-40
53	Brush Box	-	30-80

all large ?

Crown removal averaged 36-41% within harvested areas. Taken over the total compartment area (including unharvested reserved areas) canopy removal averaged 27-30%.

Many of the subdominant suppressed trees left standing following harvest will not grow on to provide top canopy, they become incorporated into the new canopy but usually remain suppressed.

Reconstruction of the canopy will come from:

- Advanced regrowth, i.e. young actively growing understorey trees; and
- Regeneration from seed germination stimulated by harvest disturbance and canopy opening.

Total reconstruction visually to canopy closure takes 15-20 years, and to preharvest height and 80-100 cm dbhob, much longer, estimated 80-120 years. However the time taken to canopy closure is variable after harvesting as in nature.

Impacts on canopy structure can be ameliorated by minimising damage to advanced regrowth stems during both the harvest and post harvest burn should that take place. In addition, by ensuring adequate regeneration is obtained throughout the disturbed area new trees will be recruited into the stand.

Understorey species will be damaged in the area harvested, but will remain undamaged in undisturbed areas. Reconstruction on the disturbed area will come from root stocks, soil stored seed and seed from seed trees and fallen crowns. Species favouring greater light intensity will be estabished first followed by shade tolerant species as the canopy closes.

The impact of harvesting on these forest types has been reviewed by D. Binns a botanist with the FCNSW. The following are conclusions he has drawn from his studies of the impact of harvesting on old growth forest vegetation.

"1. Intensive logging results in obvious structural changes, especially to the overstorey.

2. A large proportion of the woody species (90%) which occur in unlogged areas also occur in logged areas. Herbaceous species are more numerous in 10 yr post logging areas, and few occur in unlogged and 30 yr post logging areas. Vascular epiphyte species are more numerous in unlogged areas, very few species occurring in logged areas.

3. The main effect on floristics of woody vegetation (including vines) is the addition in logged sites of a number of 'invasive' species, with apparently minor or no loss of original species. However, changes in size class distribution and major changes in relative abundance may occur, particularly on a small scale, and heavily disturbed areas may be locally dominated by a single or few species. 10 yr post logging the invasives represent up to 30% of the strata in which they are most abundant. Their abundance has decreased by 30 yr post logging, although still higher than levels in unlogged stands. Some invasions such as *Helichrysum diosmifolium* appear to be short lived and are totally absent from 30 yr plots. Others such as *Acacia melanoxylon* are longer lived and persist in 30 yr and even in unlogged stands, the latter presumably from past natural or quasi-natural disturbance such as fire.
4. The density of species typical of unlogged sites is similar in all three categories, or higher in logged areas. The invasives represent additional stems taking advantage of the less than fully occupied site resulting from overstorey removal, rather than a replacement of species present pre-logging.
5. I hypothesise that a large number of species typical of unlogged areas regrow vegetatively from damaged stems or root stocks, even following severe damage. Certainly a large proportion of non-invasive stems were secondary, but it was not possible to relate this to logging history because a similarly large proportion occurred in unlogged areas, probably due to periodic fire damage in unlogged stands. Current monitoring experiments using large numbers of individually tagged plants should help resolve this issue.
6. Comparisons between 10 yr and 30 yr post logging plots are complicated by the latter being subject to an apparently more intensive disturbance due to silvicultural treatment associated with logging, even though the intensity of logging was similar. The 30 yr plots thus do not represent a simple extension in time since logging, relative to the 10 yr plots. As a result it is difficult to infer longer term changes resulting from current logging prescriptions.
7. Although the intensity of logging was similar in both 10 yr and 30 yr plots (removing 70-100% of the overstorey), it is expected that the less intense silvicultural treatment of the former would result in a lower degree of change in vegetation over similar periods of time since logging. The implications of the different treatments for eucalypt regeneration and growth rates are apparently complicated by other factors not considered in this study. Despite these complications, there is a tendency for higher stocking and slightly higher basal area increment in the treated and burnt plots, but higher diameter increment in the logged only plots, the latter related partly to lower stocking." (D.Binns pers. comm.)

It should be noted that the intensity of harvesting in D. Binns' trial areas exceeds that likely to occur within the study area

The main impact is the disturbance to the old growth forest, particularly the Tallowwood-Blue Gum forest type 47.

Type 47 does occur north of this area in Chaelundi State Forest, within the area currently subject to a Regional EIS study. It also occurs on other State Forests in Coffs Harbour, Port Macquarie, Glen Innes and Newcastle forest regions.

The type is well represented in secure reservation including National Parks on the north coast and flora reserves within the Dorrigo Management Area as shown in Table (34). There is a current proposal to create additional flora reserves in Chaelundi State Forest viz. Compartments 169 and 185. The proposed 95 ha reserve in Compartment 185 contains forests types 2/3, 47, 53, 168, 163.

Table 34. Occurrence of forest types in forest reserves

FLORA RESERVE Name	No.	Page ref.[1]	FOREST TYPE 2/3	6/23	47	53	168	163
Moses Rock	17	37				●		●
Mobong	19	38			●	●		
Edwards Plain	21	39						
Black Bull	28	43						●
Teak Tree	29	43			●			
N.W. Jolly	37	47			●			
Blicks River	46	51					●	●
Red Cedar	47	51			●			
Middle Creek	65	65	●		●			●
Dorrigo White Gum	87	74			●			●
Nicholii	137	103						●
Proposed reserve								
Compartment 169			●	●		●	●	●
Compartment 185			●		●	●	●	●

Note [1] Page number in FCNSW Research Note No. 47

No NPWS data on the extent of reservation in national parks are available, however the Washpool EIS provides areas of forest types in the previous Washpool State Forest. This indicates that a substantial area of type 47 is reserved in what has now become Washpool National Park (source: FCNSW Washpool EIS). This type also exists in Boonabilla section of Barrington Tops National Park.

5.3.3 Impacts on flora within areas to be reserved

In Section 5.3.2 above Table (29) lists the area by forest types within these three compartments which will not be harvested.

This area is made up of the following reservations:

- Visual resource
- Flora/fauna conservation
- Other rainforest conservation
- Steep slopes
- Stream filter strips

These areas will remain undisturbed except for one temporary road crossing on an intermittent creek in Compartment 200.

Timber harvesting on the remainder of the area opens the overstorey canopy which can:

- Create exposed edges to the residual stands e.g. rf.
- Create large openings which may lead to higher and lower maximum and minimum ground temperatures.
- Provide opportunity for exotic weed establishment.

Roading mechanically destroys vegetation in the road alignment. The road penetration required in this proposal involves the clearing of about 500 m^2 of forest type 47. Any commercial timber will be salvaged from this clearing.

A top disposal burn, if employed, should not penetrate these areas as it would defeat the objectives of the reservations. Measures to reduce the risk of this occuring include care in the monitoring of burning conditions to ensure that the conditions are suitable for top disposal burns and not for running fires.

The reserved areas are not fully exposed due to the level of canopy retention in adjacent harvested areas. This would have the effect of mitigating possible impacts. The lack of disturbance in reserved areas makes it unlikely that weeds could become established.

5.4 IMPACTS ON FAUNA

Compartments 180, 198 and 200 are high quality moist hardwood forests which have high animal conservation values reflecting the abundance of arboreal marsupials supported on these compartments. There is an increasing body of knowledge being accumulated relating to the ecology and habitat requirements of these and other species potentially vulnerable to impacts from harvesting operations (eg. Braithwaite 1983; Recher, Sheilds, Kavanagh and Webb 1987; Lacey, Davey and Harries 1990). There is less understanding of the ecology and habitat requirements of other types of forest dwelling fauna (Davey and Norton 1990).

An overview of the possible impacts on fauna associated with application of the standard FCNSW harvesting prescriptions to the study area was provided by Braithwaite (Appendix 11) who after more than thirteen years of carrying out, and directing research into the effects of forestry operations on wildlife in forests, states:

> "In Compartments 190, 198 and 200 I think that harvesting according to the current management plans and prescriptions will cause a reduction, possibly a permanent reduction, in the number of at least several species of arboreal mammals and in particular of the Greater Glider, the most abundant species. The effect would apply in particular to the areas actually harvested, compared to those areas reserved as part of routine forest management. Populations of gliders in areas reserved from harvesting may however, also not remain unaffected if the general effect is to change predation pressures from the large owls that occur there. Possibly arboreal animal species favoured by the regrowth forest five or more years after the initial harvesting may be the Koala, Common Ringtail Possum and the Sugar Glider. My inference is that the survival of any animal species is unlikely to be affected by harvesting operations in Compartments 190, 198 and 200 in the Chaelundi State Forest. For the reasons outlined above I regard as open, questions of the effect(s) of harvesting on the numbers (density) of populations of individual animal species. The possibility exists that, as noted above in the circumstance of the New Holland Mouse, the disturbance effects of harvesting and other forest management practices on many species of native forest wildlife may not necessarily all be adverse. To the contrary, the effects may be beneficial depending on the species."

This latter point has been illustrated by Davey and Norton (1990) where they estimate the population densities for a range of arboreal marsupials along a vegetation successional progression. The authors provide data that show that changes in the forest structure and floristics that favour some species will disadvantage others. This allows managers the option to manipulate the forest stand to provide the conditions to that will favour one species (or suite of species) over others. Research to identify the response of

animal populations to deliberate manipulation of the forest is being undertaken by the FCNSW (Kavanagh pers. comm.).

5.4.1 Impacts on rare and endangered animals

Possible impacts on the rare and endangered species identified in section 4.4.9 as either existing on the study area or within adjacent areas are discussed below.

Tiger Cat

The Tiger Cat or Spotted-tailed Quoll is listed by Strahan in the Complete Book of Australian Mammals as "common to sparse" with a distribution up the entire east coast and tablelands of NSW.

It is likely to occur uncommonly over most of the forest area where suitable habitat requirements are found and has been frequently observed by forest staff camping in the area. Its wide distribution in State Forests in this area indicates that logging may not be a particular threat to this species, although there have not been any studies to indicate this. Any increase in feral cat and fox numbers could adversely affect this species.

Long-nosed Potoroo

The habitat for this animal is the dense mesophyll shrub sections found in wet sclerophyll and disturbed rainforest. It is possible that it is favoured by rapid growth of shrub and ground cover following disturbance, and as such may not be adversely affected by logging operations. The species lives in colonies that are characterised by occupation of specific home ranges. It appears that the animals need to be familiar with the home range so that use of food and shelter can be maximised. Also knowledge of runway systems can be an effective strategy against predation. This behavioral adaptation has enabled the species to survive in small areas of retained vegetation, however it also makes it susceptible to disturbance of the structural aspects of its surroundings (Schlager 1981). This species is vulnerable to increases in numbers of feral cats and foxes.

Fawn-footed Melomys

This species is regularly trapped and within the region is regarded as common. Trappings made during the Earthwatch survey indicate that the species has a common and widespread distribution (see Section 4.4.3.).

Fletcher's Frog

Fletcher's Frog is described by Barker and Grigg in A Field Guide to Australian Frogs as having a coastal distribution from Gosford north.

The habitat for this frog should remain protected by the wildlife corridors and drainage line filter strips. Additional breeding sites may be artificially created unintentially during logging operations when depressions left by machinery fill temporarily with water.

Beech Skink

A large population was reported by Hines (1990) (Appendix 10).

The Beech Skink occurs in highland rainforest and antarctic beech forests along the Great Dividing Range from south eastern Queensland to the Armidale district (Wilson and Knowles 1988). Within the proposed logging areas it is likely to have a limited distribution and is likely to also occur in the preferred management priority reservations, i.e. the undisturbed wildlife corridors and filter strips.

Carpet Python

Although this animal is listed in NPWS Schedule 12 it has a common distribution throughout the North Coast region.

It is not considered to be threatened by the proposal and is regularly observed in regrowth forests and forest clearings.

Glossy Black Cockatoo

The Glossy Black Cockatoo has a distribution up the east coast and across the northern tablelands of NSW. Its abundance is described by Slater in A Field Guide to Australian Birds, as "uncommon to rare". It has also been observed on Hyland State Forest by FCNSW. *Allocasuarina* spp. are favoured seed trees for this species (Clout 1989) and since *C. tolulosa* will not be selectively logged, feeding areas for Glossy Black Cockatoos should be retained.

Powerful Owl

An uncommon resident of eucalypt forests, particularly in areas with high populations of its preferred prey, Greater Gliders. Because of its reliance on populations of arboreal possums, and its habit of nesting in large tree hollows, it may be desirable to retain suitable habitat trees, particularly New England hardwoods, to reduce the impact of logging on this species.

Sooty Owl

The Sooty Owl is an uncommon tree hollow dependent bird inhabiting tall open forest and rainforest in eastern Australia. In eucalypt forest it has a preference for gullies. The Sooty Owl has a broader range of prey preferences than the Powerful, taking much of its prey from the ground in the form of rodents and bandicoots. It also feeds to a lesser extent on arboreal mammals (Blakers et al. 1984). Consideration needs to be given to the benefits to be gained from maintaining adequate stands of mature forest to provide breeding sites for this species. Retention of protected strips of tall open forest along streams and wildlife corridors should mitigate impact from nearby logging operations.

White's Thrush

Commonly occurs in rainforest patches and should not be at risk as there is no proposed disturbance to rainforest patches. White's Thrush is a common bird in the forests of eastern Australia.

Cicada Bird

The Cicada bird is described by Slater as "a common migrant in northern and eastern Australia". It is moderately common in tall open sclerophyll forest where it feeds on large insects collected from leaves and bark. It is not dependent on mature trees, and should not be affected by proposed logging activities.

Crested Shrike-tit

The Crested Shrike-tit is a relatively uncommon bird found in eucalypt forests throughout southern and eastern Australia. Whilst it is not dependent on mature forests, its foraging habit of tearing strips of peeling bark from trees (Blakers et al. 1984) means that it rarely uses very young trees. Retention of substantial numbers of old trees within harvested areas will provide adequate habitat for this species.

Rufous Fantail

The Rufous Fantail is described by Slater as "a common migrant or resident in forest of eastern and northern mainland". It is migratory and common to the rainforest and moist hardwood forest. Its preference for forest thickets means that it is frequently recorded in logged forests and gullies and therefore should not be disadvantaged by the proposed logging.

White-throated Needletail

An abundant to moderately common summer migrant which is strictly aerial and is not considered to be at risk (NPWS).

Hastings River Mouse

This species is in a separate category to those listed above in that it has not been trapped in the study area nor has it been trapped in habitat similar to that within the study area. It has been trapped in Hyland,Marengo and Chaelundi State Forests. Trappings of this species in Compartments 193 and 207 by CSIRO has deferred harvesting pending the Regional EIS. Braithwaite (ref. Appendix 11) states that "on that evidence (available) my view is that such disturbance possibly does not adversely affect the species. To the contrary, the vegetation conditions created by the disturbance may be to its favour".

This species was trapped at three locations in the Earthwatch survey but not on sites with any relevance to the study area. Evidence to date from observations of habitat on all sites on which this animal has been trapped indicate that site disturbance does not adversely affect this species.

5.4.2 Impacts on mammals

Arboreal marsupials

As discussed in Section 4.4.1, evidence from a number of research workers who have studied the the animal populations within the three compartments, indicates that these forests have very high value as arboreal marsupial habitat. The area supports comparatively dense arboreal mammal populations (ref Section 4.4.1 and Appendices 8 and 9). However, the species diversity of the arboreal marsupials is not high with

Greater Gliders making up over 90% of animals recorded . Only two other species were recorded from the study area viz. Yellow-bellied Gliders and Sugar Gliders.

The relative abundance of Greater Gliders in the three compartments was assessed by the Earthwatch study at 432 animals per square kilometre (km^2). This level is very high but not unique. Higher numbers have been recorded, for example densities higher than 700/km^2 were found in Washpool (G. Watts pers. comm.) and densities higher than 500/km^2 at Coolah Tops (R. Kavanagh pers. comm.)

An examination of the data collected in the Earthwatch Survey reveals the following figures on abundance of arboreal marsupial mammals. These data provide an approximation of the relative densities of Greater Gliders living in harvested areas and unharvested areas.

1.	Relative density in Cmpts 180, 198, 200	432/km^2
2.	Relative density in harvested areas nearby	180-318/km^2
3.	Mean Relative density in unharvested areas	295/km^2
4.	Mean Relative density – harvested areas	234/km^2

There is no recorded difference in species diversity between unharvested and harvested transects.

The variation in the range of abundance in unharvested forest within the vicinity of the compartments, i.e. from 432/km^2 to from 180-318/km^2 together with counts of up to 317/km^2 (Transect 8) on harvested areas, makes it difficult to identify absolute variations in numbers as a direct measure of the impact of harvesting on populations within harvested areas. However the mean relative densities of unharvested and harvested at 295/km^2 and 234/km^2 do indicate the following: Harvesting is likely to result in a reduction in total numbers of animals, at least in the short term after harvesting; and that after harvesting the high quality habitat areas can still sustain substantial populations.

The areas of high habitat value are centred on the New England Hardwood and, to a lesser degree, Moist Hardwood Forest types (ref. Table 18 Section 4.4.2). These same forest types also sustain the highest levels of canopy removal during harvesting (ref. Table 33 Section 5.3.2). These data indicate that for these forest types the level of canopy removal resulting from application of routine prescriptions is in the order of 55-80% for NEH and 10-40 for other lower quality types.

Within the stand, animals show a preference for certain species over others. These data are presented in Table 35. There is a clear indication that the Greater Gliders have a strong preference for New England Blackbutt over Tallowwood. These two species each accounted for approximately 40% of the stand. However 69% of animals sighted were in NEB versus 6% in TWD. The same study assessed feeding preference by tree species with similar results. The NEB rated highly at 13.7 feeding observations per 100 trees, whilst the TWD rated 1.3 under the same index (Osborne 1982).

Table 35. Number of Greater Gliders recorded feeding on each species of tree

Tree species	July	October	January	Total	%
New England Blackbutt *E. andrewsii*				96	69
Tallowwood *E. microcorys*				9	6
Sydney Blue Gum *E. saligna*				23	16
Brush Box *Tristania conferta*				5	4
Forest Oak *Casuarina tolulosa*				3	2
Rainforest sp.				4	3
	0 20	0 20	0 20 40		

Source: "Vertebrate Faunal Studies in the Washpool-Gibraltar Range Region" W.S. Osborne 1982

CSIRO have collected data from the study area showing similar trends with Tallowwood accounting for a proportionally lower level of useage by animals than would be indicated by the stand composition.(M. Clayton pers. comm).

Maintenance of these high populations at preharvesting levels would require suitable habitat in the form of trees with hollows for breeding and for shelter; and trees meeting the seasonal food requirements of these animals.

Data presented in Osborne (1982) indicates that New England Blackbutt is the preferred tree species used by Greater Gliders for both hollows and feeding. In addition, Watts' Summary of the Arboreal Mammal Survey of Chaelundi has also identified Silver Top Stringybark and Diehard Stringybark as being important species. These two species were also identified as important by the CSIRO study (M. Clayton pers. comm). Therefore when considering retention of wildlife habitat trees emphasis should be given to retaining a comparatively higher proportion of species other than TWD. A proportion of the trees harvested to yield salvage logs are potentially very suitable for wildlife habitat trees with many having hollows.

Research has been undertaken to determine the **minimum** numbers of retained mature trees with hollows needed to maintain hollow dependent species within harvested areas. This research has arrived at figures ranging from around three hollow-bearing trees per hectare in *E. pilularis* forest (Mackowski 1984) to five per Ha (S. Davey 1990). It is clear from the data provided in Table 31 that retention of trees with hollows exceeds this minimum by a factor of between 8 to 10 times. IT IS BASED ON best value.

In order for these trees to provide effective habitat, they should also meet the following criteria:

- be clumped in groups of five trees or more; and
- preferably be located in or adjacent to corridors with continuity of crown cover

Habitat trees should also be conserved in a range of age and size classes. This ensures that there are adequate numbers of trees with suitable habitat values (eg hollows) recruited to ensure numbers are maintained over time.

It is generally agreed amongst research workers in this field that retention of a high proportion of the canopy during harvesting can further reduce impacts on animal abundance. Research into the effects of harvesting on arboreal mammals in the Eden Region of NSW has yielded data that indicates there was no significant drop in animal populations for two years following harvest where 50% of the original forest canopy was retained (Kavanagh pers. comm.). These trials relate to two compartment studies, one at Dragon Swamp, the other at Nunnock Swamp. Both areas were high quality arboreal mammal sites with a density of at least one animal per hectare. Maintenance of these high population levels appeared to be linked to the high quality of the habitat.

Evidence (Davey pers. comm.) indicates that the weather during the first season following harvesting can be important in determining the magnitude of changes to populations of arboreal marsupials. If drought occurs following harvesting, populations can drop more than if harvesting is followed by good growing seasons. The reliable rainfall associated with this area makes this a low risk.

The unusually high arboreal mammal populations justifies sensitive forest management and specific attention in harvesting operations. This management should include provision for wildlife movement corridors, retention of substantial numbers of mature habitat trees with hollows and should include large stands of unharvested forest, particularly along streams in association with filter strips. Effort should be made to ensure that corridors and filter strips are linked with unharvested forest (see Recher et al. 1987).

The option to vary routine harvesting prescriptions to maintain populations at near preharvesting levels is discussed in Section 6.4.2.

Small mammals

Trapping program sites B and C in the Earthwatch Study have relevance to Compartments 180, 198 and 200 with respect to location and forest types. These trappings revealed the presence of three small mammals: Brown antechinus; Bush Rat; and Fawn-footed Melomys (see above). All species are susceptable to increased predation caused by loss of understorey vegetation. The proposal could therefore result in a reduction in numbers particularly if a top disposal burn is used. Regrowth of the understorey would see these populations restored as the habitat value is restored.

Medium size ground dwelling mammals

Animals such as Potoroos and Bandicoots are those most likely to be adversely affected by harvesting. The populations of these animals could be expected to decline immediately following harvesting. With a restoration of cover their numbers could be expected to increase (Richards et al 1990)

Other mammals

No other mammal was recorded in or near the compartments. The Earthwatch Study records other animals in other harvested areas such as Eastern Grey Kangaroo, Red-necked Wallaby and Swamp Wallaby which may also be found in this area following

harvesting. These species are attracted to the harvested blocks by the regenerating plants that establish (FCNSW 1966).

Bats

Bats' requirements for hollows within the mature forest will be maintained. Therefore, species dependent on resources found in mature forest will not be disadvantaged by the proposal. No data are available on the changes in population numbers that could be expected although intuitively the levels of canopy retention would indicate that populations would be reduced not eliminated.

5.4.3 Impacts on birds

As discussed previously birds which will be disadvantaged most by the harvesting operations are the hollow dependent birds such as owls, particularly those which prey on hollow dependent fauna. Other species to be disadvantaged include species with the following feeding requirements or behavior: those dependent on the canopy; those that forage under mature bark; and birds that forage in the moist litter layer (Richards et al 1990).

As discussed measures taken to minimise the impact on hollow dependent arboreal fauna will also minimise impact on hollow dependent birds. All species dependent on mature forests will benefit from the level of canopy retention which should maintain populations albeit at reduced levels until the canopy is restored.

5.4.4 Impacts on reptiles and amphibians

There is no site data available on these animals. Most have small territories and would only be affected if the specific territory were destroyed.

Some species may be temporarily advantaged over others due to changes in micro habitat associated with the additional insolation caused by opening the canopy. These effects will occur in a mosaic pattern with substantial areas of moist habitat retained in the unharvested areas. Increased protection from regrowth can be expected to recreate the moist habitat requirements. Therefore, changes in populations, if they occur, would be short term and not significant.

5.4.5 Impacts on invertebrates

Forest invertebrate populations will be affected by the proposed harvesting operations. In view of the proposed level of canopy retention the species occupying soil and litter are the most likely to be affected.

Apart from the direct disturbance due to harvesting and fire, removal of a proportion of the canopy will impact on the micro environment of the forest floor changing light, temperature and soil moisture.

Madden et al. (1976) have proposed a three-stage model for the changes in litter and soil invertebrate populations as the forest regenerates. The first stage, 0-13 years, is a

period when litter fall greatly exceeds decomposition. There is a general rapid increase in invertebrate populations during this period in response to the rapid accumulation of a comparatively dry litter. During the second stage, 13-20 years, crown closure results in a significant alteration in the litter microclimate. Illumination and evaporation decline and temperatures become lower but more stable. Litter accumulation declines as a result of an increase in the rate of decomposition, presumably through enhanced microbial activity resulting from the more favourable microclimate. There is a general decline in invertebrate populations during this period. During the third stage, from 20 years on, the rates of litter fall and decomposition stabilise, resulting in a more or less constant standing crop of litter.

The harvesting regime proposed for the study area is likely to result in less change coupled with a quicker progression through the three stages as the canopy closure can be expected to occur more quickly than hypothesised by Madden et al.

The gum tree scale, *Eriococcus coriaceus* has been identified as affecting the growth of both Tallowwood and Blue Gum regeneration. Other species including Psyllids (lerp insects) are common, particularly in Blue Gums. These can become a significant pest of regrowth and mature forest in specific locations where predators are preferentially removed by Bellbirds. Leaf miners have also been implicated as the cause of reduced growth rates and sometimes death of trees (FCNSW 1982).

5.4.6 Effects on aquatic ecosystems

Increased turbidity and deposition of sediment in the stream bed are the two factors most likely to impact on aquatic ecosystems. There is likely to be a short term increase in turbidity associated with harvesting, particularly in the vicinity of the two crossing points discussed in Section 5.1.3.

Species most susceptible include the filter feeders. Other effects include increased invertebrate drift. These impacts are limited to sections downstream from sediment discharge points (e.g. stream crossings). More wider ranging and possibly longer term impacts could occur if sediment is deposited in the stream bed. This will reduce the available habitat for species occupying this important part of the stream. The significance of impacts on the stream biota will be linked to the success in applying erosion mitigation measures. If these measures are applied rigourously, in particular maintenance of buffer strips and measures to prevent discharge of turbid water to the stream, the impacts will be comparatively minor (Graynoth 1979; Newbold 1977; Newbold et al. 1980).

5.5 CULTURAL IMPACTS

5.5.1 Aboriginal

The predominance of moist hardwood forest with a complete litter layer within the area proposed for harvesting would make any meaningful survey very expensive, particularly in absence of a regional predictive model. Advice from regional NPWS staff indicates that there are no sites of significance to contemporary Aboriginal people within the three compartments and that it is highly unlikely that any archaeological sites

would be located within the areas proposed for harvesting. If sites did exist in these areas they would be most likely to occur on the main ridge as this would conform with expected movement patterns. Part of this area has already been disturbed as part of road construction activities. The remaining ridge top area along Broadmeadows Road will be undisturbed under the PMP classification.

There remains a possibility that sites do exist within the areas proposed for harvesting. If they do exist some could be damaged in the course of harvesting operations. Harvesting operations do not affect the entire area of the compartments, particularly in a comparatively low intensity selective harvesting operation such as is being proposed (ref. Table 27). Most of the compartment will either not be disturbed or will be lightly disturbed. Therefore, the risk of damaging a site within the areas nominated for harvesting is low. Based on this analysis, it is unlikely that any significant impacts to Aboriginal sites are likely to occur.

5.6 LANDUSE

5.6.1 Adjacent landuse

The western boundary of Compartments 180 and 200 is also part of the eastern boundary of Guy Fawkes River National Park.

This boundary follows the ridgeline between Guy Fawkes River and Pine Creek catchments for about 3 km.

Broadmeadows Road has been located along the eastern fall of the ridge so all road clearing, construction and catchment discharge is dissipated into the State Forest area and not into the park. The area between the road and the ridgeline is classed *1.1.6 – Visual Resource Protection*, in the harvesting plan.

Broadmeadows Road provides improved access which facilitates recreation use and fire control.

There is no other adjacent landuse, all other adjacent land forms part of Chaelundi State Forest.

5.6.2 Wilderness

Undertaking the proposal could affect the wilderness values of the area nominated by the Wilderness Society. Impacts, if they occur, can be assessed by examining impacts on the values of the main or 'core' wilderness and impacts on the values of areas directly affected. As discussed in Section 4.6.1, the three compartments have limited wilderness values in themselves. Harvesting would destroy those values until such a time as the forest regenerated to its previous structure, and physical evidence of disturbance such as road cuttings were broken down and weathered to a more natural appearance. Other evidence of human activity such as stumps and harvesting debris will also take a long time to rot and break down. It is not unreasonable to expect these processes to take more than 100 years. Loss of these values would not be a significant impact.

Harvesting of the three compartments would have minor impacts on the wilderness values of the main portion of the nominated area. At 561 ha, the three compartments comprise under 0.5% of the nominated area and therefore will not impact on the viability of the wilderness area in terms of its size. The lack of impacts on the size of the wilderness area is facilitated by the fact that the three compartments are located on the eastern boundary of the nominated area and are surrounded by disturbance to the west, east and south. If harvesting were to occur, evidence of human activity would not extend further to the west into the main body of the wilderness because the existing intrusion of Broadmeadows Road constitutes the western most extension of the proposed harvesting activity. Therefore harvesting of these three compartments would not affect the access remoteness or direct remoteness of the main body of the wilderness.

The apparent remoteness values will diminish during the harvesting activities in areas close to Broadmeadows Road due to noise and dust generated by the harvesting operation. Apparent remoteness will not be greatly affected because of the prescription to maintain intact a significant proportion of the forest canopy; and lack of any prominent viewing points within the nominated area which overlook the three compartments.

Based on the above analysis, it is reasonable to conclude that harvesting of the three compartments will not jeopardise the Director's consideration of the wilderness nomination. If harvesting were to proceed, it is likely that it would be completed well before any possible decision to declare the area a wilderness in view of the processes required to effect such a declaration.

5.6.3 Recreation

The impact of the proposed activity on recreation is insignificant. These compartments form a small part of the Dorrigo Management Area throughout which the road network improves access to the remote areas of the forest which leads on to increased recreation use and as this roading is already in place for these compartments there is no net increase in access.

5.6.4 Grazing

The harvest activity opens up the area which leads to an increase in grass and herbaceous groundcover and access for stock along haul and snig tracks. This leads to a short term increase in carrying capacity which diminishes over time. The potential for exotic weed infestation from stock movement, is increased with increases in access and carrying capacity.

5.7 SOCIOECONOMIC INTERACTIONS WITH THE ENVIRONMENT

In socioeconomic terms, a continuation of logging activities in specified areas of the Chaelundi State Forest would have no impact on the current environment. This is, the current nature and scope of the defined socioeconomic environment, and the role of the timber industry within that total community environment, would be maintained.

However, if such logging is not permitted, then discernible socioeconomic impacts can be expected to be observed via effects on the existing timber industry.

The industry has expressed a strong need for a continuing supply of Tallowwood, in particular. Furthermore, the industry understands from discussion with FCNSW that immediate requirements for Tallowwood (over the next 12 to 18 months, while an overall EIS is prepared for the Dorrigo Management Area) can only be met from resources within defined areas of the Chaelundi State Forest. Without access to these resources over the interim period, the viability of the industry is considered to be at risk. A decision not to allow logging in these nominated compartments could therefore result in the closure of the timber industry in this area, with resultant socioeconomic impacts as outlined in the following section.

5.7.1 Industry

As described in Section 4.7 previously, the timber industry of the region makes a significant contribution to the regional economy. Directly, and via estimated multiplier effects, the industry supports around $19 million of regional value of output, and a total of 600 employment positions. These levels can be seen to be considerable, in a rural community with little other economic activity generating either real economic wealth or jobs.

Any contraction, or even total closure, within the timber industry will place this impact at risk. The industry, as outlined below, considers that such risk is a real possibility if adequate ongoing supplies of Tallowwood are not available. The technical details of the extent to which the ability exists to substitute other species in the manufacture of timber products made from Tallowwood, and the availability of lower quality Tallowwood (if any) from other potential supply areas, are discussed elsewhere in this study.

The two mills that are located within the study region are particularly vulnerable, as they are both dependent on the timber resources contained within the Dorrigo Management Area for their operation. The Briggs and Sons mill at Briggsvale is considered likely to close if no such ongoing supplies of Tallowwood are made available, as it is estimated that this resource alone covers approximately 63% of the fixed costs of running the mill. Without Tallowwood, the operation of the mill would become uneconomic, and as this mill has been designed for Tallowwood it cannot be efficiently used for processing other species of timber. The company also considers that potential returns would not justify any conversion of the mill, certainly not for the relatively short period of time involved until the detailed EIS is prepared.

The Boral Limited (Allen Taylor & Co.) mill at Bostobrick currently provides 50% of Tallowwood cross-arms supplied to the market by this large timber operation, and management has stated that around 5000 m^3 of Tallowwood is required for 1990. This mill would become only marginally economic if no Tallowwood resource were made available to maintain operations, and the company would have to consider its closure. The financial viability of this company's processing plant at Dungog would also be adversely affected if there is not flow of timber from the Bostobrick mill, as the processing operation is stated to require 100 m^3/month from the Bostobrick mill,

assuming that 25% to 30% of timber processed at this mill consists of good quality Tallowwood.

The industry considers that a temporary closure of the industry now, in the hope of recommencement of operations after the EIS is completed and logging approval obtained, would not be a financially viable option. It is estimated that such action would incur substantial 're-establishment' costs, of up to $610,000. Additional costs could be imposed via market behaviour, with the temporary absence of Tallowwood products (particularly cross-arms) leading to a loss of market share to steel. The resultant re-design for use of the steel product is likely to mean that customers would not then return to Tallowwood. Yet more long term costs on the industry would be imposed by a permanent (or temporary) closure, as a result of the enforced suspension of the current R. & D. effort into seeking alternatives for Tallowwood cross-arms, with not only a wasted investment to date in this effort (and the loss of jobs associated with the R. & D. program), but also a prolonged dependence on Tallowwood.

Closure of these two mills would therefore result in the direct loss of around 125 employment positions. The direct loss in value of output would be somewhat less than the total contribution made by the industry to regional output (as set out in Section 4.7.2), as the mill at Grafton would continue to operate, although at reduced levels. The direct losses would be substantial, although commercial confidentiality considerations do not permit disclosure of actual data. Total economic losses would again be greater than these direct impacts, as a result of the multiplier effect. The total impacts of the industry on the socioeconomic environment, as set out in Section 4.7 provide an indication of the magnitude of the economic activity that is at risk if adequate supplies of Tallowwood timber are not maintained for the industry. The total possible socioeconomic impact that could result from the loss of Tallowwood supplies for the regional timber industry can therefore be summarised as being somewhat less that the total current impact estimated in Section 4.7.2. These data, previously presented in Table 25, are presented again in Table 36.

Table 36. **Potential impact of loss of timber industry**

	Direct ($m/yr)	Total ($m/yr)
Output	12.00	19.0
Employment	280	600

5.7.2 Social change

In addition to the obvious social consequences of the possible loss of output, and thus jobs, outlined above, additional social change would also be likely to result from industry contraction or closure. One immediate effect would that if the G.L. Briggs and Sons mill closed, it would become uneconomic for this company to maintain the improvements established at Briggsvale and Cascade. These improvements represent a total of $1.6 million invested by the company, and include some 31 houses which are occupied by company employees and retired employess (at nominal rents) and by staff wokers and others. In addition, the company maintains municipal services for the villages and provides fuel for heating and cooking. More importantly, any forfeiture of

firewood

the right to occupy these houses, under the terms of the ~~permissive occupancy~~ occupation permit lease, would incur substantial capital loss.

The loss of jobs would ultimately lead to a reduction in the size of village communities. These rural villages currently comprise close-knit communities, as the nature of the occupancy of company houses (for example) results in very low turnover of residents. Dwellings are also provided for all retired staff, for the rest of their life, further removing incentives to leave the community. The closure of mills, and the cessation of maintenance of these improvements, could cause severe dislocation, and even the possibility of dispute relating to the right of occupancy. There would certainly be hardship imposed on those losing their jobs, in having to find alternative accommodation.

Any reduction in levels of economic activity in outlying rural areas can be expected to result in population decline, in the face of limited alternate employment opportunities. A reduction in population would then be associated with a further decline in the level of community services available to the remaining residents. Little alternative employment opportunities exist, as demonstrated by the high current unemployment rate.

The possibility of tourism activities providing some additional form of economic growth for the region could also be curtailed by the cessation of logging in the area. Access to State Forest areas is provided by logging roads, and traffic counts reported in the Dorrigo Management Plan indicate significant interest in visiting the forests of the region. With no logging, there would be no access roads provided into the forests, and thus a potential decline in the relative attractiveness of the region for day-trippers from the major tourism destimations of the coastal areas.

5.7.3 Impacts on lessees

The lessees have an interest in the net Royalty gained from Compartments 180 and 198. If the area is not harvested, the lessees would not be able to realise on their 'asset' because they receive payment only if the area is harvested. Therefore, any decision to either not harvest or to postpone harvesting would represent a loss to the lessees.

6.0 IMPACTS OF ALTERNATIVES

It is apparent that there will be costs and benefits associated with either proceeding or not proceeding with this proposal. This section seeks to examine possible alternatives to the proposal and to compare the costs and benefits of adopting these alternatives.

6.1 RANGE OF ALTERNATIVES CONSIDERED

Industry restructuring

For their part, the sawmills have put forward a case that they have developed sawmilling operations that depend on a substantial proportion of high quality Tallowwood as well as large logs from other species as an essential part of their business (Section 1.2.4). In addition they assert that if these components are removed or reduced in their intake of logs that fundamental aspects of their businesses would be adversely affected with substantial restructuring of the sawmills the only way of continuing in business.

The short term nature of the proposal (1 year) means that it must be considered as an interim measure to maintain resource supplies to industry pending preparation of the Regional EIS. Therefore, this precludes consideration of options that involve possible long term industry restructuring proposals that might allow industry to be maintained but based on alternative resources if such resources could be identified as available without other imposing unacceptable impacts in other industries. These alternatives would most likely involve moves to smaller and/or poorer quality logs or logs from other species. Such moves are not feasible as an alternative for the short term because they would involve significant expense and would be a significant disruption to the mills' abilities to service their existing markets. These issues are set out in more detail in the submissions made by industry in Appendices 2A and 2B. Such changes may prove necessary or could be viable alternatives in the context of the long term wood supply forecasts considered in the Regional EIS. However, this would constitute a very onerous imposition if the disruption and expense caused by a shift in log intake were to be incurred and then to have normal supplies of high quality logs reinstated. Therefore this genre of option has been left to the Regional EIS for more detailed consideration.

Harvesting other areas

Section 1.2.3 lists alternative areas that could be harvested and sets out why other areas cannot be considered. This is primarily due to a lack of available access and/or an inability to design and construct access during the period between now and when the sawmills run out of wood.

Harvesting within the nominated compartments

The harvesting options considered range from application of routine prescriptions through to no harvesting. The option of more intensive harvesting than occurs under routine prescriptions is not considered.

6.2 CRITERIA

In undertaking any analysis of possible alternatives it is important to have a set of criteria developed that can be used to assess and compare the relative merits of each alternative. This document is seeking to assess the implications of a proposal to harvest one part of a State Forest with the only feasible alternatives being to harvest other parts of the forest or to do nothing. Irrespective of which alternative is assessed as being the preferred option, the areas will remain under FCNSW management. Therefore, the objectives of management for this forest as described by the Dorrigo Management Plan and set out in Section 2.1.2 will be used as the criteria against which potentially feasible alternatives will be assessed. These objectives have been modified by the addition of a primitiveness, naturalness criterion that is not explicitly recognised in the objectives.

Section 4 described the environment. In effect, this constitutes an inventory of the wood and non-wood values within the area. Section 5 assessed how those values might be affected by forest management, including harvesting. This allows an assessment of the degree to which these values have been affected (enhanced or reduced) by the proposal.

6.3 HARVESTING ALTERNATIVE AREAS

6.3.1. Harvesting in other high quality forest

Section 1.2.3 described the areas available for harvesting to meet commitments. Aside from the three nominated compartments, there are two alternative areas of high quality forest that have been roaded.

Alternative 1

Compartments 189, 191 and 259 (ref. Figure 3) support areas of similar, although lower quality, forest types. The volume of resource available from these areas is limited to approximately 4-6 weeks' supply for one sawmill. This is therefore inadequate as a supply source for the three mills for one year.

Alternative 2

The second alternative area, comprising Compartments 166, 167, 168, 228, 229, and 230, is unlogged and unroaded and contains forest types expected to yield 10-15% Tallowwood in the log mix.

There is a current proposal to construct about 5 km of feeder road (Grasstrees Road) to access these compartments in Chaelundi State Forest. Road construction will take abut 10 weeks following approval. (The road survey and design process has been completed.)

Because this type contains less than half the yield of Tallowwood as a proportion of standing volume, it will require 2-3 times the harvested area to yield the volumes of Tallowwood needed, perhaps more depending on how it cuts.

This alternative is marginally feasible in the sense that Tallowwood supplies could be maintained for the required duration. However, as discussed it would necessitate

harvesting between 2 to 3 times the area and would also require that these forests be selectively harvested to remove a larger proportion of Tallowwood than other species. The harvested areas would be left with merchantable trees remaining unharvested that would have to be harvested in a second harvesting operation at a later date or these resources foregone if they cannot be harvested economically.

This would represent a transfer of impacts from one place to another with the only benefit accruing that of not harvesting the three compartments.

This option could be pursued but at a considerable cost. The following assesses the potential of this alternative to meet the objectives of management:

1. Sustained yield of sawlogs. It would disrupt sustained yield by requiring the creaming of prime product, leaving the forest in condition that makes it unattractive for subsequent harvesting operations.
2. This would not constitute effective utilisation of the productive capacity of the site. Depending on how soon the second harvest took place after the initial harvest, the extent of regrowth and its vigour could be adversely affected.
3. Not affected.
4. a. This option would necessitate disturbance over 2-3 times the area of forest with 2-3 times the length of roading to obtain the same volume of timber. This would increase the likelihood of impacts on soil erosion and water quality, particularly if the compartments were to be re-opened for a subsequent harvesting operation at a later date.

   b. Not significantly affected.

   c. This option would increase both the area and time over which visual impacts occur.

   d. This would increase both the area and time over which impacts occur. Re-opening compartments at some time after the initial harvesting could result in increased disruption to the processes of revegetation and restoration of wildlife values.
5. No specific data exist on the distinctive values present on the alternative compartments so no assessment of negative impacts arising from adoption of this alternative on these values can be assessed. This alternative would mean that high wildlife values of the three compartments could be maintained intact pending preparation of the Regional EIS.
6. Because both areas are comparatively remote there are likely to be negligible benefits or costs in terms of recreational use.
7. Not significantly affected.
8. The requirement to construct and maintain additional lengths of road over a longer period of time coupled with high supervision costs means this alternative does not meet this objective.
9. Primitiveness/naturalness. The alternative compartments have equivalent values to those within the three compartments. Therefore, harvesting of 2-3 times the area would result in 2 to 3 times the loss of these values.

In conclusion, adoption of this alternative would not meet the objectives of management and would represent a less than optimum use of the public resource.

6.4 ALTERNATIVE HARVESTING PRESCRIPTIONS

All but one of the values identified within the site in Section 4 can be maintained, albeit at reduced levels in most circumstances, whilst carrying out some form of harvesting operation. The capacity to accommodate more than one value concurrently, together with the network of larger scale reservations is the essence of multiple purpose management. The one value that cannot be maintained within this context is primitiveness/naturalness, although this is not lost permanently if harvesting does not take place again.

Forest management as applied by the FCNSW can be adapted within the existing planning framework to place emphasis on any one or more of the management objectives set out in Section 2.1.2. This enables distinctive values to be recognised and appropriate management applied. Therefore, the FCNSW objectives of management have the scope to cover the full range of possible alternatives for the management of this area. This section identifies alternatives where harvesting prescriptions would be varied to place more emphasis on particular values (predominantly wildlife values).

6.4.1 Harvesting according to routine prescriptions

This would involve applying the prescriptions for routine harvesting operations as set out in Section 3. This would achieve a result similar to that on the adjacent previously harvested compartments. This is reflected by data in Section 5 that shows very high level of canopy retention which occurs throughout much of the harvested area.

1. This alternative would be consistent with the existing sustained yield strategy for sawlogs from the Chaelundi forests.
2. This option would represent the most effective utilisation of the productive site capacity as measured by timber production both now and in terms of the amount and vigour of regrowth that could be expected to occupy the site following harvesting.
3. Poles and other forest products will be supplied with few constraints as to those that can be removed. The exceptions would be in areas set aside to reflect special values. This option would maximise this value.
4. a. Soil conservation and water quality and quantity will be affected but only to a minor degree as set out in Section 5.1. The ameliorative measures described will reduce the effects to a level where they are both short term and minor.

   b. There is a negligible risk to the margin of rainforest patches associated with possible escapes of fire from top disposal burns that might penetrate the edge of the rainforest.

   c. This alternative would have an adverse impact on the aesthetic values within the compartments but because of its remote location and position relative to potential viewing points these impacts are minor in that few people would be affected. In the longer term, these values are restored as the forest regenerates.

   d. The habitat value of the harvested forest will be reduced for many fo the existing species and improved for others. The magnitude of these changes

cannot be accurately identified, however, the major species groups likely to be affected include:

- those primarily dependent on resources provided by older trees, in particular trees with hollows. The comparatively high level of hollow bearing tree retention will ensure that viable populations of these animals and birds will be maintained, however, at lower levels than existed previously.
- medium sized ground dwelling species, such as Potoroos and Bandicoots, could face increased predation from foxes and other predators due to a loss of cover.

5. The very high densities of arboreal mammals recorded from these areas accords them very high faunal values. These areas are not unique in terms of the abundance of arboreal marsupials but have been considered to be distinctive by those wildlife researchers who have undertaken studies in the area. As discussed, application of existing prescriptions would reduce the abundance of these animals possibly permanently (Braithwaite Appendix 11). To the extent that the abundance levels of themselves are distinctive in terms of the management objective and to the extent that this overall distinctiveness would be lost by reduction of these levels in the harvested areas, the management objective would be met better by some modification of the existing prescriptions.

6. The remote location and lack of distinctive features means that this area is unlikely to represent a significant recreational resource either before or following harvesting.

7. Grazing or other uses will be little affected by the proposal.

8. This alternative would maximise the net financial returns to the extent consistent with meeting the other objects of management. Direct costs and returns are set out in Table 37.

Table 37. **Direct costs and returns from harvesting Compartments 180, 198 and 200 based on application of routine harvesting prescriptions**

Roading costs		
Incurred to date –		
Survey, construction and administration 3.25 km Broadmeadows Road		$ 86,000
Additional works necessary to undertake proposal –		
Gravel part Broadmeadows Road, construct roads and tracks within harvesting areas and administration costs		$ 42,000
Returns to Forestry Commission from proposal		
Gross Royalties from operations		$ 660,000
Roading costs	42,000	
Marketing, protection and maintenance and administration costs	224,000	
	266,000	$ 266,000
		$ 394,000

Source: FCNSW

9. Primitiveness/naturalness. These values would be lost from the harvested areas for a prolonged period.

6.4.2 Harvesting at a reduced intensity

This alternative is similar to 6.4.1 except that harvesting in the New England Blackbutt forest types would be modified to retain additional trees suitable for arboreal wildlife habitat. Data presented in Section 5.4 indicates that harvesting in these types typically reaches a mean level of canopy removal of 65%. Data from other research indicates that for high quality habitat sites maintenance of a minimum of 50% of the canopy can maintain populations at near pre-harvesting levels.

In addition, the species favoured by the sawmillers (viz. Tallowwood) is the species least utilised by the Greater Gliders. Therefore, this alternative consists of altering prescriptions to mark additional New England Blackbutt and Sydney Blue Gum trees for retention in areas where, under normal harvesting prescriptions retention of less than 50% canopy could be expected. On average, this would necessitate retention of an additional 15% of trees in these types.

Based on average yield by species presented in Table 2 Section 1.2.2, this would involve retaining a higher proportion of the 'B' class trees, preferably in the medium and large size class. The loss to industry, in terms of resource, and the FCNSW, in terms of stumpage, would be less than the estimate of additional retention requirements might indicate as these species are not as valuable as the Tallowwood and trees of this size, with hollows, often contain significant levels of defect. This level of additional retention could be achieved by retaining additional doubtful trees that typically yield ex-quota or salvage logs.

The following analyses this alternative against the criteria:

1. This option would result in a loss of approximately 10-12% of the resource at the lower end of the quality spectrum. This would typically involve the so-called salvage or optional logs with a small proportion of quota logs. Within the order of accuracy of the sustained yield determination and the regulation of it, no adjustment would be necessary.
2. Higher levels of retention of old hollow bearing trees will reduce the timber productivity of the site somewhat through a reduction in the area regenerated to vigorously growing regeneration. Where regeneration does establish, its performance will be dependent on the degree to which retained trees exert an inhibitory effect.
3. This value should be unaffected as most of these products are not suited as habitat trees.
4. a. No difference from Section 6.4.1.
4. b. No difference from Section 6.4.1.
4. c. No difference from Section 6.4.1.
4. d. Populations of arboreal mammals and hollow dependent birds would be maintained at pre-existing levels. Other species could be affected as per Section 6.4.1.
5. Distinctive arboreal faunal abundance would be maintained.
6. As per Section 6.4.1.

7. As per Section 6.4.1.
8. Revenues from the sale of a high proportion of optional or ex-quota logs and few quota logs would be foregone. As an indicative estimate, the stumpage foregone would be likely to be less than $25,000.
9. Primitiveness/naturalness as per Section 6.4.1

6.4.3 Do nothing alternative

This alternative would see the industry continue harvesting in the current compartments and then, when harvesting in these areas is complete no further access to high quality forest would be available until completion of the Regional EIS.

A significant level of disruption would occur to industry through a loss of a substantial proportion of its annual throughput. In addition, industry would incur substantial costs to convert to other timber species. In view of the short term nature of the proposal such a level of disruption could not be considered prudent.

The positive aspects which would accrue from this alternative are that all non-wood values within the three compartments would be maintained unchanged from their existing condition pending preparation of the Regional EIS.

6.5 CONCLUSION

There are two basic options available as alternatives and several variations within each option.

Options which would retain the three compartments unharvested pending completion of the Regional EIS. These options include:

- do nothing
- harvesting alternative high quality areas
- harvesting alternative low quality areas

All three variations were assessed as not being feasible with the key problem that of maintaining supplies of Tallowwood to industry. None of these options explored could sustain industry's requirements for the duration of the required period of time in a way that is consistent with good forestry management and that does not prejudice sustainability of future sawlog supplies.

The second basic option would involve harvesting the three compartments. Two variations to this option were identified. The first seeks to maximise the net financial return consistent with achieving other objectives. This would amount to a routine harvesting operation in these forest types.

The second alternative would seek to maintain arboreal marsupial numbers at levels near to those existing preharvesting by maintaining higher levels of retained canopy than the previous alternative. This option would mean that industry would have to

forego a proportion of the logs currently extracted. However, the trees that would be most suited for wildlife habitat are those least suited for sawmilling. Typically, such trees would yield logs in the optional or salvage log category.

Both options would meet the principal objective of the proposal to keep industry supplied with suitable resources. Where they differ is in the margins – one seeks to maximise the net financial yield consistent with satisfying the other objects of management (ref. Section 6.4.1). The other seeks to maintain the very high arboreal marsupial abundance levels (ref. Section 6.4.2).

Adoption of the first alternative would diminish the distinctive wildlife values by reducing the abundance of animals within the area.

There is no regional context within which to assess the necessity for maintaining these distinctive values. A key aspect of this assessment is the extent to which Crown lands in the region have adequate areas of unharvested forest carrying similar abundant populations. An associated aspect is the rate and extent to which the abundance levels would increase after harvesting towards those existing preharvesting.

The second alternative would forego a proportion of the income expected to accrue from the operation. The objective of management concerning maximisation of the net financial yield does require that this objective be met to the extent possible under the other objectives. Therefore, if it is accepted that the abundant arboreal marsupial populations present are distinctive in terms of management objective 5, and that it is their abundance that is the distinctive value, then it follows that the objectives of management would be best met by the second alternative in that it better meets the objectives of management for the study area.

7.0 ENERGY

Energy usage for the proposal has been calculated for the various components of the proposal. This includes the following:

- Roading (new roading i.e. not including Broadmeadows Road)
- Harvesting
- Transport of logs.

The energy usage for each component is set out in Table 38. Data to prepare this table have been drawn from equipment supplies FCNSW (1981) and consultants' estimates.

The order of magnitude of energy consumption is 20 million MJ or 760 000 MJ/m^3 (gross) of log produced. Removal of timber represents a further impact in terms of energy 'consumption'. The plants currently occupying the site utilise photosynthesis to capture and convert energy into usable forms, a proportion of which is used by the plant to create biomass. This represents a renewable source of energy.

Removals from the ecosystem in the form of logs, and living biomass that is burnt or left to decompose is replaced in time.

Table 38. Total estimate of energy that would be consumed by undertaking the proposal

transport of logs			
volume/year	26000		
number of loads/22t (1m3=1.12t)	1324		
av haul distance km	85		
fuel usage l/km	2		
total fuel useage l/year	382531		
conversion to energy value			
diesel (MJ)	38,30	14650933.82	
roading			
class of road	length km	diesel fuel l/km	petrol fuel l/km
iii	2.50	2431.00	191.00
iv	6.00	1111.00	191.00
total		3542.00	382.00
conversion to energy value			
diesel	38.30	135658.60	
petrol	34.70	13255.40	
total energy cost for roading (MJ)		148914.00	
harvesting energy costs			
snigging (1)	51150		
transport of crews/supervisors (2)	8800		
conversion to energy value			
diesel	38.30	1959045.00	
petrol	34.70	305360.00	
total energy cost for roading (MJ)		2264405.00	

(1) assumes 5hrs operation/day/220days/3crews 50%load @20 l/hr- 50%unload @11 l/hr
(2) assumes 220 days/yr 1 vehicle/crew x3crews 1 vehicle/supervisor @100km /visit

total energy consumption for operation (MJ)	17,213,167

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APPENDIX 1.

Premier's statement on preparation of Regional EIS

Forestry Commission of New South Wales

Meeting the Environmental Challenge

A Forestry Strategy

June 1990

Introduction

Forestry in New South Wales is facing an increasingly difficult legal and political environment.

Forests, especially native forests, are a valuable resource to be carefully managed to provide a range of benefits, now and for the future, on a sustainable basis.

We need to demonstrate to the community that our forests are in good hands and that they are being managed in a way that will maintain both their ecological integrity and the survival of the industries and jobs which depend on them.

The challenge is to review forest management strategies in the light of new Government policy directions and community attitudes, and to adopt policies and strategies that will ensure sustainable and balanced use of resources.

Forests considered to be substantially undisturbed – often referred to as "old growth forests" – merit special attention.

Forestry and Timber in an Environmental Future

There are sound reasons why forestry should proudly take its place as a central plank in any responsible environmental policy. Forests are renewable provided that their ecosystems and processes are not irreversibly altered. Timber, the major material product of forests, is a very environmentally friendly product.

Timber:-

- is renewable
- is environmentally benign and non-polluting
- is recyclable, biodegradable
- requires low energy input for processing
- has high energy conservation attributes when in service in buildings
- stores CO_2 from the atmosphere and therefore works against global warming
- involves processes in its production which have much lower environmental impacts than agriculture or mining
- has outstanding aesthetic qualities.

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The forest products industry also plays a vital role in Australia's economy. It is the second largest manufacturing industry and the most significant in rural areas. Yet Australia currently imports $2.3 billion worth of forest products each year, leaving a net trade deficit of $1.7 billion.

Sustainable forest management including timber production must play an important role in any environmentally and economically responsible future for this State. The Government is committed to achieving and maintaining a proper balance in the use of the forest resource for the production of both timber and other values, including water quality, wildlife and flora conservation.

The New Environmentalism

In his recent major statement on the environment, the Premier defined the Government's broad policy direction and philosophical approach to the environment and provided the basis for developing more detailed policies for natural resource management. Philosophically the approach can be restated as follows:

- Nature is neither sacrosanct nor something to be pillaged. Rather, nature contains resources which we must use sensibly and rationally, but use nevertheless, if we are to maintain the quality of our lifestyles. This is a view shared by the great majority of Australians.
- While we may embrace many of the concerns of the hard-core environmental movement, we are not bound to embrace the ideological and sometimes silly nostrums they offer as solutions to our problems. Wider community concerns are not centred around a simplistic "green" agenda, but recognise the need to balance legitimate and sometimes competing interests. We must be willing to respond to the concerns of the majority.
- It is not ideology that matters, but solutions; solutions which work in the real world. These solutions lie in an economically rationalist approach and in better management. There must be a deliberate choice of achievable reform over "deep green" ideology.
- There is a need for stability and predictability in long term government policy.

Principles for Public Forest Management

The NSW Government accepts the following principles as a necessary and practical foundation for management of our State Forests:

- Decision-making must be based on a comprehensive information base covering relevant ecological, social and economic attributes of particular forest areas.
- Forests must be managed on an ecologically sustainable basis which maintains the ecosystem and provides for the interests of future generations in respect of both wood supply and environmental benefits.
- Forest management must be economically viable and efficient and must provide for a viable and efficient forest products industry.
- Decision-making must be balanced and open, and provide for public participation in the planning process.
- Forest management must be publicly accountable in ecological, social and economic terms, and responsive to evolving community concerns.

While a great deal has been achieved already in putting these principles into practice in NSW forests, the community now reasonably expects a higher level of visible commitment to their implementation.

The challenge is to develop strategies for fully applying these principles within the constraints of available funds, commercial viability, and rapidly evolving legal and political imperatives. In particular "old growth" forest has emerged as an issue requiring immediate attention.

A Strategic Direction

It is entirely appropriate that one of the practical expressions of the "New Environmentalism" should be directed to the conflict surrounding the management of native forests.

The central dispute in this conflict is a question of land use rather than forest management. There is no right or wrong answer in this land use dispute. The "Deep Green" lobby is calling for an end to all native forest logging. The timber industry and its employees are understandably anxious and want assurances that they can look forward to a sustainable and stable future in this important industry. An acceptable balance must be achieved.

Both the Governmentand and, some of the major conservation groups, acknowledge that there must be some logging of old growth forests to maintain the viability of industry over the next 20-30 years. After that time current yields can be sustained entirely from previously logged areas. However, it is important to examine these forests and their values in considerable detail, evaluate the options for land use, and determine those areas where logging can be undertaken using sensitive management practices in order to lessen and ameliorate the environmental impact.

It is recognised that there is wide community concern about our environment. Government decisions will reflect that concern by increasing significantly the openness and accountability of the natural resource management of public authorities, such as The Forestry Commission.

The new forest strategy represents a real step forward in a number of respects:

- It recognises community concern about forestry issues and the need for more public involvement in forest management decisions.
- It provides for that involvement through the provisions of The Environment Planning and Assessment Act. In fact it will go beyond those legal requirements.
- The Forestry Commission will not conduct these EISs behind closed doors. It will hire Independent Consultants to carry out some of the more sensitive EISs. In addition, the Commission will go to the community and seek its assistance in determining the scope of the EISs, and the issues that will be addressed in them.
- There will be a moratorium on harvesting in 14 major old growth areas until the EISs have been completed. This will occur progressively over a five-year period.
- An order of priority will be established for the sequential preparation of EISs. Priority will be given to management areas having substantial areas of "old growth" forming part of the sustained yield resource base, and for which EISs have not yet been completed.

- In establishing priorities, an assessment of the whole State has identified the following key areas of unlogged old growth forest within State Forests, for which EISs have not already been completed.

Management Area	State Forests	Key Areas
Urbenville	Richmond Range, Yabbra	Duck Creek
Murwillumbah	Nullum	Blackbutt Plateau
Tenterfield	Boorook, Spirabo, Forestland	–
Glen Innes	London Bridge, Glen Nevis, Oakwood,	London Bridge
Casino West	Mount Marsh	Mount Marsh
Grafton	Dalmorton	Cunglebung
Dorrigo	Chaelundi	Chaelundi
Walcha-Nundle	Ben Halls Gap, Tuggolo, Giro	Ben Halls Gap,
Kempsey	Nulla Five Day, Styx River,	–
Wauchope	Doyles River, Mount Boss, Yessabah, Kippara	–
Wingham	Dingo, Bulga, Doyles River, Enfield	–
Gloucester	Stewarts Brook, Barrington Tops	Barrington Tops
Chichester	Chichester, Boonabilla	Whispering Gully, Boonabilla
Mount Royal	Mount Royal	Davis Creek

These identified areas comprise some 180 000 ha within 14 separate forest management areas.

Old Growth Forest

Old-growth forests have attracted considerable attention. There are practical problems in defining just what is meant by "old growth" forest. At one extreme, it may include any forest with old trees, and this definition covers practically all State Forest where selective logging has been practised for decades. A more meaningful definition would include only natural forest with few or no signs of human disturbance.

Using a definition of "old growth" based broadly on "forest with little or no disturbance", there are about 5 million ha of such forest in the State, distributed throughout different land tenures as follows (areas in millions of ha):

National Park	2.0
State Forest	1.6
Various Crown Lands	1.1
Privately-owned Lands	0.3
	5.0

Major areas of old growth are already reserved within the State's National Park system. Many of these Parks resulted from the revocation of extensive areas of State forest, particularly in recent years.

Of the 1.6 million ha within State Forests, 1.3 million ha are deliberately excluded from logging (eg in Flora Reserves or for catchment protection) or are unsuitable (eg

excessively steep terrain and economically inaccessible areas). Together with the 2.0 million hectares protected with National Parks, this represents 92% of the total "old growth" conserved within either National Parks or State Forests.

The debate about the harvesting of old growth forest therefore revolves around approximately 0.3 million ha of State Forest or about 8% of the total old growth permanently conserved within National Parks and State Forests. This 0.3 million ha, together with the 1.5 million ha of previously logged (and regenerated) State Forest currently provides our resource base for long term sustained yield of the State's hardwood timber needs.

The EIS process will determine the most appropriate use of these forests in line with sound, economic, social and environmental principles.

The "Rainforest Decision of 1982"

The current dispute in the North coast forests should also be seen in the context of decisions made in 1982.

The "Rainforest" decision of the former State Government in 1982 removed from production some 100 000 ha of old growth, formerly part of the north coast's sustained yield resource. Impacts on industry viability and jobs were significant, but industry concern was tempered by a firm Government guarantee that the remaining resource base would not be eroded.

Industry was given a written undertaking by the Government that alternative (i.e. remaining) timber resources would be identified, "the availability of which will be assured by Government." It also guaranteed the "maintenance of employment levels consistent with those existing and predicted from the current management proposals of the Forestry Commission of NSW," (NSW Government Rainforest Policy 1982). Thus both industry and the Forestry Commission were able to make adjustments to the reduced resource base, secure in the knowledge that it was guaranteed by Government.

Environmental lobby groups now have made further demands for the exclusion of harvesting from what remains of the north coast hardwood resource, specifically in those State Forests identified in 1982 by the former government as the "alternative" resource for industry.

Industry, having adjusted to the trauma of 1982 and having received firm undertakings from the Wran and Unsworth Governments, has good reason to expect the maintenance of its resource base.

The Legal Challenge

The Environmental Planning and Assessment Act, enacted in 1979, requires an Environmental Impact Statement (EIS) for any activity likely to significantly affect the environment. It does not require an EIS for logging per se. It was not envisaged at the time, nor did the then Minister or the Department of Planning suggest, that an EIS would be required for all logging activities. In fact consultations with the Department led to the development of a system of internal environmental review designed to meet the requirements of the Act and identify those cases where EIS preparation might be required.

Since the Act came into force in 1980, the Forestry Commission has completed five EISs for operations within areas seen to have particular sensitivity. However, interpretation of a Land and Environment Court ruling in 1989 suggests that EISs could be required for a considerably broader range of logging operations than previousiy thought, and particularly in respect of "old growth" forest. In fact there is considerable doubt as to when an EIS might be held not to be required. This ruling,

which has been successfully exploited by anti-logging groups, is the cause of the current crisis facing the Forestry Commission and the timber industry, particularly on the North Coast.

This situation, coupled with perceived community concerns, gives additional impetus to the need to implement a strategy for the management of old growth forest.

Other Related Initiatives

The above strategy is complemented by a number of additional initiatives.

The Forestry Commission is reviewing its policy on hardwood plantations and identifying options for pursuing a more positive program consistent with broader timber supply objectives and economic efficiency.

The Government is exploring the feasibility of plantation share-farming schemes within NSW through a working party composed of representatives of the Forestry Commission, Nature Conservation Council, Land Conservation Council and Soil Conservation Service.

The Government will continue to pursue Commonwealth financial assistance for hardwood plantation schemes.

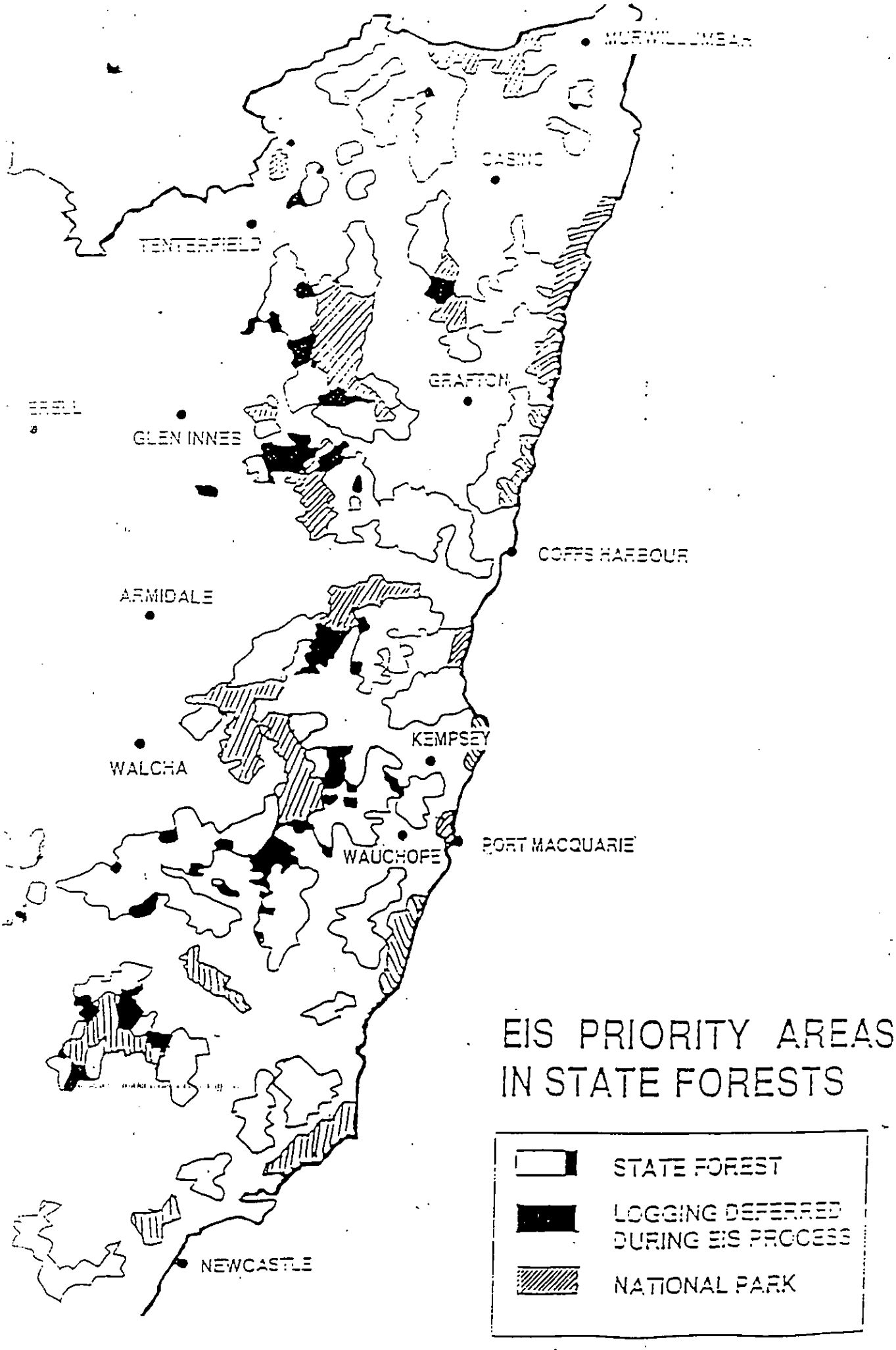
The Forestry Commission is currently establishing hardwood plantations at a rate of about about 200 hectares per annum.

The Forestry Commission will develop a more pro-active and adequately resourced communications program so as to increase the community's access to information about its policies and activities, particularly their environmental significance. The program will also provide avenues for feedback from the community.

The Forestry Commission is developing a computer based Geographic Information System as a basis for improving its resource data bases and analytic capabilities. This system will greatly enhance community access to forest resource information and the ability to formulate management plans and evaluate environmental impacts.

Summary

The strategy outlined above, provides a responsible and workable basis for a new approach to the legal, ecological and economic requirements for the management of "old growth" within State Forest. It will allow greater public participation in decision making processes and a higher degree of accountability to the community for the management of what it rightly regards as a precious natural resource.


MURWILLUMBAH
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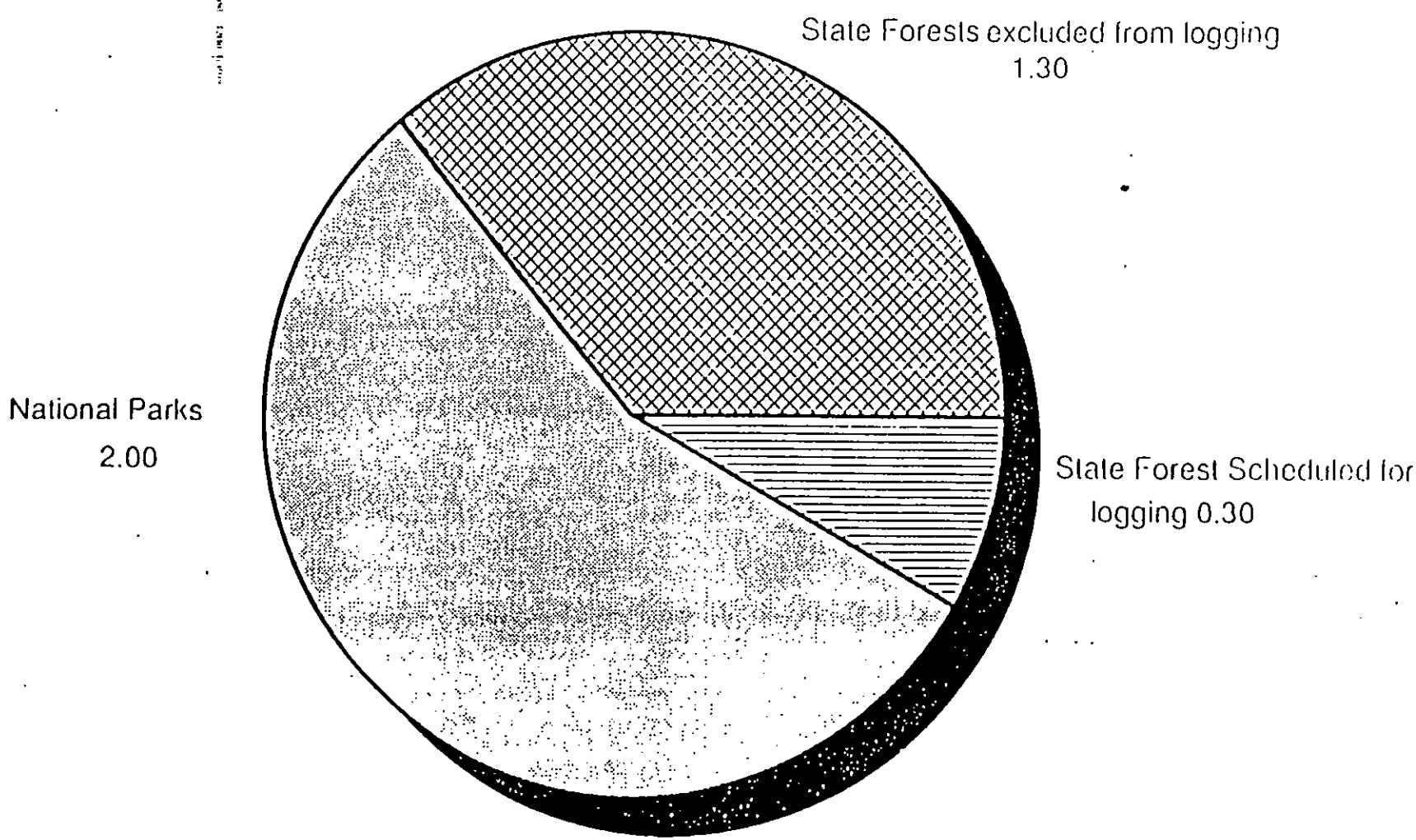
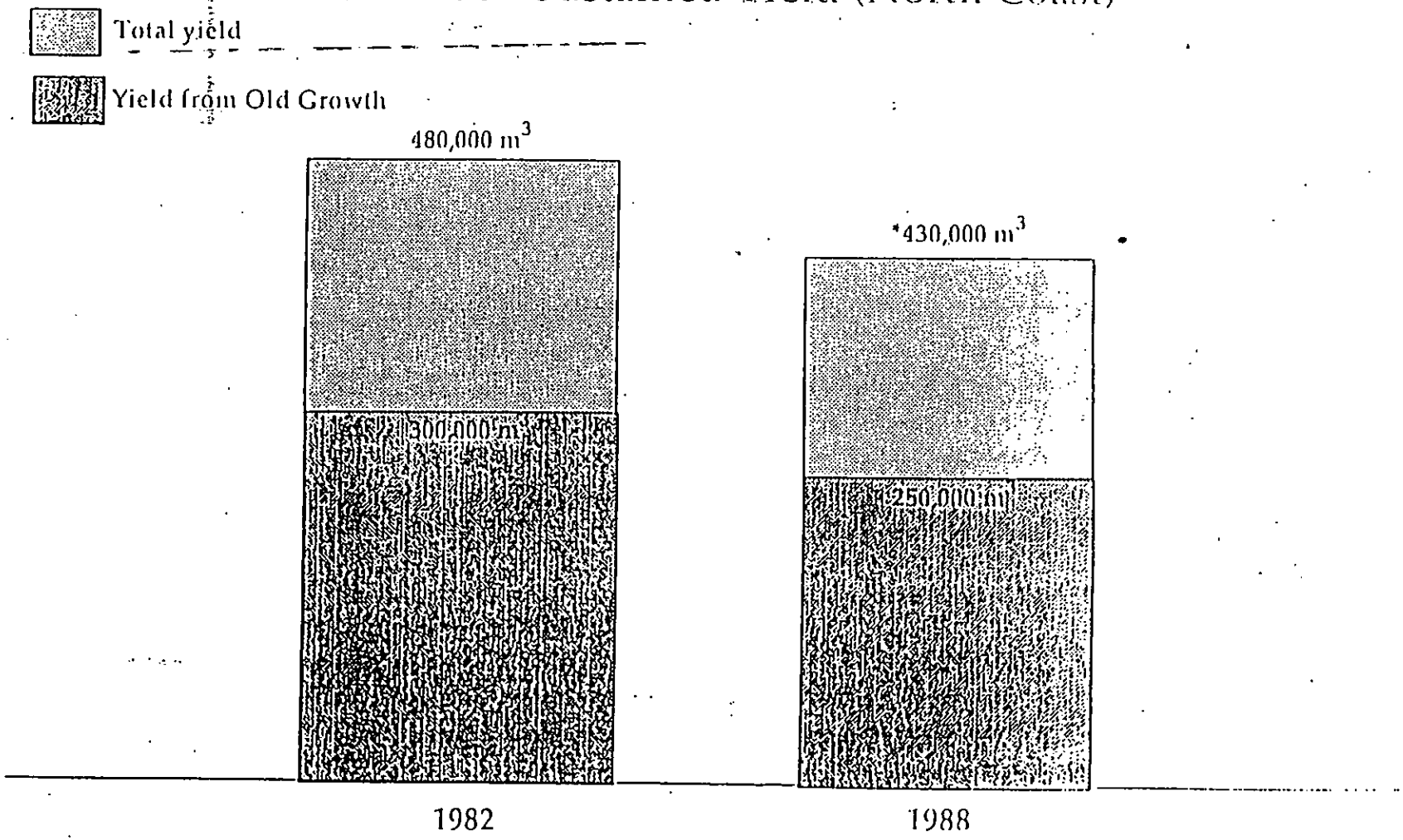
GLEN INNES
COFFS HARBOUR
ARMIDALE
KEMPSEY
WALCHA
WAUCHOPE
PORT MACQUARIE
NEWCASTLE
EIS PRIORITY AREAS
IN STATE FORESTS
STATE FOREST
LOGGING DEFERRED
DURING EIS PROCESS
NATIONAL PARK

OLD GROWTH FOREST IN NATIONAL PARKS & STATE FORESTS - 3.6 Million Hectares



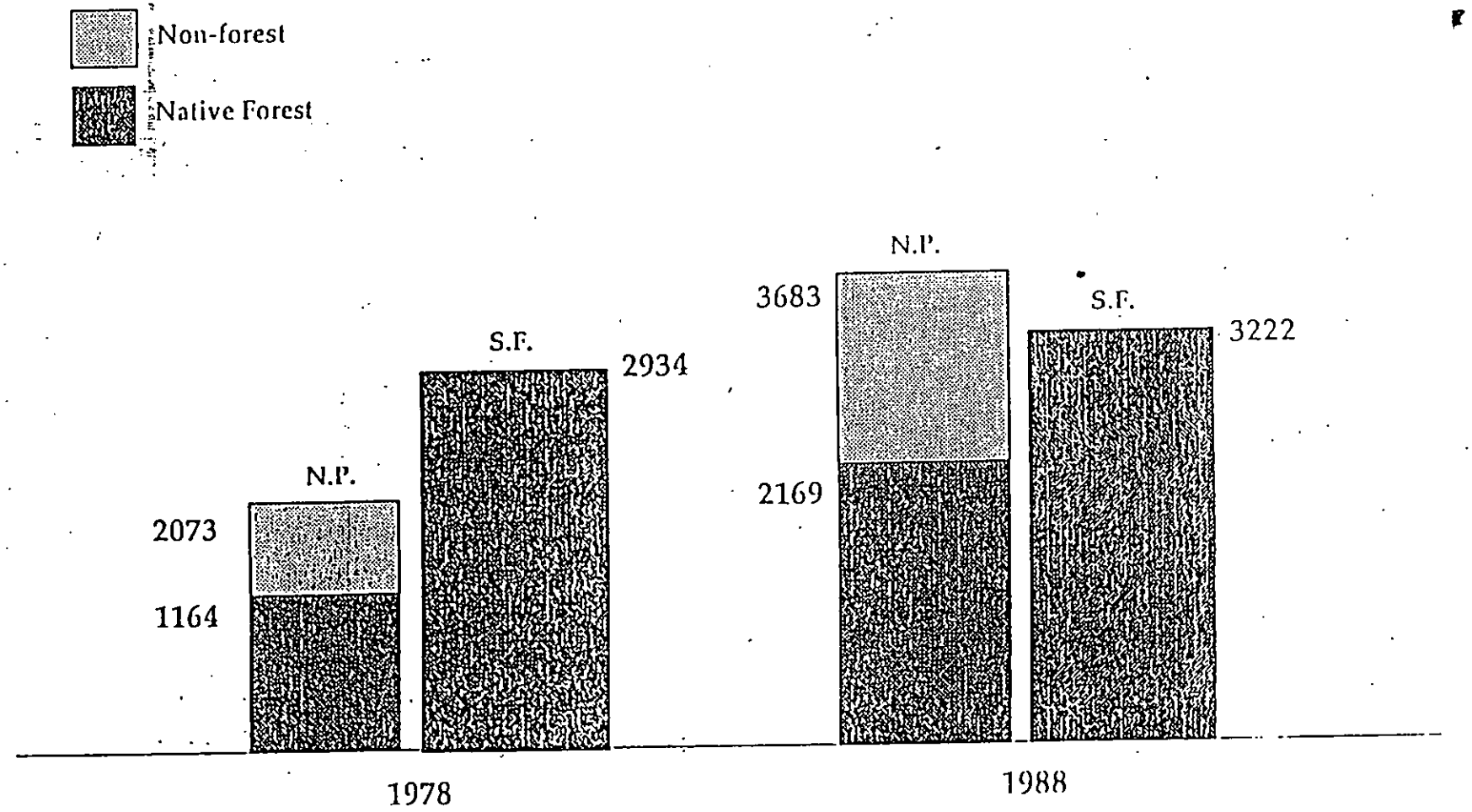
Hardwood Sustained Yield (North Coast)



* Reduction of 50,000 m^3/p.a. due to "Rainforest" Decision of 1982-83

National Parks and State Forests, N.S.W.

000 ha



APPENDIX 2A.

Submission – Allen Taylor & Co. Ltd

Doug Parsonson
Marqules

DRAFT SUBMISSION BY ALLEN TAYLOR & COMPANY LIMITED TO MESSRS MARQULES & PARTNERS FOR PURPOSES OF PREPARING AN ENVIRONMENTAL IMPACT STATEMENT FOR CHAELUNDI STATE FOREST

1. Allen Taylor & Company Limited has, conducted sawmilling operations since around the turn of the century, if not longer.

2. In 1983, the Wran Government's "Rain Forest Decision" cut the Company's quota for hardwood timbers by about one-third. As a result, the Company entered into extensive discussions with the Forestry Commission to determine what timber resources would be available to it in the long term and then embarked on a rationalisation programme. That program resulted in the Company reducing the number of its sawmills in New South Wales to six and entering into long-term contracts with the Forestry Commission for the supply of timber.

3. Another result of the "Rain Forest Decision" was that the Company decided to invest in plant and equipment designed for processes to add value to timber which it harvests. These processes include:

   (a) air drying;

   (b) kiln drying;

   (c) dressing.

4. One of the Company's sawmills is at Bostobrick.

5. As a result of its planning after the "Rain Forest Decision" which included discussions with the Forestry Commission concerning volumes of timber which would be available to the Company over time, the fourth

respondent rebuilt the Bostobrick mill in 1984 at a cost of $1,966,212.00 and has since made further modifications and upgradings.

6. The Bostobrick mill is set up to process high quality hardwood logs with big end sections and long lengths to supply the Company's markets for cross-arms, wharf structures and similar products.

7. Timber for the Bostobrick mill comes from the Dorrigo Management Area.

8. It usually requires three years' planning to prepare for harvesting once the Forestry Commission makes its harvesting plans available. The Forestry Commission allocated a nett 15,680 cubic metres of logs from the Dorrigo Management Area to the Company for the calendar year 1990, that is, logs without tops or branches. The Company expected the species mix to be as follows:

(a) 25% - 30% good quality Tallowwood;

(b) 10% - 15% Spotted Gum;

(c) 14% Silver Top Stringy Bark;

(d) 12% New England Blackbutt;

(e) 24% - 39% mixed hardwood (Blue gum, Brush Box etc).

In that expectation, the Company had budgeted for tallowwood to contribute 50% of the profit from the Bostobrick mill during the same period.

9. If the Bostobrick mill cannot have access to the timber in the area which is the subject of the Court's order of 13

March 1990, then the Company expects the following species mix from the resources available to that mill:

(a) 5% lower quality Tallowwood;

(b) 30% Spotted Gum;

(c) 10% Silver Top Stringy Bark;

(d) 8% New England Blackbutt;

(e) 47% mixed hardwoods.

The available tallowwood is of lower quality and smaller size than that in the area subject to the Court's order. It is therefore not suitable for specialty uses which comprise 30% of the Company's market for tallowwood.

Spotted gum is not as durable as tallowwood and is susceptible to Lyctus borer. The law requires spotted gum sapwood to be treated for this borer. If the Company is forced to use spotted gum as a substitute for other species, it will use more spotted gum and, therefore, its cost of production at the Bostobrick mill would rise by 2%.

The mixed hardwoods have a high proportion of defect and are therefore not suitable for the market into which tallowwood products are sold. Under current market conditions, if the Company were to harvest all the mixed hardwoods, large proportions of those products would simply have to be held in stock, thus increasing the Company's overheads.

10. Fifty percent of the tallowwood cross-arms which the Company supplies to the market come from the Bostobrick mill. In order to meet orders for cross-arms for the calendar year 1990, the Bostobrick mill must have access to 5,000 cubic metres of tallowwood.

11. The Company's processing plant is situated at Maxwell's Creek, Dungog. The Company spent $5,000,000 on commissioning the plant in the last 12 months. The operational plan for the Maxwell's Creek plant requires 100 cubic metres of timber products from the Bostobrick mill to be processed per month. That plan was put together on the assumption that 25% to 30% of the logs to be processed at the Bostobrick Mill would be comprised of good quality tallowwood.

Tallowwood is cheaper to process for the market because the dressing of tallowwood can be carried out while the timber is green whereas other species must be dried to varying degrees before they can be dressed. Tallowwood therefore makes a more immediate contribution to the profit of the Maxwell's Creek plant than other species. If timber is not available from Bostobrick, then the Maxwell's Creek plant's profit and cash flow will be affected adversely.

12. If timber is not available from Chaelundi State Forest, then, under current market conditions, the Bostobrick mill will become marginally economic and the Company will have to consider closing down.

13. The Bostobrick mill provides the following jobs:

(a)	mill: permanent	28
	casual	3
(b)	extraction:	7
(c)	haulage:	
	sawn timber (full time equivalent)	4
	woodchips (full time equivalent)	2
	sawdust (full time equivalent)	.5
	TOTAL	44.5

14. These employees will lose their jobs if the Bostobrick mill closes down.

15. The company believes that all the mill and extraction employees, one of the sawn timber haulage employees and one of the wood chip haulage employees live in the Dorrigo district, making a total of 40 employees of the Bostobrick mill who live in the Dorrigo district. If those people remain unemployed after closure of the Bostobrick mill, then that will have a significant effect on the Dorrigo district's economy.

.....

F G Day
Operations Manager

M11687 (B)

APPENDIX 2B.

Submission – G.L. Briggs and Sons Pty Ltd

~~DRAFT~~ SUBMISSION BY G L BRIGGS & SONS PTY LIMITED TO MESSRS MARGULES & PARTNERS FOR PURPOSES OF PREPARING AN ENVIRONMENTAL IMPACT STATEMENT FOR CHAELUNDI STATE FOREST

This document is prepared at the request of Mr Douglas Parsinson of Margules and Partners for the purposes of a proposed environmental impact statement to be prepared in respect of proposed logging activities in the Chaelundi State Forest and is directed at the consequences which, from the point of view of G L Briggs & Sons Pty Limited, would flow if such logging activities were not permitted to be carried out.

A. HISTORY OF G L BRIGGS & SONS PTY LIMITED

1. The origins of the business of the Company can be traced to 1908 when George Largie Briggs the elder opened a sawmill at Dorrigo. In 1924 the Company was incorporated for the purpose for purchasing the business of George Largie Briggs. There followed a period when George Largie Briggs' brothers ran the company. Then John Briggs, the founder's son, took over the management of the company until 1979 when the present general manager, Robert Largie Briggs, became responsible for the day-to-day management of the Company's business. John Briggs remains as chairman of the company's board of directors.

Robert Briggs started work with the Company at the age of sixteen years. He graduated a Bachelor of Engineering from the University of Sydney in 1975 having studied full-time for that degree. He then studied part-time for and graduated as a Master of Business Administration from Macquarie University in 1982. He is a graduate member of the Institute of Engineers.

2. The Briggs family has an accumulation of experience stretching back into the last century in rainforest resource utilisation in South East Queensland and New Zealand and, in Dorrigo rainforests by supplying veneer for the mosquito

fighter bomber during World War II. As a result of this experience accumulated from those activities, the Company decided at some time before the end of World War II that it should conserve rainforest timber resource by ceasing to use rainforest species for general sawmilling purposes. From 1946, when government direction of timber supply ceased, the second respondent ceased to use rainforest species for sawmill operations and confined the timber used for those operations to eucalypt species.

After World War II, the Company consistently lobbied the Forestry Commission and the industry to utilise renewable eucalypt resource rather than rainforest and it backed this up in practice by developing the technology to peel veneers from eucalypt species available from re-growth and plantations to make plywood products.

In 1950, the Company commenced trial peeling of veneer from renewable eucalypt species.

Meanwhile, the Company observed that its decision to move away from rainforest species was not being followed in the rest of the industry. Indeed, other sawmilling operations continued to use rainforest for general sawmilling into the 1970's.

In order to conserve rainforest resources, the Company in the early 1970's offered to the Forestry Commission to close down its rainforest veneer operations altogether if the Forestry Commission would close down general rainforest logging in the Dorrigo district. The Forestry Commission agreed and carried out this policy.

B. <u>THE NATURE OF G L BRIGGS & SONS PTY LIMITED'S BUSINESS</u>

3. The Company's business is primarily the supply of timber products. Those timber products fall into two classes:

(a) <u>Sawn timber products</u>.

These products comprise approximately 75% of the Company's business. About one-third of the sawn timber products are made from tallowwood. Sawn tallowwood products include:

(i) cross-arms;

(ii) truck body components;

(iii) wharf, bridge and marina structures;

(iv) light decking;

(v) bearings;

(vi) ferry fenders;

(vii) buffers on wharves.

The strength, durability and other technical properties of tallowwood make it the preferred species and sometimes the only species which the market will accept for the types of products set out in the list above. The Company has supplied tallowwood for such purposes for many years. Particular examples are the wharves and promenade at Darling Harbour and the roller coaster at Australia's Wonderland. The Company has developed a specialist market both within Australia and abroad for the construction of marinas from tallowwood.

(b) Veneer products.

These products comprise approximately 25% of the Company's business. The Company does not manufacture any veneer products from tallowwood. It uses primarily blackbutt and rose gum in the manufacture of its veneer products. Such products are used in the manufacture of:

(i) concrete formwork plywood;

(ii) speciality pallets;

(iii) high strength structural ply;

(iv) decorative plywoods.

4. Broadly speaking, the Company's business for the supply of sawn timber products made from species other than tallowwood derives from its business in tallowwood. That is, our customers come to us seeking supplies of tallowwood products because of our reputation for reliability of supply and quality and then ask us to supply their other needs for timber products made from other species.

The Company's annual turnover for tallowwood products is about $757,000.00. This turnover is derived primarily from eleven customers who have been dealing with the Company for between one and forty years. The products supplied to these customers cover the complete range of the Company's sawn timber products.

5. As the best of sawn timber products shows, part of the Company's business is the supply of tallowwood cross-arms. The Company supplies cross-arms to authorities which generate and/or distribute electricity. The Company for some time recognised that there is a need to develop alternatives to tallowwood cross-arms. It has therefore embarked on a project to develop an alternative made from man-grown (regrowth) blackbutt species which involves the treatment of blackbutt to make it superior to tallowwood. The market has not yet accepted the blackbutt alternative and research and development must continue to ensure that the market does accept it.

6. The funding of research and development for the cross-arm project has come from profits made from tallowwood because tallowwood products fetch up to four times the price of

similar products made from other species of timber. Up to January 1990, the royalty payable to the Forestry Commission for the harvesting of the group of species to which tallowwood belongs was greater than the royalty for other groups of species. The flat rate royalty introduced by the Forestry Commission in 1990 would have increased the profit from tallowwood, which, in turn, would have permitted an accelerated rate of development of the blackbutt alternative to tallowwood cross-arms.

C. G L BRIGGS & SONS PTY LIMITED'S RIGHT OF ACCESS TO TIMBER IN CHAELUNDI STATE FOREST

7. The Forestry Commission issued a forestry licence number 15319 to the Company pursuant to the Forestry Act, 1916 to take 19,180 cubic metres of timber from the Dorrigo Management Area during the calendar year 1990. The Dorrigo Management Area includes Chaelundi State Forest.

The terms on which the Company may obtain timber pursuant to the licence are governed by:

(a) the order of working of the forest compartments covered by the license published by the Forestry Commission;

(b) the following four letters:

(i) Forestry Commission to the Company dated 13 November 1989;

(ii) the Company to the Forestry Commission dated 15 December 1989;

(iii) Forestry Commission to the Company dated 9 January 1990;

(iv) Forestry Commission to the Company dated 7 February 1990;

8. On 5 May 1990 the Forestry Commission amended licence number 15319.

9. The Company has made long-range plans, has entered into contracts to supply timber products and has made commitments to supply timber products in the expectation that the arrangements represented by the licence, the order of working and the letters referred to above would be implemented and remain in force.

D. CONSEQUENCES OF LOSING THE RESOURCES OF THE CHAELUNDI STATE FOREST

10. The Company understands from discussions with representatives of the Forestry Commission that the Company's immediate requirements for tallowwood can only be met from resources within the Chaelundi State Forest.

11. If the Company cannot have access to resources of tallowwood by the end of October 1990, then other consequences will flow:

12. First, the Company operates a sawmill at Briggsvale. The sawmill provides all of the Company's sawmilling requirements. It is an integrated sawmill and veneermill plant. ~~Derivatives~~ Income/Revenue from Tallowwood products covers approximately 63 % of the fixed costs of running the sawmill. If the Company is deprived of its revenue from tallowwood products, then the sawmill will become uneconomic and the Company must close it down unless changes are made in the conditions under which the Company operates which are beyond the ~~second respondent's~~ Company's control such as royalty rates, access to resources of other species and the availability of markets to accept an influx of products made from other species.

13. The sawmill is designed and set up for the processing of tallowwood and is incapable of being used efficiently for processing other species without substantial and costly

modifications. The sawmill presently uses a twin band saw installed specifically for sawing specialty products that are mainly made from tallowwood. Such modifications would involve installing other sawing equipment and associated handling equipment and docking facilities. It would take about six months to make the necessary changeover. The total cost of conversion would be between $150,000 and $250,000. It would be uneconomic for the Company to spend this amount of money to modify the sawmill in the short-term, that is, for the period of about fifteen months during which the Forestry Commission will be preparing an environmental impact statement for the Chaelundi State Forest. For such modifications were to be economic in the long term, it would be necessary for the Company to change "midstream" to an entirely new strategy to sell the additional output of traditional non-tallowwood products into existing markets. Alternatively, the Company would have to develop entirely new products or entirely new markets for existing traditional non-tallowwood products. Current market conditions are extremely difficult and, if they continue, the Company would not be able to compete. Therefore unless other changes are made in the conditions under which it operates which are beyond the second respondent's control the sawmill will have to close down.

14. Secondly, if the sawmill closes, the Company will have to terminate the contracts of service of all personnel employed at the sawmill (51 in number), the contracts of service of marketing personnel employed in Sydney (~~in number~~) and contracts with 29 loggers and logging companies who cut timber for the Company, 5 of whom provide a total of about 15 jobs work exclusively for the Company. This means a large number ~~of number~~ jobs will potentially be lost if the sawmill closes.

15. Thirdly, the Company has built two villages called Briggsvale and Cascade on land in respect of which the Forestry Commission has granted an occupation permit to the Company. The Company has built 31 houses, a water supply

system and a reticulated sewerage system. It has invested $1,560,747 in improvements at Briggsvale and Cascade since 1924 and has insurance cover for reinstating the capital improvements at Briggsvale and Cascade as follows:-

31 houses at $1.2 million.

The sawmill and other improvements at $6 million.

16. The Company maintains the improvements at Briggsvale and Cascade and pays rates on the land comprising the villages ~~at an approximate cost of $ per annum.~~

17. If it becomes necessary to close the sawmill, it will be uneconomic for the Company to maintain the improvements at Briggsvale and Cascade and to comply with the conditions of the occupation permit which, in turn, will render the occupation permit liable to cancellation or non-renewal. If the occupation permit is cancelled or not renewed, then, pursuant to the final clause of the Conditions Of Occupation Permit (For Sawmill Site), the Company may be put to the expense of clearing the site of all improvements within three months of the date of cancellation or non-renewal or, alternatively, such improvements as are not removed will become crown property. Thus the Company would suffer a very substantial capital loss. The Company could not afford to lose the improvements and then replace them if logging were to be permitted to recommence at some later time.

18. Fourthly, the communities at Briggsvale and Cascade consist of workers at the sawmill and their families and other employees of the Company and their families who pay a nominal occupation fee to the Company. A total of [insert number] people live at Briggsvale and Cascade. Three generations of the Sly, Duck and Dury families live at Briggsvale. There is a low turnover of residents in these villages, so they are close-knit communities. The Company has a policy of permitting workers who retire from employment with it at or after normal retirement age to

occupy one of the houses at Briggsvale or Cascade for the rest of his or her natural life. Presently, one such former employee, Merle Turner, who will not disclose her age but is about 80 years old, occupies a house at Briggsvale. There is a great deal of goodwill and mutual help between the community and the Company. The residents of the villages operate a voluntary fire watch service to prevent fire from damaging the improvements in the villages. The Company supplies the residents of the villages with firewood free of charge from offcuts from the sawmill.

19. If the second respondent were to close the sawmill and cease maintaining the improvements at Briggsvale and Cascade, then arrangements would have to be made for the maintenance of the improvements in the villages and an issue might arise as to the legal entitlement of the residents to continue to live there. If no satisfactory arrangements can be made to enable the residents to continue to live at Briggsvale and Cascade, then they will have to seek alternative accommodation, probably at normal commercial rates, which could well cause them hardship, particularly if they cannot find alternative employment.

20. Fifthly, if the sawmill must close because of a lack of tallowwood but can recommence operations after completion of an environmental impact statement and, assuming that the site area does not have to be cleared in the meantime, then the Company estimates it will incur the following costs of re-establishing operations at the mill:-

(a) Obtaining new staff because existing staff will have got other jobs and may not return - $150,000.00;

(b) Training new staff - $100,000.00;

(c) Maintenance costs in the intervening period - $40,000.00;

(d) Special costs of re-commissioning the plant - $10,000.00 to $20,000.00;

(e) Re-establishing lost markets and goodwill - $300,000.00.

21. Sixthly, if the second respondent has no access to tallowwood until mid-1991, it will have to suspend its research and development into alternatives for tallowwood cross-arms because, without profits from tallowwood, the project cannot be funded. If the Company has to abandon the cross-arm project, then its investment will be wasted. The contracts of service of the personnel engaged in research and development and marketing for the project will have to be terminated. This will result in the loss of 2 jobs. If harvesting of tallowwood were to be permitted to resume at some future time, but research and development cannot be continued in the meantime, then there will be delay in the introduction of the alternative blackbutt product into the market with the consequence that the Company's dependence on tallowwood will be prolonged. Further, the introduction of the alternative to tallowwood cross-arms must be gradual and depends on the continuing availability over time of a proportion of tallowwood cross-arms to the market until the users' confidence in the alternative product grows to a level where dependence on tallowwood cross-arms will decline and, ultimately, abate entirely. Further again, the Company will lose market share to its competitors in the cross-arms market whose products are made from steel rather than timber. Timber cross-arms are only a fraction the cost of steel cross-arms. If timber cross-arms are not available because tallowwood is unavailable, the Company's competitors will have the opportunity to supply steel cross-arms to the Company's customers. Once those customers decide to change to steel cross-arms, they will have to spend money on redesigning and modifying their power lines and will have to invest in capital equipment and training for the finishing and re-galvanising of steel cross-arms. Having made that

commitment of capital to steel cross-arms, the Company's customers are unlikely to change back to tallowwood cross-arms if they become available again.

11. SUMMARY

12. In summary, this Company submits that, if it is unable to obtain tallowwood from the Chaelundi State Forest from the end of October 1990, serious adverse economic consequences will flow to the employees of the Company, the communities of Briggsvale, Cascade and Dorrigo and the the Company itself.

.....

K L Briggs
General Manager

M11682 (B)

APPENDIX 3.

PMP Classification

APPENDIX 3

FORESTRY COMMISSION OF N.S.W.

S.O. 308 D. West, Government Printer

H O No. 13117 (MPD)

Circular 1100(re-issue)

Preferred Management Priority Classification

Introduction

Circular No. 1100 of 28th August, 1980 initiated a system of area classification within State Forests which will provide a ready reference to long term planning intent in a spatial plane so as to recognize particular values and to form a basis for applying appropriate management prescriptions designed to maintain and/or enhance such values. The proposal reflected a need for more detailed spatial planning than can be achieved within a management plan, to facilitate management generally, to protect important environmental values more specifically, and to communicate with the public.

A Preferred Management Priority (P.M.P.) Classification will consist of a map, subject to formal approval by the Commission or delegated officers, showing by different shadings the boundaries of management priority classes. This map will be a planning document in its own right, distinct from, but parallel to the management plan and in no way superseding or replacing it. Where a management plan gives detailed prescriptions, is spatially broad and subject to periodic revision, the proposed classification will be broad in its prescriptions, spatially detailed and subject to continuing revision. In the long term, management plans will refer to the corresponding management priority classification and will set out detailed prescriptions applicable to each priority class.

Outline of Classification

The classification is a three-stage hierarchical system with each category being designated by decimal numbering. This is illustrated on the attached chart.

Each category is defined as follows:

First Stage Categories

1. Indigenous Forestry Use

. Areas to be managed indefinitely under generally indigenous vegetative cover. This may include non-forest formations (e.g. water, heaths, swamps, rock outcrops, natural clearings, buildings, roads, recreation areas) which are integral to such management.

2. Exotic Forestry Use

. Broad areas generally established to and being managed as plantations of exotic tree species or kept for establishment of exotic plantations in the future. Areas in the latter category may be subject to extensive, non-developmental management of existing vegetation (e.g. harvesting of natural timber, grazing, apiary, extensive recreational use) pending conversion to exotic plantation. The class may contain as small inclusions (islands or narrow belts, but not broad

areas), land not suitable for exotic plantations such as watercourse fringes, swamps, rocky areas, log loading sites, forest building sites or minor recreation sites.

3. Non Forested Use

. Significant areas (generally greater than 10 hectares or, if strip developments, generally wider than 100 metres) set aside for use in a non-forested state.

Second Stage Categories

1.1 Multiple Use Natural Forest

. Areas carrying native forest vegetation to be maintained indefinitely under indigenous forest cover and used for timber production, catchment protection, wildlife habitat, forest recreation, grazing and apiculture to varying degrees.

1.2 Undeveloped Natural Forest

. Native forest areas of low commercial timber value by reason of forest types, site quality and difficult terrain and location, to be retained essentially as protection forest.

. Developments restricted to extensive fire protection activities, walking trails and minimum fire trail access necessary for fire protection.

. Timber production at most, restricted to minor selective harvesting involving only temporary surface access tracks. Harvesting or other forest operations should have negligible effect on forest stand or hydrological conditions.

. Silvicultural development of timber stands excluded.

1.3 Preserved Natural Forest

. Areas of natural forest to be maintained in an undisturbed natural condition and for the preservation of specific biological values. Includes Flora Reserves, Forest Preserves and other areas of known unique, rare or uncommon biological values which are worthy of consideration for formal preservation. Development is generally excluded from this class. All timber harvesting is excluded and recreational use is restricted to levels which will not prejudice the preserved forest values.

1.4 Native Species Plantation Forestry

. Broad areas generally established to and being managed as plantation of indigenous tree species or kept for establishment of indigenous plantations in the future: Includes only areas to be managed as full plantation; does not include natural areas where planting of indigenous tree species may be used to assist natural regeneration in rehabilitating to a full natural forest cover following harvesting. The class may contain as small inclusions, (islands or narrow belts but not broad areas) land unsuitable for plantation culture such as watercourse fringes, swamps, rocky sites, forest building sites or minor recreation sites.

2.1 Amenity Plantation

. Areas of or intended for exotic plantations primarily for some amenity purpose, such as soil reclamation, landscape improvement etc. Timber production to the extent compatible with the retention of the amenity value is permissible for such plantations but is not the primary purpose.

2.2 Timber Production Plantation

. Areas of existing or intended exotic plantation primarily for timber production.

3.1 Use as Cleared Land

. Significant areas of cleared land (generally greater than 10 hectares) within a general forest complex to be retained for some use e.g. banana plantation, pasture, crop paddock, in their cleared state.

3.2 Special Site Development

. Significant areas (10 hectares plus) used and retained for some special site development, such as nurseries, forest headquarters buildings, forest villages, major transmission lines. Does not include small areas occupied by small structures e.g. picnic facilities, huts, within generally forested areas.

Third Stage Categories

The third stage categories apply only to multiple use native forest and plantations. In short, those lands for which timber production development is permissible under the first and second stage zoning. Third stage classifications may apply from broad areas down to near point locations. They provide an additional qualification on the general management intent provided in first and second stage classification, in the emphasis of management on specific values inherent in the particular areas as follows:

1. General

. Management for timber production and other forest values without particular emphasis on any of the non-wood values.

2. Special Emphasis Recreation

. Areas possessing inherent natural features of direct significance to forest recreation e.g. proximity to waterways, waterfall, scenic vantage points, aesthetic or interesting timber stands or vegetation features or areas which, by virtue of location or tradition have significant social meanings unique to the particular site. Does not include areas which might be used periodically as minor picnic sites but which possess no special long term value for forest recreation. Management for other uses in this class is constrained to the levels necessary to ensure maintenance of the recreation value.

3. Special Emphasis Education

. Areas of special value through location and vegetation type for the demonstration of forest values and forestry practice. Management for other uses is constrained to a level designed to maintain the features of educational values.

4. Special Emphasis Research

. Areas containing features required for long term research e.g. arboreta, planting trials, long term experimental plots. Management is directed to the maintenance of the characteristics being researched.

5. Special Emphasis Catchment Protection

. Areas forming catchments of particularly sensitive water supplies or aquatic ecosystems where above-normal prescriptions or constraint in catchment use for maintenance of water quality and soil stability may be necessary. Does not include filter strips or streamside reservations from clearing or logging etc. which are the result of routine prescriptions.

6. Special Emphasis Visual Resource Protection

. Areas of particular visual sensitivity such as escarpments or hillsides forming noticeable landscape components relative to population centres or routes and which may require extraordinary treatments or constraints in management to maintain visual quality. Areas should normally exceed about 100 m in width before being separately classified.

7. Special Emphasis Flora and Fauna Protection

Areas containing habitats of rare or endangered or otherwise especially valued flora or fauna including areas reserved for general habitat protection, where the protection of such habitats does not necessarily require full preservation of the whole area but where management needs some adjustment from normal to ensure maintenance of the specific habitats, may include reservations of areas for general habitat protection e.g. in chipwood operations or plantation conversion, but only where these exceed routine prescriptions for filter strips or streamside reservation under erosion mitigation conditions.

8. Special Emphasis Historical Values

. Areas containing structures, ruins or artifacts of significance to the history of non-Aboriginal man in Australia and in which these historical values should be maintained.

9. Special Emphasis Aboriginal Sites

. Areas of established significance to the history and/or culture of Aboriginal man, where management should be oriented to the maintenance of these cultural values.

Implementation

Preferred Management Priority classification should proceed independently of Management Plan preparation. In due course, classification will be integrated with Management Plans, with differing prescriptions, such as for harvesting, being made for different categories. This will occur gradually as Management Plans are revised or new plans initiated.

a) Area: The classification should be undertaken for each separate management area but should extend only to State Forests, since the management responsiblity for other Crown-timber lands is limited.

b) Intensity: The classification should proceed only to the level warranted by existing knowledge of the area and by definite long term intent. Although the classification should proceed to the third stage for all areas, the "general" category should be used except where the need for a special emphasis classification is clearly known and demonstrable. Variations in treatment which result from the routine application of general prescriptions (e.g. to protect catchment, faunal or visual values within a multiple-use forest) should not be reflected in the classification. Such routine variations are implied within the appropriate "general" category. Departure from the "general" category implies the existence of a value which is to some extent unique to that area and which requires modification of routine prescriptions for the long term maintenance or enhancement of that value.

First and second stage classifications should not be made for areas less than 10 ha or 100 m in width. Third stage classification may be for near-point locations (e.g. for historic or aboriginal sites) but not usually for narrow strips (e.g. roadside or streamside reserves).

It is not the intention that classification should be dependent on exhaustive resource surveys. Classification should proceed on the basis of present knowledge and will be subject to amendment as new information and management strategies emerge.

The National Parks and Wildlife Service has requested that P.M.P. maps not reveal site locational information to the public, so as not to encourage public visitation and subsequent accidental site disturbance or deliberate vandalism. Although all areas meeting the criteria should be classified, base P.M.P. maps, which are public documents, should not include any P.M.P. 1.1.9 areas based on a single Aboriginal site and generally less than 10 hectares in extent, or otherwise likely to disclose the locations of specific Aboriginal sites. Broader areas, including notified Aboriginal Areas should nevertheless be included. Those P.M.P. 1.1.9 areas excluded from base P.M.P. maps should be separately recorded on an appropriate detachable map overlay. This overlay, while forming part of the official P.M.P. classification, shall not be available for inspection by the public.

Within the above definitions and guidelines, a considerable degree of ambiguity in the application of categories will be experienced initially. It is virtually impossible to eliminate this ambiguity fully. Examples of the classification process are provided in the Appendix to this circular which should provide some guidance. If necessary, subsequent review by Management Officers will provide the mechanism to achieve better consistency.

The classification should produce a comprehensive and mutually exclusive partition of the State Forests in the management area. That is, each area should be in one, but only one category. The basic class is 1.1.1 and all classification, at each level, should be considered as advances from this base. In third level classification, higher number categories should normally take precedence over lower numbers on the basis that these would involve greater management constraint and hence generally meet the requirements for special emphasis of lower order. For example, in an area of visual resource protection including unique recreational resources category..6 would normally be applied. In each case, however, the required level of management planning constraint should be the final basis of judgement.

c) Maps: Classification plans should be presented on base maps specially prepared and maintained for that purpose only. It is considered that the 1:25 000 series management or CMA maps should be the most appropriate where these are available. Where not available a scale in this range should be chosen. The intent is that the maps should explicitly and unambiguously define the areas. They should not be considered schematic. (1:15 840 would be suitable but perhaps too awkward for easy reference; 1:50 000 would still be suitable; a project map would be quite unsuitable). In management areas where state forests are widely scattered (e.g. in Western Districts) individual or group-of-state-forest maps at the appropriate scale should be used.

d) Legend: A standard legend has been devised and this is outlined in the following tables with suggested colours for both Town and Country Inks and Derwent Pencils. The particular shades are illustrative only, however the basic colour pattern, with lighter shades for the general category and a single darker shade for the special emphasis categories should be maintained.

The letter symbols which delineate the special emphasis categories should be carefully hand printed over the areas to form a grid approximately 1 cm square, using a fine black felt tipped pen or black mapping pen. Point locations should be designated by a single symbol.

The maps will be management planning documents and available to the public with the exception of Aboriginal site overlays and deriving their force from the Forestry Act, should therefore be of an appropriate high standard. While in some cases it may be practicable to have maps tinted in Regional Offices, pencil coloured maps produced in District Offices will be adequate. Each map should be fully labelled and the legend shown, and should carry an up to date approval certificate signed by the appropriate officer.

Approval for Classification and Amendment

The initial plans will be approved by Management Officers in the course of their regular visits to each District.

The classification has been designed so that increasing planning constraint in management correlates with increasing classification number. Plans may be amended subsequently on the Regional Forester's authority for any amendment involving an advance in number of second and third stage level, but only on Head Office authority for a change in first stage classification or a regression in number in second and third stage classification.

Approval should be renewed by the Regional Forester at the beginning of each financial year. Approved plans should be held in both District and Regional Offices and, with the exception of Aboriginal site overlays, be available for inspection by the public.

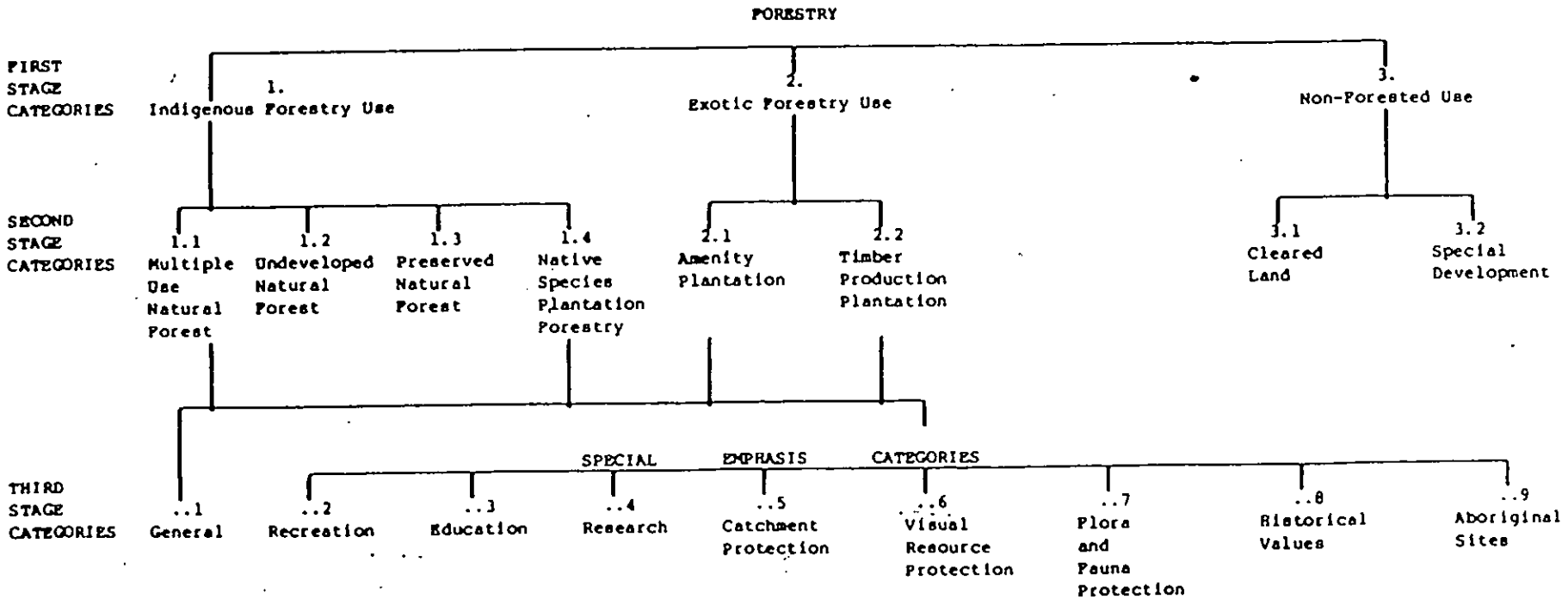
Circular No. 1100 of 28th August, 1980 is hereby cancelled.

G.S. LUGTON,
Secretary.

per:

14th November, 1983.

PREFERRED MANAGEMENT PRIORITY CLASSIFICATION



Standard Colour Legend for P.M.P. Classification

Category		Basic Colour	Suggested/Approximate Shades T & C Colour	Pencil No.
1.1	Multiple Use Natural Forest			
	1.1.1 General	Light Green	Green 1.2	44
	1.1.2-9 Special Emphasis	Dark Green	Green 1	46
1.2	Undeveloped Natural Forest	Brown	Yellow Brown 2	57
1.3	Preserved Natural Forest	Green Grey	Green Grey 1	45
1.4	Native Species Plantation Forestry			
	1.4.1 General	Light Blue	Blue 1.1	39
	1.4.2-9 Special Emphasis	Dark Blue	Blue 2	35
2.1	Amenity Plantation			
	2.4.1 General	Light Purple	Blue Purple 1.2	26
	2.1.2-9 Special Emphasis	Dark Purple	Red Purple 1.1	23
2.2	Timber Production Plantation			
	2.2.1 General	Light Red	Red 2.2	17
	2.2.2-9 Special Emphasis	Dark Red	Red 1	14
3.1	Cleared Land	Yellow	Yellow 1	2
3.2	Special Development	Orange	Orange 1.1	8

Special Emphasis Symbol Legend

Category		Symbol
..2	Recreation	Rec
..3	Education	E
..4	Research	R
..5	Catchment Protection	C
..6	Visual Resource Protection	V
..7	Flora and Fauna Protection	F
..8	Historical Values	H
..9	Aboriginal Sites	A

APPENDIX: Examples of Preferred Management Priority Classification

A. Typical Native Forest

FIRST STAGE CATEGORIES

In this typical native hardwood Management Area, the whole of the area is classified as 1. Indigenous Forestry Use - except for an O.P. for agricultural purposes, which being over 10 hectares has been classified as 3. Non-Forested Use (3.1 Cleared Land). The Indigenous Forestry area includes one large lake (over 10 hectares) and a substantial area (20 hectares +) of heath type vegetation. It also includes a trial plot of P. radiata established in the 1940s.

SECOND STAGE CATEGORIES

At the second stage of classification, the greater part of the 1. Indigenous Forestry Use area has been classified as 1.1 Multiple Use Natural Forest. Advances on this basic classification have been made as follows:

- Two Flora Reserves, three Forest Preserves and an area of rainforest which is currently under investigation for probable reservation have been advanced to 1.3 Preserved Natural Forest.
- A large (over 1 000 hectares) area with very steep slopes where harvesting would be both economically and environmentally unacceptable together with a similarly large separate area of very low quality swampy land and the adjoining heath type vegetation which have been advanced to 1.2 Undeveloped Natural Forest.
- All that area which has been established to full eucalyptus plantation has been advanced to 1.4 Native Species Plantation Forestry. This area (at present 800 hectares) is made up of a number of non-adjacent areas (down to about 40 - 50 hectares) which were tractor-cleared and planted with jiffy pots in consequence of non-regeneration after logging in a moist hardwood type.

All of the remaining area, classified as 1.1 Multiple Use Natural Forest, includes a variety of different forest types including a substantial area of rainforest, intermingled with the hardwood forest, where routine logging is not permitted, and areas which have been planted with jiffy pots in a general regeneration programme based on natural regeneration together with some snig track extension and dump site planting.

THIRD STAGE CATEGORIES

At the third stage of classification, the 1.1 Multiple Use Natural Forest has to a large extent been classified as 1.1.1 General. Advances from this basic classification have been made as follows:

- A developed picnic area situated on the shores of the lake together with an adjacent area containing a walking trail has been classified as 1.1.2 Special Emphasis Recreation. (However three small fireplace table roadside rest areas along the main forest road, having little inherent recreational value have been retained as 1.1.1 General).

- A creek side flat, currently inaccessible and undeveloped, but with good recreational potential, and likely to be accessible in future has been advanced to 1.1.2 Special Emphasis Recreation.

- A nature trail, which has been developed specially for use by school groups with interpretive signs and literature, and which covers a unique area for the purpose including examples of a variety of vegetation types, past treatments and early logging has been advanced to 1.1.3 Special Emphasis Education.

- Three commission research plots, including a P. radiata trial plot together with an area in which a University department has been allowed to establish a long term wildlife study have been advanced to 1.1.4 Special Emphasis Research to reflect a need for special considerations in harvesting, burning regimes etc. A number of inventory and permanent growth plots, as well as an area being used for short term study of the impact of routine harvesting operations have not been advanced beyond 1.1.1 General, reflecting the routine nature of their management.

- An area of about 500 hectares, within the immediate catchment of the local shire water storage, where the shire has expressed some interest and concern for the maintenance of water quality has been advanced to 1.1.5 Special Emphasis Catchment Protection.

- Four areas have been advanced to 1.1.6 Special Emphasis Visual Resource Protection. The first covers an area of forest close to the main regional population centre, which forms an important visual backdrop to the town and although no specific concern has been expressed by residents to date, it could be expected, if the quality of the view were somehow to be impaired. The second is a strip along the major state highway which traverses one of the forests of the Management Area. This area is over 100 m wide (each side of the highway) and includes some very fine, large stands of eucalypts which are periodically treated to remove undergrowth and improve depth of view, together with a roadside rest area. The third area is a strip (over 100 m wide) along the top of a major escarpment which forms a significant feature of the landscape, visible over a wide region. The fourth is a strip (over 100 m wide) along a river identified as having wild and scenic values, and used for canoing and rafting.

- A number of wildlife corridors identified on the basis of research into habitat preferences and designed to maintain a network of suitable habitat over the Area have been advanced to 1.1.7 Special Emphasis Flora and Fauna Protection.

- Two areas of a half a hectare each, containing a tree of outstanding size were advanced to 1.1.7 Special Emphasis Flora & Fauna Protection.

- A small area of about 50 hectares which contains a stand of a relatively unusual eucalypt species has been advanced to 1.1.7 Special Emphasis Flora and Fauna Protection. Although this species is adequately represented in Flora Reserves in other Management Areas, it is the only occurrence in this Management Area and has significant local value. This classification will ensure that logging does not inadvertently cause its local extinction.

- The route of an old logging railway, including a trestle bridge, has been advanced to 1.1.8 Special Emphasis Historical Values

* Two sites, one a rock face carvings and the other identified by local aborigines as being sacred to them have been advanced to 1.1.9 Special Emphasis Aboriginal Sites.

The remainder of this 1.1 Multiple Use Natural Forest, which retains the 1.1.1 General classification includes three small roadside rest areas, inventory and permanent growth plots, filter strips left in logging and plantation clearing, rainforest and a Forest Drive. Each of these areas are subject to special prescriptions in the Management Plan, but are considered to be within the scope of routine multiple use management and have not been separately classified.

The area classified as 1.4 Native Species Plantation Forestry has been further classified as 1.4.1 General except for two areas:

* Three hectares have been developed as a demonstration area for different silvicultural regimes and this area has been advanced to 1.4.3 Special Emphasis Education

* A species trial plot set up by W.T. & F.R. Division has been advanced to 1.4.4 Special Emphasis Research.

B. Typical Exotic Pine Plantation Forest

FIRST STAGE CATEGORIES

In this typical exotic plantation Management Area, two first level categories are defined 1. Indigenous Forestry Use and 2. Exotic Forestry Use.

1. Indigenous Forestry Use includes broad areas which have not been and are not planned to be converted to exotic pine plantation. This includes areas generally unsuitable for plantation growth due to soils, climate etc. These areas are quite distinct from the rest of the Area. Within the area generally suitable for plantation, a number of smaller, discrete areas have been excluded from conversion as a result of steep slopes, or other considerations. Where these areas are generally greater than 100 m in width and over 10 hectares in area, they have been classified as 1. Indigenous Forestry Use. A Forest Preserve, which is surrounded by pine plantation, has been included as 1. Indigenous Forestry Use and advanced to 1.3 Preserved Natural Forest. Another block of retained native forest, unremarkable in itself, but nevertheless significant for general habitat conservation in an area generally converted to pasture and plantation has also been included as 1. Indigenous Forestry Use and advanced to 1.1.7 Special Emphasis Flora and Fauna Protection. Further classifications within this area have been made along the general lines outlined in example A above.

2. Exotic Forestry Use therefore includes all areas currently established to pine plantation, those areas designated as suitable for conversion and ultimately planned for that use, together with small included areas such as filter strips, wildlife corridors, visual buffers and a recreation area all of which have been retained under native forest cover and will continue to be maintained as such, but which are generally less than 100 m wide and 10 hectares in area. It is anticipated that as plantation establishment continues, some large areas will be identified as unsuitable for conversion and these will then revert to 1. Indigenous Forestry Use. Similarly some pre-war plantings were made on areas now considered to be marginal plantation propositions and it is planned to re-establish these areas to native forest after final felling. These areas

will also be reclassified to 1. Indigenous Forestry Use in that Management Plan period during which final felling is scheduled.

SECOND & THIRD STAGE CATEGORIES

No areas have been classified as 2.1 Amenity Plantation, therefore the whole of the 2. Exotic Forestry Use area also becomes 2.2 Timber Production Plantation. Most of this area has been classified at the third stage as 2.2.1 General. The following advances on this basic classification have been made.

- A Forest Park established within a pre-war stand of pine and another recreation site established in a small area retained under native forest, have been advanced to 2.2.4 Special Emphasis Recreation.

- Various research plots including an arboretum and some provenance trials have been advanced to 2.2.4 Special Emphasis Research. Inventory plots have been retained as 2.2.1 General.

- An area adjacent to a municipal water storage and within its catchment has been advanced to 2.2.5 Special Emphasis Catchment Protection.

- An area of pre-war pine alongside a major state highway, which includes a well-known and well-used roadside rest area has been advanced to 2.2.6 Special Emphasis Visual Resource Protection. Another area, which has been maintained under native vegetation mainly to add visual diversity to a major internal forest road, has similarly been advanced to 2.2.6 Special Emphasis Visual Resource Protection. A third area which forms part of the skyline visible from the main population centre has been similarly classified. This latter area would not now be converted to plantation, but rather retained as native forest. It was however converted thirty years ago, and present management will aim to sensitively manage the exotic stand to reduce visual impacts in subsequent operations

- A small area of 3 hectares has been maintained as native forest to preserve the habitat of a relatively rare shrub which is known from only four other localized sites in the region. This area has been advanced to 2.2.7 Special Emphasis Flora and Fauna Protection.

- A four hectare plot of pre-war Pinus radiata representing one of the earliest plantings in the Area and considered to be of some historical value has been advanced to 2.2.5 Special Emphasis Historical Values.

- A number of areas, containing early plantings of a variety of different pine species which are no longer generally planted have been advanced to 2.2.7 Special Emphasis Flora and Fauna Protection.

- An Aboriginal relic site has been identified in the native forest which is planned for future conversion. One hectare surrounding this site has been advanced to 2.2.9 Special Emphasis Aboriginal Sites.

APPENDIX 4A.

Harvesting plans – Compartment 180

DRAFT COPY ONLY

HARVESTING PLAN - DORRIGO.

STATE FOREST. Chaelundi State Forest 906 COMPARTMENT No. [illegible]

AREA: GROSS 231 Ha. NET 182 Ha.

Excluded from harvesting
- Special Emphasis Areas.
  - Visual Resource Protection [illegible]ha
  - Flora and Fauna Protection
    - Wildlife Corridors [illegible]ha
    - Other 4ha
- Other Rainforest Areas 12ha

Modified Harvesting 12ha

LEASE DETAILS (i) Tenure: Crown Lease 1940/18

(ii) Registered Holder: Mrs D.E. Tippett

TREE MARKING CODE

Yellow - Trees marked for retention not to be damaged
Pink - Trees marked for removal (axe blaze can be used)

AREA MARKING CODE

Blue - Compartment boundary
White - Dump Site
Orange - Road or track location

DRAINAGE LINE PROTECTION

3.1 FILTER STRIPS - Filter strips shown on map are 20 metres each side of water course.

3.2 PROTECTION STRIPS - Protection strips shown on map are 10 metres each side of water course.

EROSION MITIGATION (Standard Erosion Mitigation Conditions for Logging in N.S.W. shall apply).

CROSS DRAIN SPACING ON SNIG TRACKS

TRACK SLOPE	AVERAGE EROSION CLASS
Less than 15	60m
15 - 20	40m
20 - 25	20m
25 - 30	15m

6. ORDER OF WORKING

6.1 Dry Weather Areas: Log Dumps 2, 3, 9, 10, 11, 12, 13, 14, 15

6.2 Wet Weather Areas: Log Dumps 1, 4, 5, 6, 7, 8

PRODUCT SPECIFICATION AND ESTIMATED VOLUMES.

PRODUCT	SPECIFICATION	EST.VOLUME	LICENCEE
Poles & Girders	Conforming with AS 2209 for poles and suitable for current orders.	100m³G	LJ Williams
Quota Logs	Minimum length 3.0m, Minimum Small End diameter of 30cm. Maximum defect levels specified in Schedule of Compulsory Utilisation Limits for Dorrigo District.	10000m³	Allen Taylor & Co. Ltd
Other	Logs not meeting specifications above.	1000m³	Mitchells Mill

FOREST TYPE DESCRIPTION.

Type 47a (TWD-BG) (27ha.) This type is limited in the compartment, and occurs on lower slopes in western part of compartment.

Type 53a (Brushbox) 8ha. Several isolated pockets of BBX type are found within the compartment, generally associated with gullies and SE aspect.

Type 163a (New England Hardwood) 130ha. Dominant Type in compartment. Contains high SQ NEB but also TWD, STS, some BG as associated species.

Type 163b (New England Hardwood) 23ha. Lower site quality stands dominated by NEB occurring on ridge tops.

Type 168 (New England Stringybark) 11ha. Productive Type occurring in eastern part of Compartment. Contains Silvertop Stringybark, some TWD, NEB.

Type 2/3, 3/11 (Subtropical rainforest) 32ha. Well develcped stands occur in compartment generally associated with gullies The types are either excluded from harvesting by Special Emphasis Classification or harvesting prescriptions.

9. STAND CONDITION DESCRIPTION.

The compartment has not been previously logged. Eucalypt stands are mature and overmature throughout compartment. Compartment has a generally south easterly aspect and is characterised by moist understorey. The are is within Crown Lease, but the nature of the vegetation is such that burning activities have been minimal.

MODIFIED PRESCRIPTION AND SPECIAL EMPHASIS AREAS.

10.1 Mature and overmature trees suitable for provision of Wildlife habitat shall be retained at a frequency of at least 1 tree per ha, preferably in clumps of up to 5 trees scattered throughout the harvesting area.

10.2 Trees identified as feeding trees for Yellow Bellied Gliders and nearby refuge trees shall be retained.

10.3 In areas designated as Special Emphasis Flora and Fauna Protection (Wildlife Corridors,) no trees shall be felled within 20 metres of the centre of the strip, while harvesting shall be modified in the outer 20 metre zone to retain at least 50% canopy cover. Only those trees marked for removal by Forestry Commission personnel shall be felled in this outer zone.

10.4 All practical steps shall be taken to avoid damaging trees in rainforest stands. To this end hardwood trees which may cause damage to rainforest stands shown on the map shall be retained.

10.5 No disturbance either through tree felling, tractor or vehicular movement shall occur in the visual resource protection area 1.1.6 situated between Broadmeadows Road and National Park Boundary.

10.6 Ground disturbance in areas within 40m of eastern edge of Broadmeadows Road shall be minimised. Harvesting of salvage logs shall also be minimised within 40m of road.

11. ADDITIONAL INFORMATION.

11.1 Operations shall conform with Coffs Harbour Region Code of Logging practices and Conditions of Timber/Contractors/ Operators Licences.

In particular, the licensees attention is specifically drawn to the following clauses:-

i) 5.12 Requirements for stockpiling and spreading of topsoil on log dumps.

ii) 5.16 Requirements for progressive dispersal of bark from log dumps.

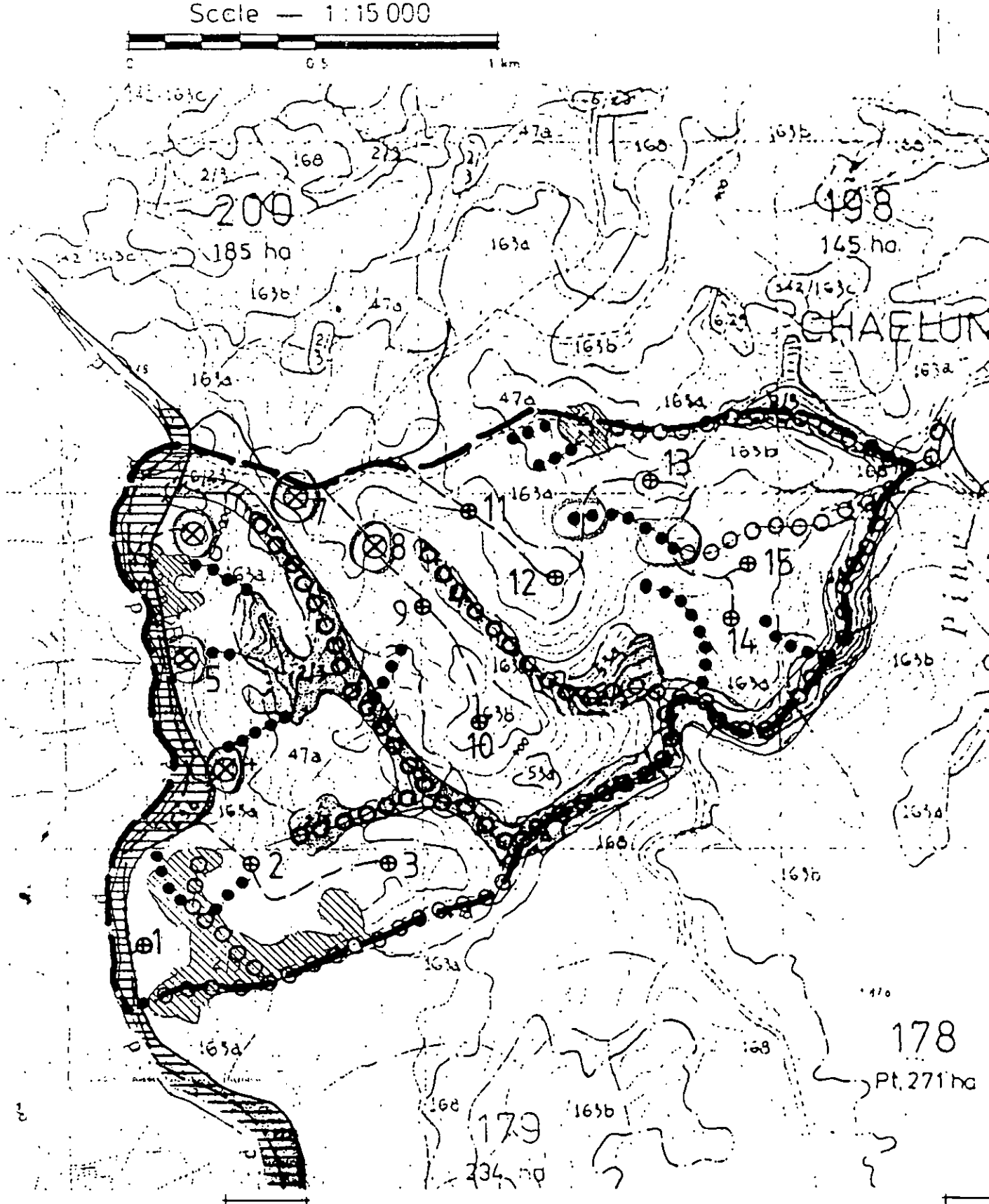
12. PREPARED BY: ..... APPROVED BY: .....

D.J. Murray D.J. Murray

DISTRICT FORESTER.

DATE 21st April,1990 DATE

Compartment 180



Compartment boundary
Fence
Filter strips
Protection strips
Reserved from logging
Rock, gravel pit, cliff

Feeder road, dump site
Special emphasis: 1.1.6 Visual resource protection
1.1.7 Flora and fauna protection
Forest type
Wet weather dumps
Rainforest areas other than 1.1.7 Special emphasis

APPENDIX 4B.

Harvesting plans – Compartment 198

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HARVESTING PLAN - DORRIGO.

1. STATE FOREST. Chaelundi State Forest 996 COMPARTMENT No. 198

AREA: GROSS 145 Ha. NET 130 Ha.

Excluded from Harvesting

Special Emphasis Areas.	
Flora and Fauna Protection	
Wildlife Corridors	4ha
Other	3ha
Other Rainforest Areas	2ha
Steep Topography	6ha
Modified harvesting	5ha

LEASE DETAILS (i) Tenure: Crown Lease 1940/18

(ii) Registered Holder:Mrs D.E. Tibbett

2. TREE MARKING CODE

Yellow - Trees marked for retention not to be damaged
Pink - Trees marked for removal (axe blaze can be used)

3. AREA MARKING CODE

Blue - Compartment boundary
White - Dump Site
Orange - Road or track location

4. DRAINAGE LINE PROTECTION

3.1 FILTER STRIPS - Filter strips shown on map are 20 metres each side of water course.

3.2 PROTECTION STRIPS- Protection strips shown on map are 10 metres each side of water course.

5. EROSION MITIGATION (Standard Erosion Mitigation Conditions for Logging in N.S.W. shall apply).

CROSS DRAIN SPACING ON SNIG TRACKS

TRACK SLOPE	AVERAGE EROSION CLASS
Less than 15	60m
15 - 20	40m
20 - 25	20m
25 - 30	15m

6. ORDER OF WORKING

6.1 Dry Weather Areas: Log Dumps 4, 5, 6, 7, 8

6.2 Wet Weather Areas: Log Dumps 1, 2, 3

PRODUCT SPECIFICATION AND ESTIMATED VOLUMES.

PRODUCT	SPECIFICATION	EST.VOLUME	LICENSEE
Poles & Girders	Conforming with AS 2209 for poles and suitable for current orders.	100m³G	LJ Williams
Quota Logs	Minimum length 3.0m, Minimum Small End diameter of 30cm. Maximum defect levels specified in Schedule of Compulsory Utilisation Limits for Dorrigo District.	6000m³	Duncans Holdings Ltd.
Other	Logs not meeting specifications above.	500m³	A & F Sawmill FM Neaves Sawmilling

FOREST TYPE DESCRIPTION.

Type 47a (TWD-BG) 5ha. This type is limited in the compartment, and occurs on western part of Compartment on south easterly aspect.

Type 163a (New England Hardwood) 28ha. Contains high SQ NEB but also TWD, STS, some BG as associated species.

Type 163b (New England Hardwood) 75ha. Lower site quality stands dominated by NEB occurring on upper slopes.

Type 168 (New England Stringybark) 22ha. Productive Type occurring in eastern part of Compartment on lower slopes. Contains Silvertop Stringybark, some TWD, NEB.

Type 142/163c (New England Stringybark - New England Hardwood) 9ha. Low site quality stands generally associated with rocky outcrops.

Type 2/3, 6/23 (Rainforest) 6ha. The types are either excluded from harvesting by Special Emphasis classification or harvesting prescriptions. The types occur in limited gully locations.

5. STAND CONDITION DESCRIPTION.

The compartment has not been previously logged. Eucalypt stands are mature and overmature throughout compartment. Compartment has a generally easterly aspect and is characterised by moist understorey in the southern part of compartment. The area is within Crown Lease, and has been used for grazing purposes.

10. MODIFIED PRESCRIPTION AND SPECIAL EMPHASIS AREAS.

10.1 Mature and overmature trees suitable for provision of Wildlife habitat shall be retained at a frequency of at least 1 tree per ha, preferably in clumps of up to 5 trees scattered throughout the harvesting area.

10.2 Trees identified as feeding trees for Yellow Bellied Gliders and nearby refuge trees shall be retained.

10.3 In areas designated as Special Emphasis Flora and Fauna Protection (Wildlife Corridors,) no trees shall be felled within 20 metres of the centre of the strip, while harvesting shall be modified in the outer 20 metre zone to retain at least 50% canopy cover. Only those trees marked for removal by Forestry Commission personnel shall be felled in this outer zone.

10.4 All practical steps shall be taken to avoid damaging trees in rainforest stands. To this end hardwood trees which may cause damage to rainforest stands shown on the map shall be retained.

11. ADDITIONAL INFORMATION.

11.1 Operations shall conform with Coffs Harbour Region Code of Logging practices and Conditions of Timber/Contractors/ Operators Licences.

In particular, the licensees attention is specifically drawn to the following clauses:-

i) 5.12 Requirements for stockpiling and spreading of topsoil on log dumps.

ii) 5.16 Requirements for progressive dispersal of bark from log dumps.

12. PREPARED BY:..... APPROVED BY:.....

D.J. Murray D.J. Murray

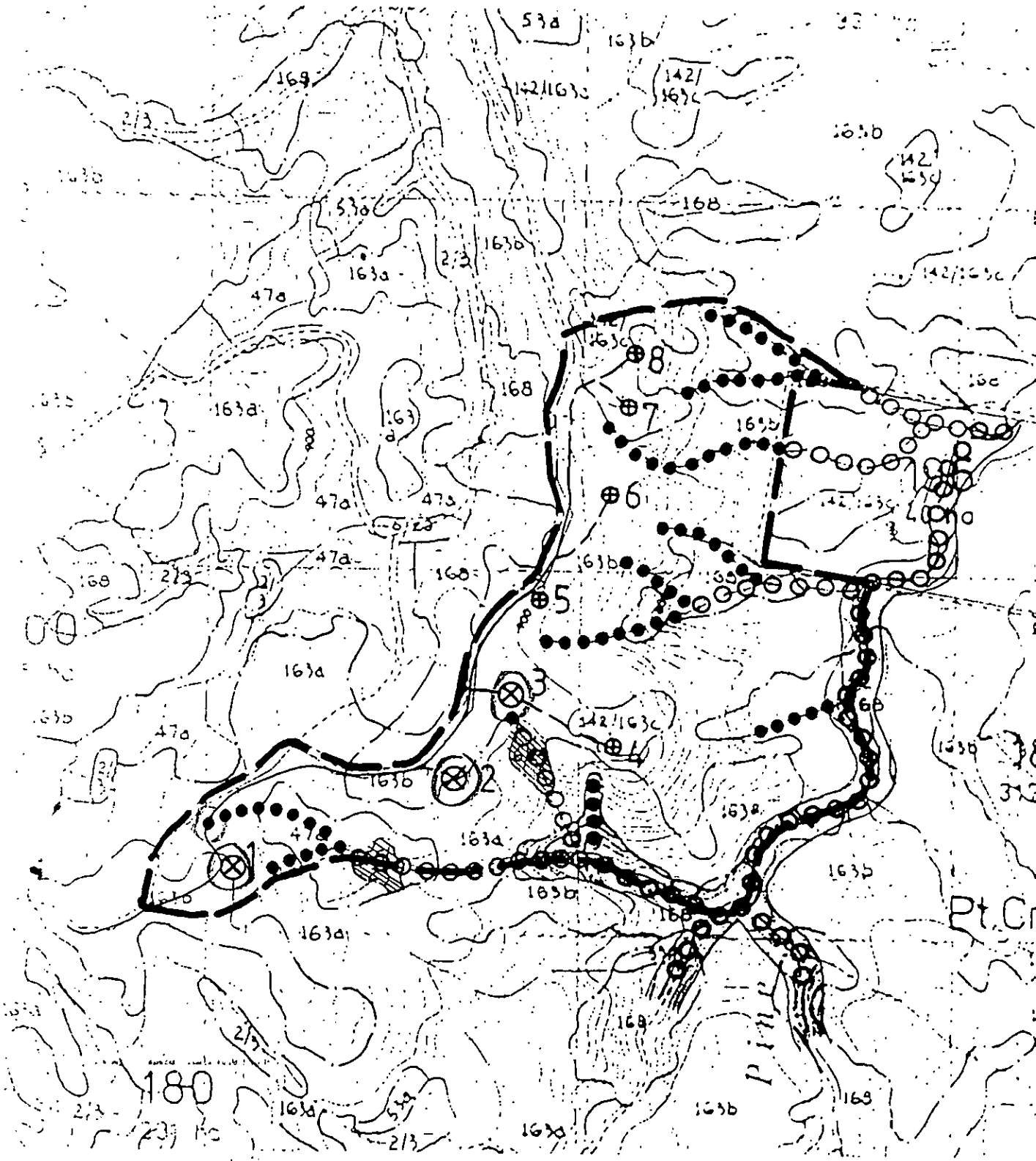
DISTRICT FORESTER.

DATE 21st April,1990 DATE

Compartment 198

Scale — 1 : 15 000

0 5 1 km



Compartment boundary

Line

Filter strips

Protection strips

Reserved from logging

Rock, gravel pit, cliff

Feeder road, dump site

Special emphasis: 1.1.7 Flora and fauna protection

Forest type

Wet weather dumps

Rainforest (not included in Special emphasis)

APPENDIX 4C.

Harvesting plans – Compartment 200

DRAFT COPY ONLY

HARVESTING PLAN - DORRIGO.

STATE FOREST. Chaelundi S.F. 996 COMPARTMENT No. [illegible]

AREA: GROSS 185 Ha. NET 153 Ha.

Excluded from harvesting

Special Emphasis Areas.	
Visual Resource Protection	5ha
Flora and Fauna Protection	
Wildlife Corridors	13ha
Other	15ha
Other Rainforest Areas	1ha
Modified harvesting	8ha

TREE MARKING CODE

Yellow - Trees marked for retention not to be damaged
Pink - Trees marked for removal (axe blaze can be used)

AREA MARKING CODE

Blue - Compartment boundary
White - Dump Site
Orange - Road or track location

DRAINAGE LINE PROTECTION

3.1 FILTER STRIPS - Filter strips shown on map are 20 metres each side of water course.

3.2 PROTECTION STRIPS- Protection strips shown on map are 10 metres each side of water course.

EROSION MITIGATION (Standard Erosion Mitigation Conditions for Logging in N.S.W. shall apply).

CROSS DRAIN SPACING ON SNIG TRACKS

TRACK SLOPE	AVERAGE EROSION CLASS
Less than 15	60m
15 - 20	40m
20 - 25	20m
25 - 30	15m

6. ORDER OF WORKING

6.1 Dry Weather Areas: Log Dumps 1, 2, 3, 8, 9, 10 - 15

6.2 Wet Weather Areas: Log Dumps 4, 5, 6, 7

PRODUCT SPECIFICATION AND ESTIMATED VOLUMES.

PRODUCT	SPECIFICATION	EST.VOLUME	[illegible]
[illegible] & [illegible]	Conforming with AS 2209 for poles and suitable for current reavers.	100m³	[illegible]
[illegible] Logs	Minimum length 3.0m, Minimum Small End diameter of 30cm. Maximum defect levels specified in Schedule of Compulsory Utilisation Limits for Dorrigo District.	700m³G	GL Dr[illegible] and [illegible]
[illegible]	Logs not meeting specifications above.	100m³G	[illegible]

BEST TYPE DESCRIPTION.

Type 17a (TWD-BG) 41ha. Occurs on eastern part of Cpt [illegible] slopes.

Type 163a, 163b (New England Hardwood) 17.a, 11ha. [illegible] altitude areas predominantly on western part of Cpt. Type a contains TWD and STS associated with NEB. Type 163b is [illegible] with some STS,DHS.

Type 168 (STS-TWD) 3ha. limited in extent in moist gu[illegible] nation.

Type 142/163 (Low SQ New England Hardwoods) 12ha. [illegible] outcrops.

Type 213 (Subtropical Rainforest)- (Yellow Carabeen, [illegible] 11ha Most of the type is covered by Special emphasis [illegible] fication (F.M.P. 1.1.7) and is excluded from harvesting [illegible] tion 10.4.

STAND CONDITION DESCRIPTION.

The area has not been previously logged. The compartment [illegible] mains mature and overmature stands throughout. It has a moist [illegible] erstorey component with little evidence of fire. Trees suitable [illegible] poles and girders are limited.

MODIFIED PRESCRIPTION AND SPECIAL EMPHASIS AREAS.

.1 Mature and overmature trees suitable for provision of Wildlife habitat shall be retained at an average frequency of [illegible] trees per ha, preferably in clumps of up to 5 trees [illegible] throughout the harvesting area.

.2 Trees identified as feeding trees for Yellow Bellied Gliders and nearby refuge trees shall be retained.

.3 In areas designated as Special Emphasis Flora and Fauna Protection (Wildlife Corridors), no trees shall be felled within 20 metres of the centre of the strip, while harvesting shall be modified in the outer 20 metre zone to retain at least 50% canopy cover. Only those trees marked for removal by Forestry Commission personnel shall be felled in this outer zone.

.4 All practical steps shall be taken to avoid damaging trees in rainforest stands. To this end hardwood trees which may cause damage to rainforest stands shown on the map shall be retained.

.5 No disturbance either through Tree felling, tractor or vehicular movement shall occur in the visual resource protection area 1.1.6 situated between Broadmeadows Road and National Park Boundary.

.6 Ground disturbance in areas within 40m of eastern edge of Broadmeadows Road shall be minimised. Harvesting of salvage logs shall also be minimised within 40m of road.

ADDITIONAL INFORMATION.

.1 Operations shall conform with Coffs Harbour Region Code of Logging practices and Conditions of Timber Contractors/ Operators Licences.

.2 In particular, licensees attention is specifically drawn to the following:

(i) 5.12 Stockpiling and spreading of topsoil on log dumps.

(ii) 5.16 Dispersal of Bark progressively from dump.

PREPARED BY: D.J. Murray APPROVED BY: D.J. Murray

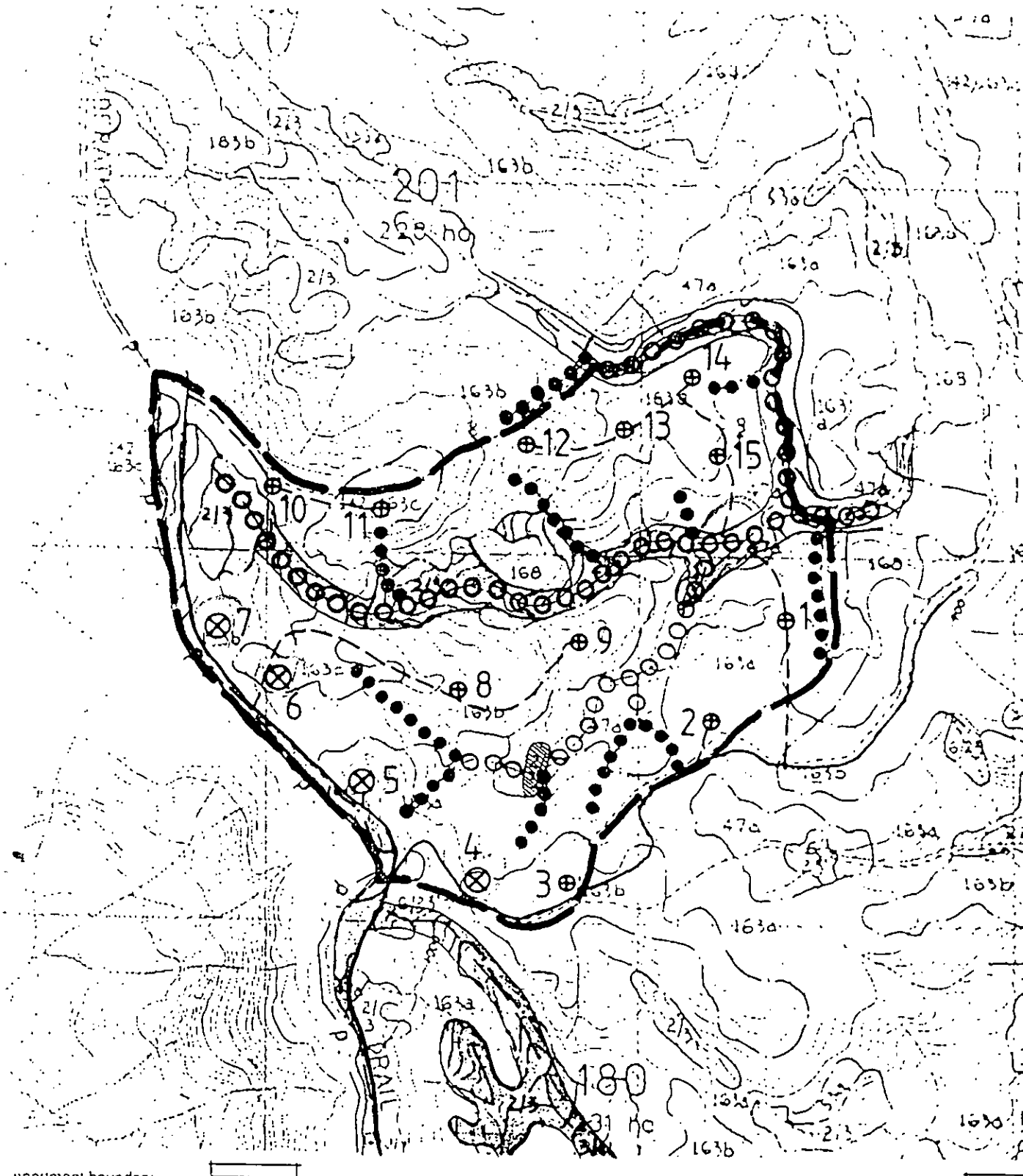
DISTRICT FORESTER.

DATE 11th April, 1990 DATE

Compartment 200

Scale — 1 : 15 000

0 5 1 km



- Compartment boundary
- Feeder road, dump site
- Special emphasis: 1.1.7 Flora and fauna protection
- Forest type
- Wet weather dumps
- Rainforest (not included in Special emphasis)
- strips
- reserved from logging
- gravel pit, cliff

APPENDIX 5.

Soil profiles

FROM FC UTBFRD 02 8716941 ... 14:51

CHALLUNDI S.F. EIS

SOIL DATA SYSTEM

PROFILE MAP DETAILS

Map Sheet No. | Eastings | Northings

Scale of Mapping: 1:25 000; 1:10 000; 1:8 000; 1:4 000; 1:126 720; 1:63 360; 1:31 680; other

SURVEY DETAILS

Described By | Profile Date | Same as Site | Photo Taken

Nature(s) of Exposure

SITE LOCATION DESCRIPTION

ROADMEADOWS RD; CPT 200, 500M N ON E

TOPOGRAPHY

Slope Percent

Elevation (metres)

Aspect

SOIL & MAP CODES

Factual Key | Atlas (Northcote) Code | Atlas (A & M) Code | Geology Map Code

CB

Soil Map Code

Land System

Soil Taxonomy

INSTRUCTIONS FOR USE

- USE 2B PENCIL ONLY
- ERASE CLEANLY & THOROUGHLY
- DO NOT BEND FORM
- CORRECT
- INCORRECT

LANDFORM

Site Process | Site Morphology | Slope Morphology | Microrelief | Landform Pattern

Site Morphology: flat; crest; hillock; ridge; upper slope; mid slope; simple slope; lower slope; open depression; closed depression

Slope Morphology: waxing; waning; maximal; minimal

Local Relief: extremely low (< 9m); very low (9-30 m); low (30-90 m); high (90-300 m); very high (> 300 m)

Microrelief: none; normal gilgai; crabhole gilgai; linear gilgai; lattice gilgai; melonhole gilgai; hummocky; terracettes; other

Landform Pattern: alluvial fan; alluvial plain; anastomotic plain; badlands; bar plain; beach ridge plain; caldera; chenier plain; coral reef; covered plain; delta; dunefield; escarpment; floodplain; hills; horst; lava plain; low hills; made land; meander plain; metamorphic plain; mountains; pediment; pediplain; peneplain; plain; plateau; playa plain; rises; sand plain; sheet-flood fan; stagnant alluvial plain; terrace; tidal flat; volcano

Landform Element: crest; mound surface; cone; tor; ...; bar; beach ridge; levee; ... stream; scroll; dune; foredune; lunette; embankment; mound; dam; hillslope; cliff/scarp; bench; landslide; footslope; pediment; talus; scree; bank; beach; fan; cut face; berm; plain; backplain; flood-out; channel bench; rock flat; rock platform; scald; tidal flat; valley flat; cut over surface; fill top; drainage depression; gully; alcove; estuary; streambed; stream channel; swale; tidal creek; trench; cirque; crater; sink hole/doline; maar; lagoon; lake; pan/playa; ox-bow; swamp; blow-out; pit

00748

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VEGETATION

Crown Separation Ratio

Upper Stratum Height

Vegetation Community

Growth Forms

Species

Upper Stratum

Mid Stratum

Lower Stratum

Dominant

Sub-Dominant

SITE CONDITION

Ground Cover %

Current Condition

Expected Dry Condition

Site Disturbance

LITHOLOGY

Outcrop

Outcrop Same As

Identification Method

Substrate Material

Substrate Strength

Weathering & Alteration

Solum P.M.

Substrate

HYDROLOGY

Presence of Free Water

Free Water Depth

Run-on

Run-off

Permeability

Profile Drainage

EROSION HAZARD

SALINITY

EROSION

Type

Erosion Severity

Present Condition

Gully Depth

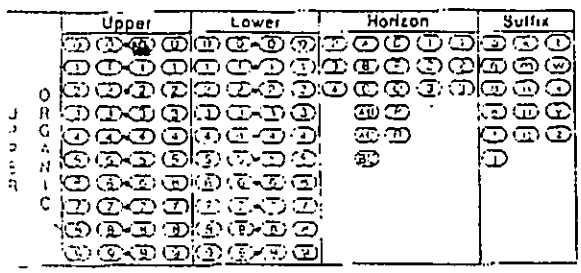
LAND USE

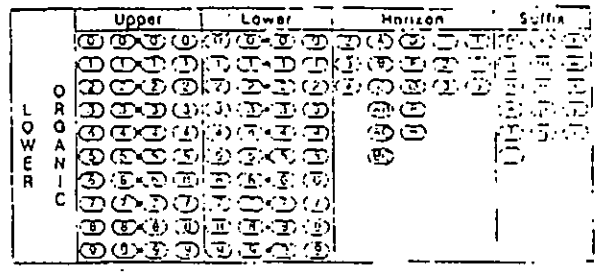
Site

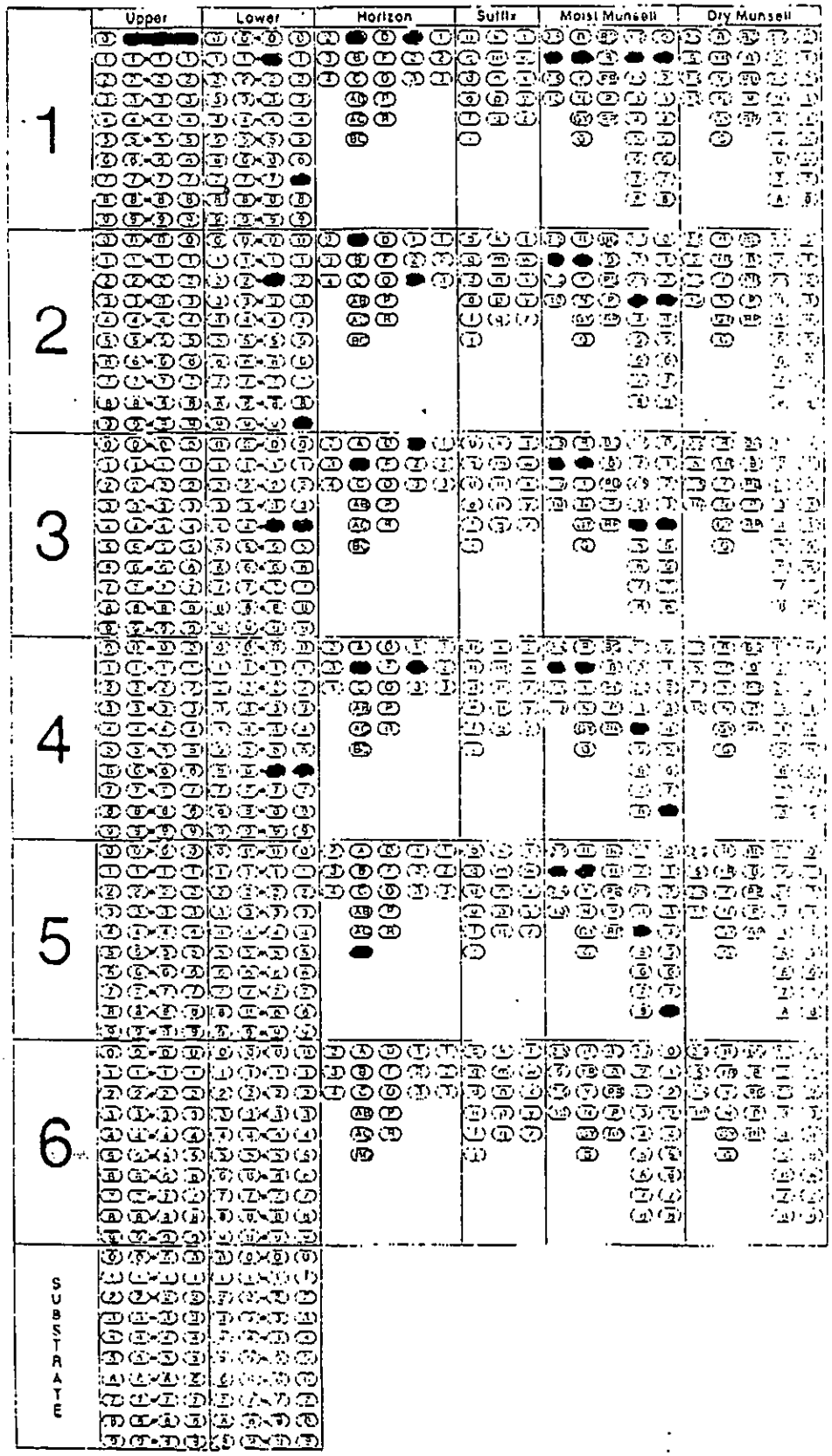
General Area

PROFILE ADDENDUM

LAYER STATUS







MOTTLES

Dominant				Type	Sub-Dominant					
3	4	5	6		1	2	3	4	5	6
				not evident						
				unspecified						
				biological						
				mechanical						
				weathered						
				Colour						
				dark						
				red						
				orange						
				yellow						
				brown						
				pale						
				grey						
				gley						
				Contrast						
				faint						
				distinct						
				prominent						
				Abundance						
				0%						
				< 2%						
				2% - 10%						
				10% - 20%						
				20% - 50%						

Dominant

1	2	3	4	5	6

Sub-Dominant

1	2	3	4	5	6

MECHANICAL TESTS

Shear (kpa)

1	2	3	4	5	6

Compressive (kpa)

1	2	3	4	5	6

CHEMICAL TESTS

Chloride	1	2	3	4	5	6
no precipitate						
light precipitate						
copious white precip.						
Carbonate						
no effervescence						
audible/slight efferv.						
strong effervescence						
Manganese Dioxide						
no effervescence						
effervescence						

pH

1	2	3	4	5	6

ERODIBILITY TESTS

Crumb Test	1	2	3	4	5	6
no change						
aggregates slake						
aggregates disperse						
worked bolus disperses						
Bolus Formation						
no deflocculation						
deflocculation						

LAYER BOUNDARY

Distinctivonnss	1	2	3	4	5	6
not evident						
sharp (5mm)						
abrupt(5 - 20mm)						
clear (20 - 50mm)						
gradual (50 - 100mm)						
diffuse (100mm)						
Shape						
smooth						
wavy						
irregular						
tongued						
broken						

FIELD TEXTURE

Texture Grade	1	2	3	4	5	6
sand						
loamy sand						
clayey sand						
sandy loam						
loam						
silty loam						
sandy clay loam						
clay loam						
clay loam, sandy						
silty clay loam						
sandy clay						
silty clay						
clay						
fibric peat						
hemic peat						
sapric peat						
sandy peat						
loamy peat						
clayey peat						
granular peat						

Sand Fraction	1	2	3	4	5	6
coarse						
fine						
Clay Fraction						
light						
light medium						
medium						
medium heavy						
heavy						
Organic Fraction						
sapric						
fibric						

CONSISTENCE

Rupture Test 1 2 3 4 5 6
Loose
Very weak force
Weak force
Firm force
Very firm force
Extreme force

Texture Modifier 1 2 3 4 5 6
decrease 1 grade
no change
increase 1 grades
increase 2 grades

Degree of Plasticity 1 2 3 4 5 6
non plastic
slightly plastic
moderately plastic
very plastic

Stickiness
non-sticky
slightly sticky
moderately sticky
very sticky

Bearing Test
Triangle
Oblate
Crumbly
Tabular
Blocky

SOIL WATER STATUS

1 2 3 4 5
dry
moderately moist
moist
wet

SAMPLE TAKEN

none
undisturbed
disturbed
undisturbed
micro-morphological

FABRIC

sandy
earthy
rough-faced peds
smooth-faced peds

SOIL ERODIBILITY

low
moderate
high

STRUCTURE

Degree of Pedality 1 2 3 4 5 6
Single Grained
massive
weakly pedality
strongly pedality
strongly pedality

PED SIZE — Dominant / Sub-Dominant 1 2 3 4 5 6

	2mm
	2 - 5mm
	5 - 10mm
	10 - 20mm
	20 - 50mm
	50 - 100mm
	100 - 200mm
	200 - 500mm
	500mm

PED SHAPE — Dominant / Sub-Dominant 1 2 3 4 5 6

platy
lenticular
prismatic
columnar
angular blocky
sub-angular blocky
polyhedral
granular
crumb
round

PED COATING

Coating Amount 1 2 3 4 5 6
none
few (< 10%)
common (10 - 50%)
many (> 50%)

Coating Type
clay
manganese
stress cutans
slickensides
topsoil
organic
other

Coating Distinctiveness
faint
distinct
prominent

SOIL FAUNAL ACTIVITY

Faunal Activity Degree 1 2 3 4 5 6
none
few (< 10%)
moderate (10 - 50%)
high (> 50%)

Faunal Activity Type
soil burrows/krotovinas
earthworm casts
termite channelling
ant channelling
other

COARSE FRAGMENTS

Fragment Type 0 1 2 3 4 5 6
not evident
not identified
as substrate
as rock outcrop
as parent material
quartz
feldspar
sesquioxide
ironstone
basalt
shells
charcoal
pumice
opalised wood
other

Fragment Amount
none
very few (< 2%)
few (2 - 10%)
common (10 - 20%)
many (20 - 50%)
abundant (50 - 90%)
very abundant (> 90%)

Fragment Distribution
stratified
dispersed

Fragment Orientation
reoriented
undisturbed

Fragment Weathering
non-weathered
weakly weathered
strongly weathered

Fragment Shape
rounded
rounded tabular
rounded platy
sub-rounded
sub-rounded tabular
sub-rounded platy
sub-angular
sub-angular tabular
sub-angular platy
angular
angular tabular
angular platy

Fragment Size
fine gravel (2 - 6mm)
gravel (6 - 20mm)
coarse gravel (20 - 60mm)
cobbles (60 - 200mm)
stones (200 - 600mm)
boulders (> 600mm)

CRACKS & MACROPORES

Crack Width	Amount	1	2	3	4	5	6
5mm	none						
	evident						
5 - 10mm	none						
	evident						
10 - 20mm	none						
	evident						
20 - 50mm	none						
	evident						
> 50mm	none						
	evident						

Macropore	Amount	1	2	3	4	5	6
< 1mm	none						
	few (< 1/10 x 10mm)						
	common (1 - 5/10 x 10mm)						
	many (> 5/10 x 10mm)						
1 - 2mm	none						
	few (< 1/10 x 10mm)						
	common (1 - 5/10 x 10mm)						
	many (> 5/10 x 10mm)						
2 - 5mm	none						
	few (< 1/100 x 100mm)						
	common (1 - 5/100 x 100mm)						
	many (> 5/100 x 100mm)						
5mm	none						
	few (< 1/100 x 100mm)						
	common (1 - 5/100 x 100mm)						
	many (> 5/100 x 100mm)						

PANS

Pan Type	1	2	3	4	5	6
not evident						
calcrete						
silcrete						
earthy pan						
duripan						
hardpan						
sandpan						
dark brown hardpan						
thin ironpan						
ferricrete						
alcrete						
manganiferous						
orthstein						
organic pan						
cultivated						
other						
Pan Cementation						
Uncemented						
Weakly cemented						
Moderately cemented						
Strongly cemented						
Very strongly cemented						
Pan Continuity						
continuous						
discontinuous						
broken						
Pan Structure						
massive						
vesicular						
concretionary						
nodular						
platy						
vermicular						

SEGREGATIONS

Segregation Type	1	2	3	4	5	6
not evident						
calcareous						
gypseous						
manganiferous						
ferruginous						
manganiferous						
organic						
not identified						
other						
Segregation Amount						
none						
very few (< 2%)						
few (2% - 10%)						
common (10% - 20%)						
many (20% - 50%)						
abundant (> 50%)						
Segregation Strength						
weak						
strong						
Segregation Form						
soft segregations						
nodules						
fragments						
crystals						
veins						
concretions						
coatings						
tubules						
Segregation Size						
fine (< 2mm)						
medium (2 - 6mm)						
coarse (6 - 20mm)						
very coarse (20 - 60mm)						
extremely coarse (> 60mm)						

ROOTS

Root Size	Roots Amount (10 x 10cm)	1	2	3	4	5
Fine	none					
	few (1 - 10/10 x 10cm)					
	common (10 - 25/10 x 10cm)					
	many (25 - 100/10 x 10cm)					
	abundant (> 200/10 x 10cm)					
1 - 2mm	none					
	few (1 - 10/10 x 10cm)					
	common (10 - 25/10 x 10cm)					
	many (25 - 100/10 x 10cm)					
	abundant (> 200/10 x 10cm)					
2 - 5mm	none					
	few (1 - 2/10 x 10cm)					
	common (2 - 5/10 x 10cm)					
	many (> 5/10 x 10cm)					
5mm	none					
	few (1 - 2/10 x 10cm)					
	common (2 - 5/10 x 10cm)					
	many (> 5/10 x 10cm)					

TITLE CHAELUNDI S.F. EIS

SOIL DATA SYSTEM

PROFILE MAP DETAILS

Card No | Map Sheet No | Eastings | Northings

Mapping: 1:25 000; 1:10 000; 1:8 000; 1:4 000; 1:126 720; 1:63 360; 1:31 680; other

SURVEY DETAILS

Described By | Profile Date | Photo Taken

SITE LOCATION DESCRIPTION

OnDMEODOWS RD, CPT 180, 100M N ON E

TOPOGRAPHY

Slope Percent

Elevation (metres)

Aspect

SOIL & MAP CODES

Factual Key | Atlas (Northcote) Code | Atlas (A & M) Code | Geology Map Code | Soil Map Code | Land System | Soil Taxonomy

INSTRUCTIONS FOR USE

- USE 2B PENCIL ONLY
- ERASE CLEANLY & THOROUGHLY
- DO NOT BEND FORM
- CORRECT
- INCORRECT

Landform Pattern

alluvial fan; alluvial plain; anastomotic plain; badlands; bar plain; beach ridge plain; caldera; channel plain; coral reef; covered plain; delta; dune field; escarpment; floodplain; hills; karst; lava plain; low hills; mountains; plain; playa plain; volcano; tidal flat

LANDFORM

Site Process | Site Morphology | Slope Morphology | Microrelief

Site Morphology: flat; crest; hillock; ridge; upper slope; mid slope; simple slope; lower slope; open depression; closed depression

Slope Morphology: waxing; waning; maximal; minimal

Microrelief: none; normal gilgai; crabhole gilgai; linear gilgai; lattice gilgai; biotic; terracettes; other

Local Relief: extremely low (< 9m); very low (9-30 m); low (30-90 m); high (90-300 m); very high (> 300 m)

Landform Element

crest; summit surface; cone; tor; cliff; bar; ridge; levee; stream; scroll; dune; foredune; lunette; embankment; mound; dam; hillslope; cliff/scarp; bench; landslide; footslope; pediment; talus; scree; bank; beach; fan; cut face; berm; plain; backplain; flood-out; channel bench; rock flat; rock platform; scald; tidal flat; valley flat; cut-over surface; fill top; drainage depression; gully; alcove; estuary; streambed; stream channel; swale; tidal creek; trench; cirque; crater; sink hole/doline; maar; lagoon; lake; pan/playa; ox bow; swamp; blow-out; pit

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VEGETATION

Crown Separation Ratio
- dense 0.25:1 overlap
- sparse 0.25:1-20:1
- isolated > 20:1
- absent

Upper Stratum Height
- 0.25m
- 0.25 - 0.5m
- 0.5 - 1m
- 1 - 3m
- 3 - 6m
- 6 - 12m
- 12 - 20m
- 20 - 35m
- 35m

Vegetation Community
- unknown
- rainforest
- wet sclerophyll forest
- dry sclerophyll forest
- woodland grass u'storey
- woodland shrub u'storey
- tall shrubland
- low shrubland
- heath
- grassland/herbland
- swamp complex
- littoral complex
- no vegetation

Growth Form
- tree
- tree mallee
- shrub
- mallee shrub
- heath shrub
- chenopod shrub
- hummock grass
- tussock grass
- sod grass

Species

Upper Stratum Dominant	Upper Stratum Sub-Dominant	Mid Stratum Dominant	Mid Stratum Sub-Dominant	Lower Stratum Dominant	Lower Stratum Sub-Dominant
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SITE CONDITION

Ground Cover %

Current Condition

Expected Dry Condition
- hardsetting
- surface crusting
- self mulching
- seasonal cracking
- loose

Site Disturbance
- no effect ...

LITHOLOGY

Outcrop

Outcrop Same As
- parent material
- substrate
- parent material & subs

Identification Method
- persons assessment
- geology map
- soil assessment ...

Substrate Material
- not solum parent mat.
- solum parent mat.
- lower solum parent mat.
- upper solum parent mat.

Substrate Strength
- weak
- moderately strong
- strong

Weathering & Alteration
- ferruginised
- kaolinised
- silicified
- calcified
- fresh rock
- faintly weathered rock
- slightly weathered rock
- mod. weathered rock
- highly weathered rock
- structured saprolite
- massive saprolite
- other

Lithology

Solum P.M. / Substrate

- unconsolidated
- gravel
- sand
- ...
- organic material
- ...
- colluvium
- lacustrine
- ...
- marine
- calcareous sand
- ...
- sedimentary
- shale
- siltstone-mudstone
- sandstone-quartz
- sandstone-lithic
- conglomerate
- mudstone
- tuff
- breccia
- greywacke
- arkose
- dolomite
- calcrete
- aeolianite
- chert
- jasper
- metamorphic
- gneiss
- schist, phyllite
- slate
- hornfels
- quartzite
- greenstone
- amphibolite
- marble
- igneous
- coarse-acidic
- coarse-intermediate
- coarse-basic
- fine-acidic
- fine-intermediate
- fine-basic
- serpentine
- gabbro
- dolerite
- diorite
- syenite
- granodiorite
- adamellite
- granite
- aplite
- quartz porphyry
- basalt
- andesite
- trachyte
- rhyolite
- obsidian
- scoria
- ash
- agglomerate
- other

HYDROLOGY

Presence of Free Water
- none
- above soil surface
- below soil surface

Free Water Depth

Run-on
- none
- low
- moderate
- high
- very high

Run-off

Permeability
- very slowly permeable
- slowly permeable
- moderately permeable
- highly permeable

Profile Drainage
- very poorly drained
- poorly drained
- imperfectly drained
- moderately well drained
- well drained
- rapidly drained

EROSION HAZARD

SALINITY

EROSION

Type

Erosion Severity 1 2 3 4 5 6 7 8
- none
- not evident
- evident
- minor
- moderate
- severe
- very severe

Present Condition
- stable
- partly stabilised
- active

Gully Depth
- 1.5m
- 1.5 - 3.0m
- 3.0m

LAND USE

Site / General Area
- national/state parks
- timber/scrub/unused
- logged native forest
- hardwood plantation
- softwood plantation
- sown native pasture
- improved pasture
- cropping
- orchards, vineyards
- vegetables/flowers
- urban
- industrial
- quarry/mining
- other

PROFILE ADDENDUM

[illegible]

LAYER STATUS

UPPER ORGANIC	Upper	Lower	Horizon	Suffix

LOWER ORGANIC	Upper	Lower	Horizon	Suffix

Layer	Upper	Lower	Horizon	Suffix	Moist Munsell	Dry Munsell
1						
2						
3						
4						
5						
6						
SUBSTRATE						

3

MOTTLES

Dominant 3	4	5	6	Type	Sub-Dominant 1	2	3	4	5	6
				not evident						
				unspecified						
				biological						
				mechanical						
				weathered						
				Colour						
				dark						
				red						
				orange						
				yellow						
				brown						
				pale						
				grey						
				gley						
				Contrast						
				faint						
				distinct						
				prominent						
				Abundance						
				0%						
				< 2%						
				2% - 10%						
				10% - 20%						
				20% - 50%						

Dominant

1	2	3	4	5	6

Sub-Dominant

1	2	3	4	5	6

MECHANICAL TESTS

Shear (kpa)

1	2	3	4	5	6

Compressive (kpa)

1	2	3	4	5	6

CHEMICAL TESTS

Chloride	1	2	3	4	5	6
no precipitate						
light precipitate						
conspic. white precip.						
Carbonate						
no effervescence						
audible/slight efferv.						
strong effervescence						
Manganese Dioxide						
no effervescence						
effervescence						

pH

1	2	3	4	5	6

ERODIBILITY TESTS

Crumb Test	1	2	3	4	5	6
no change						
aggregates slake						
aggregates disperse						
slaked solus disperses						
Solus Formation						
no deflocculation						
deflocculation						

LAYER BOUNDARY

Distinctiveness	1	2	3	4	5	6
not evident						
sharp (< 5mm)						
abrupt (5 - 20mm)						
clear (20 - 50mm)						
gradual (50 - 100mm)						
diffuse (> 100mm)						
Shape						
smooth						
wavy						
irregular						
tongued						
broken						

FIELD TEXTURE

Texture Grade	1	2	3	4	5	6
sand						
loamy sand						
clayey sand						
sandy loam						
loam						
silty loam						
sandy clay loam						
clay loam						
clay loam, sandy						
silty clay loam						
sandy clay						
silty clay						
clay						
fibric peat						
hemic peat						
sapric peat						
sandy peat						
loamy peat						
clayey peat						
granular peat						

Sand Fraction	1	2	3	4	5	6
coarse						
fine						
Clay Fraction						
light						
light medium						
medium						
medium heavy						
heavy						
Organic Fraction						
sapric						
fibric						

ONSISTENCE

Consistence Test 1 2 3 4 5 6
loose
very weak force
weak force
firm force
very firm force
extremely firm force
Bearing Test
non-plastic
plastic
slightly plastic
moderately plastic
very plastic

Texture Modifier 1 2 3 4 5 6
Organic Peaty
Sandy
Silty
Clayey

Stickiness
non-sticky
slightly sticky
moderately sticky
very sticky

Degree of Plasticity 1 2 3 4 5 6
non-plastic
slightly plastic
moderately plastic
very plastic

SOIL WATER STATU

1 2 3 4
Dry
Moist
Wet

SAMPLE TAKEN

none
undisturbed
disturbed
undisturbed
macro-morphological

FABRIC

1
Massive
Weak Pedality
Moderate Pedality
Strong Pedality

SOIL ERODIBILITY

low
moderate
high

STRUCTURE

Grade of Pedality 1 2 3 4 5 6
single grained
massive
weak pedality
moderate pedality
strong pedality

Dominant 1 2 3 4 5 6
Sub-Dominant 1 2 3 4 5 6

PED SIZE
Dominant 1 2 3 4 5 6
Sub-Dominant 1 2 3 4 5 6
< 2mm
2 - 5mm
5 - 10mm
10 - 20mm
20 - 50mm
50 - 100mm
100 - 200mm
200 - 500mm
> 500mm

PED SHAPE
Dominant 1 2 3 4 5 6
Sub-Dominant 1 2 3 4 5 6
platy
lenticular
prismatic
columnar
angular blocky
sub-ang. blocky
polyhedral
granular
crumb
other

PED COATING

Coating Amount 1 2 3 4 5 6
none
thin (10%)
moderate 50%)
many (50%)

Coating Type
clay
manganese
stress cutans
carbonates
humus
organic
other

Coating Distinctiveness
faint
distinct
prominent

SOIL FAUNAL ACTIVITY

Faunal Activity Degree 1 2 3 4 5 6
none
low (10%)
moderate (10 - 50%)
high (50%)

Faunal Activity Type
termite chambers
worm casts
termite channelling
ant channelling
other

COARSE FRAGMENTS

Fragment Type 0 1 2 3 4 5
not evident
not identified
as substrate
as rock outcrop
as parent material
quartz
feldspar
silcrete
ironstone
bauxite
shells
charcoal
pumice
opalised wood
other

Fragment Amount
none
very few (2%)
few (2 10%)
common (10-20%)
many (20-50%)
abundant (50-90%)
very abundant (90%)

Fragment Distribution
stratified
dispersed

Fragment Orientation
reoriented
undisturbed

Fragment Weathering
non-weathered
weakly weathered
strongly weathered

Fragment Shape
rounded
rounded tabular
rounded platy
sub-rounded
sub-rounded tabular
sub-rounded platy
sub-angular
sub-angular tabular
sub-angular platy
angular
angular tabular
angular platy

Fragment Size
fine gravel (2-6mm)
gravel (6-20mm)
coarse gravel (20-60mm)
cobbles (60-200mm)
stones (200-600mm)
boulders (> 600mm)

CRACKS & MACROPORES

Crack Width Amount 1 2 3 4 5 6
5mm
none
evident
10mm
none
evident
20mm
none
evident
50mm
none
evident
50mm
none
evident

Macropore Amount
< 1mm
none
few (< 1/10 x 10mm)
common (1 - 5/10 x 10mm)
many (> 5/10 x 10mm)
1 - 2mm
none
few (< 1/10 x 10mm)
common (1 - 5/10 x 10mm)
many (5/10 x 10mm)
2 - 5mm
none
few (< 1/100 x 100mm)
common (1 - 5/100 x 100mm)
many (> 5/100 x 100mm)
5mm
none
few (< 1/100 x 100mm)
common (1 - 5/100 x 100mm)
many (5/100 x 100mm)

PANS

Pan Type	1	2	3	4	5	6
not evident						
calcrete						
silcrete						
salty pan						
sunpan						
tirapan						
dunspan						
gypsum hardpan						
iron hardpan						
ferricrete						
duricrete						
hardgan/cerous						
orstein						
organic pan						
cultivated						
other						
Pan Cementation						
uncemented						
weakly cemented						
moderately cemented						
strongly cemented						
very strongly cemented						
Pan Continuity						
continuous						
discontinuous						
broken						
Pan Structure						
massive						
vesicular						
concretionary						
nodular						
platy						
vermicular						

SEGREGATIONS

Segregation Type	1	2	3	4	5	6
not evident						
calcareous						
gypseous						
manganiferous						
ferruginous						
ferromanganiferous						
organic						
not identified						
other						
Segregation Amount						
none						
very few (< 2%)						
few (2% - 10%)						
common (10% - 20%)						
many (20% - 50%)						
abundant (> 50%)						
Segregation Strength						
weak						
strong						
Segregation Form						
soft segregations						
nodules						
fragments						
crystals						
veins						
concretions						
root linings						
tubules						
Segregation Size						
fine (< 2mm)						
medium (2 - 6mm)						
coarse (6 - 20mm)						
very coarse (20 - 60mm)						
extremely coarse (> 60mm)						

ROOTS

Root Size	Roots Amount (0 - 10cm)	1	2	3	4	5	6
1mm	none						
	few (1 - 10 / 10 x 10cm)						
	common (10 - 25 / 10 x 10cm)						
	many (25 - 100 / 10 x 10cm)						
	abundant (> 100 / 10 x 10cm)						
1 - 2mm	none						
	few (1 - 10 / 10 x 10cm)						
	common (10 - 25 / 10 x 10cm)						
	many (25 - 100 / 10 x 10cm)						
	abundant (> 100 / 10 x 10cm)						
2 - 5mm	none						
	few (1 - 2 / 10 x 10cm)						
	common (2 - 5 / 10 x 10cm)						
	many (5 - 10 / 10 x 10cm)						
5mm	none						
	few (1 - 2 / 10 x 10cm)						
	common (2 - 5 / 10 x 10cm)						
	many (5 - 10 / 10 x 10cm)						

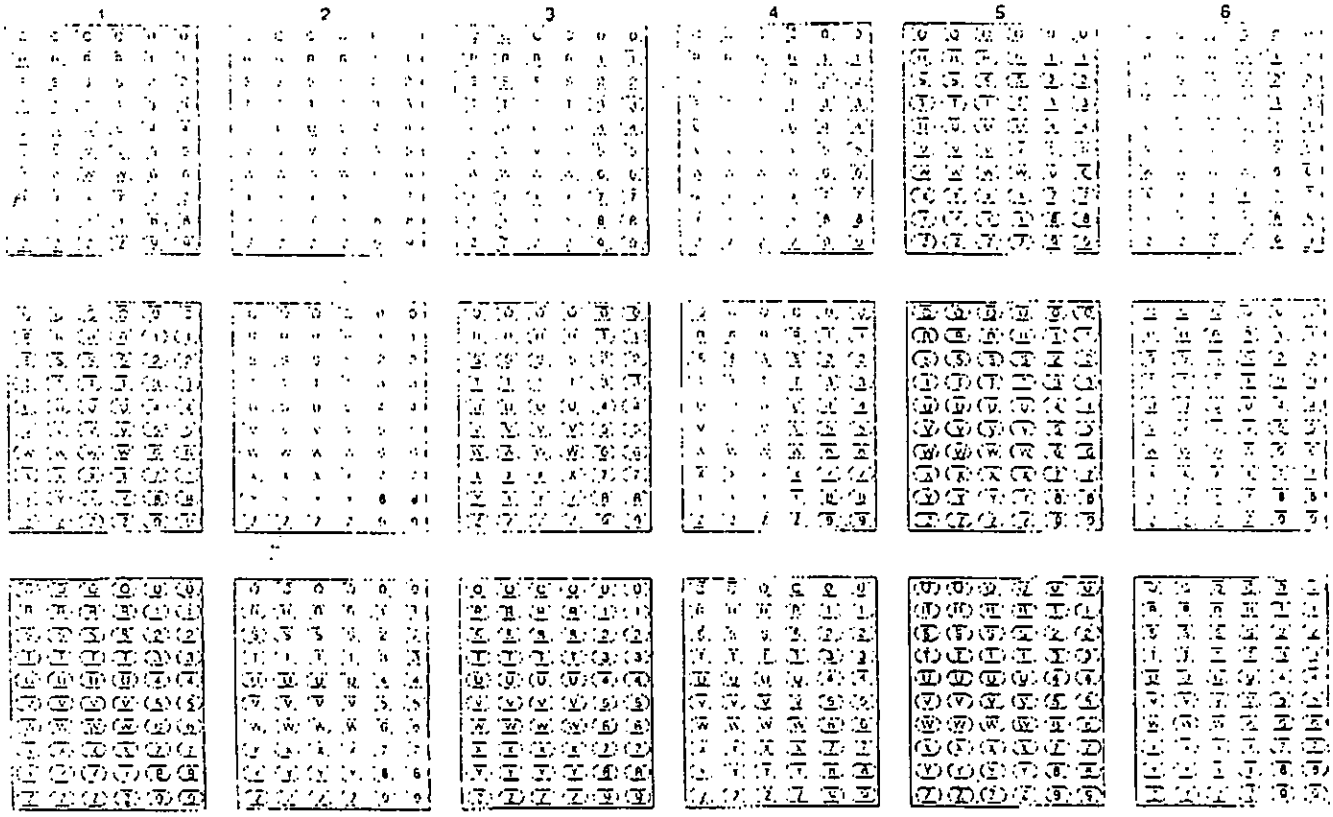
SITE FIELD NOTES

SOIL IS FORMED FROM ACID LAVA DYKE INTRUDING FROM CHALLUNDI GRANITE TO THE WEST

LAYER FIELD NOTES

UPON WETTING THIS SOIL DISPERSED AND WAS VERY DIFFICULT TO WORK

LAYER ADDENDUM CODES



APPENDIX 6.

Gilmour, P.M. – Affidavit describing vegetation

IN THE LAND AND ENVIRONMENT COURT
OF NEW SOUTH WALES

No. 40052 of 1990

JOHN ROBERT CORKILL
Applicant

FORESTRY COMMISSION OF
NEW SOUTH WALES
Respondent

A F F I D A V I T

I PHILIP MARK GILMOUR of Bishops Creek, Darkwood Road, Thora, in the State of New South Wales do solemnly sincerely and truly affirm and declare as follows :

1. I am a Bachelor of Science, Australian National University, and ecological consultant. My curriculum vitae is set out in Annexure "A".

2. On the 2 and 3 of June 1990 I visited the Chaelundi State Forest and carried out a brief survey of the forest vegetation of compartments 200, 198 and 180 and also some of the logged areas in compartment 179. Due

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SYDNEY NSW 200

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REF : BRUCE WOOLF

to time constraints, the area surveyed was mainly the higher altitude western part of these compartments.

3. The area surveyed in compartments 200, 198 and 180 contains significant stands of mature unlogged eucalypt forest with many trees with diameter breast height of 1 metre or more, stands of unlogged mixed sub-tropical/ warm temperate rainforest and, to my knowledge, previously undocumented occurences of two rare plant species, Austrobuxus swainii and Dodonaea megazyga. The vegetation of these unlogged areas is what is known as "old growth forest".

4. To my knowledge, no detailed survey of the vegetation of Cheelundi State Forest has been carried out. The New South Wales Forestry Commission carried out an Environmental Review in 1988, which covers the compartments in question and earlier a forest type map was prepared for the area, also by the New South Wales Forestry Commission.

DESCRIPTION OF AREA

5. The major topographic feature of the area is a north-south ridge with a maximum altitude of about 1080 metres at the northwest corner of compartment 200. The

area slopes away to the east towards the upper catchments of Pine Creek and Needle Creek, with the lowest altitude of just over 700 metres on the east edge of compartment 198. The steepness of slopes is variable, and there are a number of sections of gentle slope near the upper ridge line, giving way to steeper slopes near the headwaters of Pine Creek and Needle Creek.

VEGETATION COMMUNITIES

6. Several vegetation communities occur in the three compartments in question and these are described below.

RAINFOREST

7. There are a number of patches of rainforest, mainly in compartments 200 and 180. The patch surveyed contains a number of canopy tree species. The most common are Argyrodendron actinophyllum (Black Booyong) and Sloanea woollsii (Yellow Carabeen), while Orites excelsa (Prickly Ash), Dysoxylum fraserianum (Rosewood), Ceratopetalum apetalum (Coachwood), Caldcluvia paniculosa (Corkwood), Schizomeria ovata (Crabapple), Litsea reticulata (Brown Bolly Gum), Brachychiton

aceriifolius (Flame Tree), Dolyphora sassafras (Sassafras) and Diploglottis australis (Native Tamarind) are also present.

8. Small tree and shrub species include Austrobuxus swainii (Pink Cherry), Acronychia pubescens (Hairy Acronychia), Polyosma cunninghamii (Featherwood), Alangium villosum ssp. polyosmoides (Black Muskheart), Linospadix monostachyus (Walking-Stick Palm), Aristotelia australasica (Mountain Wineberry) and Solanum laeceillaterum (Gin's Whiskers). Common ground layer species are Lastreopsis sp. (a shieldfern) and Pteris umbrosa (Jungle Brake).

9. Epiphytes such as Asplenium australasicum (Bird's Nest Fern), Dictymia brownii and Pyrrosia sp. (Felt Fern) and vines such as Rubus sp. aff. moorei (Green-Leaved Bramble), Palmeria scandens (Anchor Vine) and Aphanopetalum resinosum (Gum Vine) also occur.

10. The canopy height of this community is about 30 to 40 metres, and it appears in a mature, undisturbed condition, with mixed age classes of most species. This rainforest would fit a mixed sub-tropical/warm temperate classification and according to Floyd's floristic classification would contain elements from

both the Argyrodendron actinophyllum (Black Booyong) and Ceratopetalum apetalum (Coachwood) alliances.

TALL OPEN FOREST (SILVERTOP STRINGYBARK/TALLOWWOOD)

11. A tall open forest dominated by Eucalyptus laevopinea (Silvertop Stringybark) and Eucalyptus microcorys (Tallowwood) occurs on the upper sheltered slopes. Some Eucalyptus Saligna (Sydney Blue Gum), Eucalyptus andrewsii ssp. campanulata (New England Blackbutt) and Lophostemon confertus (Brush Box) also occur in this community.

12. A small tree layer of species such as Acacia melanoxylon (Blackwood), Acacia irrorata (Blue Skin Wattle), Daphnandra sp. (Socketwood), Rhodamnia rubescens (Brush Turpentine) and Caldcluvia paniculosa (Corkwood) is often present and a dense shrub layer usually occurs, with species such as Cryptocarya rigida (Rose Maple), Elaeocarpus reticulatus (Blueberry Ash), Synoum glandulosum (Scentless Rosewood), Cassinia sp. (Dogwood) Hedycarya angustifolia (Native Mulberry), Polyscias sambucifolius (Elderberry Panax) and Myoporum montanum (Mountain Boobialla) present.

13. The vine species Cissus hypoglauca (Five-leaf Water

Vine), Pipterocalyx moorei (Bitter Vine) and Achanopetalum resinosum (Gum Vine) are sometimes common while the ground layer includes species such as Blechnum cartilagineum (Gristle Fern), Culcita dubia (Soft Bracken), Senecio sp. (a Groundsel) and Drymophylla moorei.

14. This forest community contains many large mature trees with breast height diameters of 1 metre or more and a canopy height of about 40 to 50 metres and does not show signs of frequent burning.

OPEN FOREST (NEW ENGLAND BLACKBUTT/DIEHARD STRINGYBARK)

15. On the ridges and drier slopes an open forest or tall open forest community dominated by Eucalyptus andrewsii ssp. campanulata (New England Blackbutt) and Eucalyptus cameronii (Diehard Stringybark) with some Eucalyptus laevopinea (Silvertop Stringybark) and Eucalyptus microcorys (Tallowwood), occurs.

16. Small tree species include Allocasuarina torulosa (Forest Oak), Acacia melanoxylon (Blackwood), Acacia binervata (Two Veined Hickory), Elaeocarpus reticulatus (Blueberry Ash) and Synoum glandulosum (Scentless

Rosewood) and shrub species include Persoonia attenuata (Geebung), Pimelea ligustrina (Tall Riceflower), Trochocarpa laurina (Tree Heath), Leucopogon lanceolatus (Beard Heath) Goodia lotifolia (Golden Tips) and Solanum species.

17. The ground layer includes Pteridium esculentum (Bracken), Poa sp., Lomandra longifolia (Spiney Matt Rush) and Gonocarpus tetragynus (Raspwort).

18. In drier, lower altitude areas the small tree and shrub layer becomes less dense and Acacia falciformis (Hickory) and Indigofera australis (Indigo) occur.

19. The canopy height of this community is about 25 to 35 metres, with tree diameters generally less than the previous community, and the lower altitude, drier areas appear to have been burnt more frequently than the higher altitude moist forests.

TALL OPEN FOREST (TALLOWWOOD/SYDNEY BLUE GUM/BRUSHBOX)

20. On sheltered slopes and gullies east of the main ridgeline, a tall open forest dominated by Eucalyptus microcorys (Tallowwood), Eucalyptus saligna (Sydney

Blue Gum) and Lophostemon confertus (Brush Box) occurs. This community may have a well developed rain forest understorey, particularly in gullies.

21. Species in this understorey include Argyrodendron actinophyllum (Black Booyong), Caldcluvia paniculosa (Corkwood), Schizomeria ovata (Crabapple), Pennantia cunninghamii (Brown Beech) and Cryptocarya rigida (Rose Maple).

22. Shrub and ground layer species include Solanum laciniatum (Gin's Whiskers) Lastreopsis sp. (Shield Fern), Adiantum formosum (Giant Maidenhair) and Lomandra spicata (Orange Matt Rush).

23. This community contains many large mature trees with canopy height possibly exceeding 50 metres in places. There is some evidence of infrequent ground fires.

SWAMP FOREST

24. A small area of a swamp forest community dominated by Callistemon salignus (Willow Bottlebrush) occurs in a drainage line in compartment 200. A gum bark eucalypt that may be Eucalyptus deanei (Round-leaved Gum) occurs as an emergent in this community and Blechnum nudum

(Fishbone Fern) forms a dense ground cover in plac

SIGNIFICANT FEATURES

25. Rare Plants. Two plant species that are listed in "Rare and Threatened Australian Plants" (Briggs and Leigh, 1988) were recorded during this brief survey. These are Austrobuxus swainii and Dodonaea megazyga. Both these species have a risk code of 3RC in Brigg and Leigh.

26. In this code "3" indicates a species with a range o 100 km in Australia, but occuring only in small populations which are mainly restricted to highly specific and localised habitats; "R" rare - species which are rare in Australia but which overall are no currently considered Endangered or Vulnerable. Such species may be represented by a relatively large population in a very restricted area or by smaller populations spread over a wider range, or some intermediate combination of distribution; "C" - indicates where a species is known to be represented within a national park or other proclaimed reserve; - when used in conjuction with the Conservation Codi this indicates that the species is considered adequately reserved, with a total population of 1,000

plants or more known to occur within a conservation reserve.

Austrobuxus swainii grows into a large tree in rainforest communities and occurs from the Bellinger River to far southern Queensland (Tallebudgera Creek). Several individuals were noted in and on the margin of the rainforest patch near the north west corner of compartment 200. One specimen was immediately adjacent to the lower embankment of the newly constructed Broadmeadow Road.

Dodonaea megazyga is a small to medium sized shrub with distinctive pinnate foliage. It has a scattered occurrence from near Sydney to just north of the Queensland border, in sclerophyll forest or on the margins of rainforest. In the survey area it was recorded near the boundary between compartments 200 and 180 and there was also considerable regeneration along Broadmeadow Road and in logged areas of compartment 179.

29. The occurrence of Argyrodendron actinophyllum (Black Booyong) at an altitude of over 1,000 metres is unusual. This sub-tropical rainforest influence in this high altitude area would indicated a higher soil

fertility than suggested in the Forestry Commission Environmental Review.

30. The forests of these three compartments (200, 198 and 180) are unlogged, contain numerous large mature trees with many hollows suitable for arboreal fauna, and also contain many younger trees with most age classes represented.

31. There is no evidence of recent severe wildfire and, in the moist forest areas, little evidence of frequent ground fires. These forests would fit the recent concept of "old growth forest". Such forest on gentle to moderate topography is becoming uncommon in Eastern Australia.

CONSERVATION OF VEGETATION COMMUNITIES

32. In the broad sense, the vegetation communities present in the survey area are probably adequately conserved, but "old growth" examples of some of these communities may not be adequately conserved.

33. At a local level the conservation situation is not clearly defined. There are no Forestry Commission reserves in Chaelundi State Forest, but moist forest

and rainforest types similar to those in the survey area may occur in Middle Creek Flora Reserve in Marengo State Forest (not Chaelundi State Forest as stated in the Environmental Review).

34. Immediately west of Chaelundi State Forest is Guy Fawkes River National Park. There is no detailed survey information available for this park, but most of it is at lower altitude, with steeper slopes and lower rainfall than the survey area, and therefore would not be expected to support the same vegetation communities as the survey area.

35. There are small areas of gentle to moderate topography at higher altitude on the eastern edge of the National Park adjacent to the survey area which may support similar communities to the survey area, although the aspect of these areas in the park is mainly westerly and thus they are more exposed than the generally easterly aspects of the survey area.

FORESTRY COMMISSION FOREST TYPE MAP

36. There are several areas in and near the survey area on the Forest Type Map that are typed as 142/163C - New England Peppermint - New England Blackbutt, site height

<30m. Eucalyptus nova-anglica (New England Peppermint) is a species that generally occurs on the tableland areas, particularly in sites with poor drainage.

37. Benson (1989) considers the Eucalyptus nova-anglica association as endangered mainly by dieback and grazing. If Eucalyptus nova-anglica is present in the Chaelundi State Forest area a substantial area should be conserved.

38. It would be unusual for Eucalyptus nova anglica to occur in the area, particularly in the three compartments in question. After further ground survey, Foresty Commission may need to amend their type map accordingly.

IMPACTS OF ROADWAY, LOGGING, FIRE REGIMES AND GRAZING

39. The most significant and immediately obvious impact of the logging operations is the removal of most of the large mature trees over much of the area. This severely modifies the structure of the forest and the pre-logging structure would not be regained for hundreds of years.

40. Operations also lead to increased weed invasion and

this is already evident with species such as Sigesbeckia orientalis (Indian Weed), Cirsium vulgare (Spear Thistle), Conyza sp. (Fleabane) and Phytolacca octandra (Ink Weed). This weed invasion is enhanced by easier vehicular access and the large areas of disturbed soil resulting from logging operations.

41. In comparison to the logged and roaded areas, the unlogged areas surveyed are virtually weed-free.

42. Logging has occured right up to the margin of a rainforest patch in compartment 179. This results in the rainforest being much more exposed to wind and drier air and could cause die back of rainforest areas. According to the Environmental Review logging is allowable in rainforest.

43. The proposed fire regime would not favour regeneration of rainforest species nor would the occurrence of large canopy gaps which would allow severe ground frosts to occur.

44. Any increase in grazing in the area, was suggested in the Environmental Review, could lead to introduction of more weed species unless strict quarantining of stock occured before they were moved into the area, and the

increased selective grazing of certain species.

45. The rare species, Dodonaea megazyga is regenerating in disturbed areas along roads and in logged areas, but the extent of disturbance could result in an exhaustion of the soil seed bank of this species and if regrowth was burnt before an adequate set of new seed, this species could decline.

46. The full references to the texts referred to above are in preparation of the as follows :

Beadle, H C W (1971-1987) : Students Flora of North Eastern New South Wales. 6 Volumes University of New England.

Benson, J (1989) : Establishing Priorities for the Conservation of Rare and Threatened Plants and Plant Associations in New South Wales in The Conservation of Threatened Species and their Habitats IUCN Occasional Papers 2.

Briggs, J D and Leigh, J H (1988) : Rare and Threatened Australian Plants ANPWS Special Publication 14

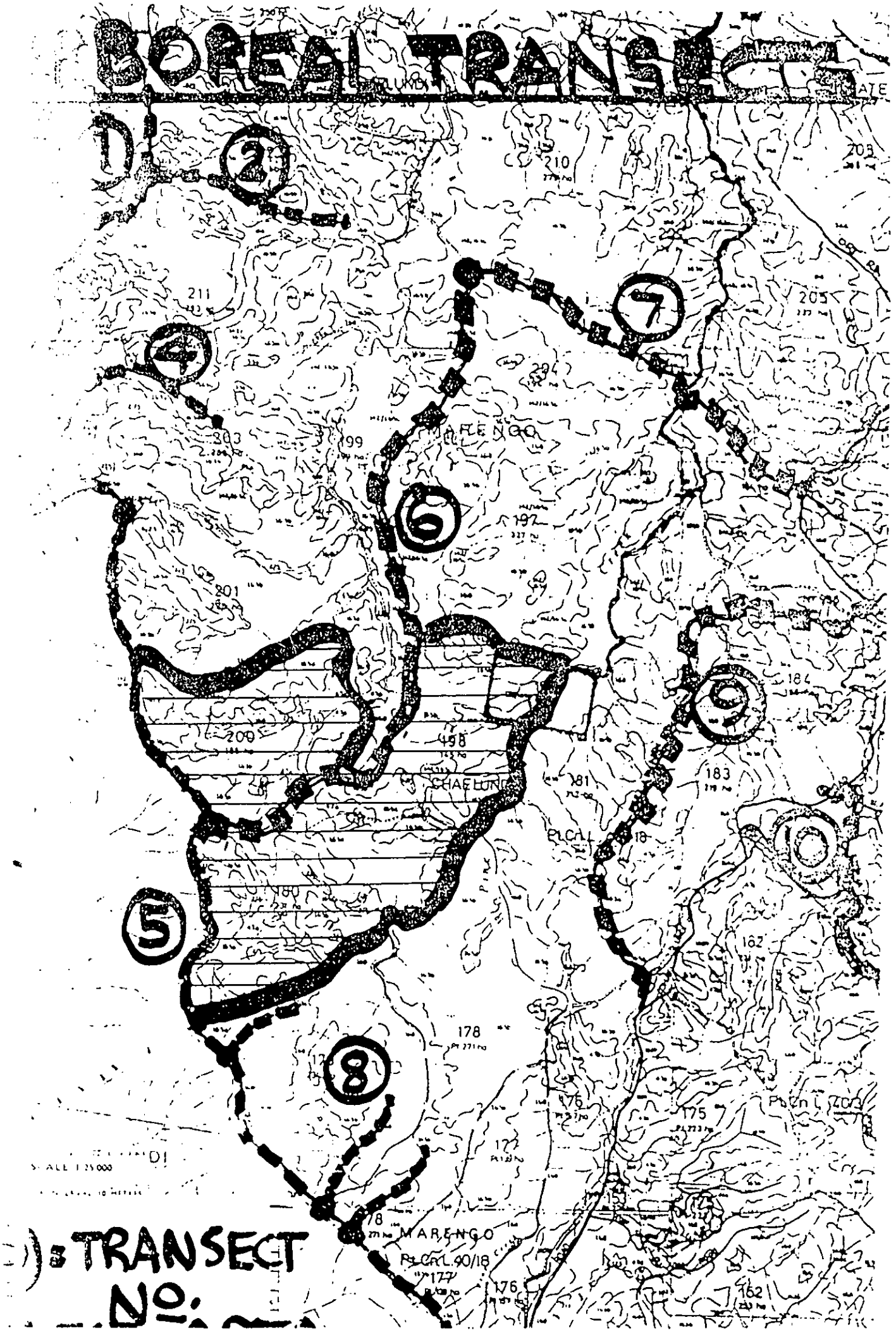
Floyd, A G (1989) Rainforest Trees of Mainland South-Eastern Australia Forestry Commission of New South Wales.

APPENDIX 7.

Fauna and Flora Joint Study FCNSW-Earthwatch

KEY TO ARBOREAL TRANSECTS

TRANSECT NO.	LOCATION. WALKING/DRIVING	LOGGED/ UNLOGGED	FOREST TYPES
1	LIBERATION TRAIL 2KM-3.5KM DRIVING TRANSECT	UNLOGGED	NEH
2	UN-NAMED SPUR RD. WALKING TRANSECT	UNLOGGED	NEH
3	LIBERATION TRAIL 0KM-2KM WALKING TRANSECT	UNLOGGED	NEH
4	UN-NAMED SPUR RD. WALKING TRANSECT	UNLOGGED	NEH
5	BROADMEADOWS RD. DRIVING TRANSECT	(L) NPWS (R) LOGGED & UNLOGGED	NEH & RF
6	PINE CK TRAIL *EIS AREA* DRIVING TRANSECT	UNLOGGED	NEH & MH
7	PINE CK TRAIL. DRIVING TRANSECT	UNLOGGED	NEH
8	CPTS 178 & 179 DRIVING TRANSECT	RECENTLY LOGGED	NEH
9	FELLABINDI RD. DRIVING TRANSECT	RECENTLY LOGGED	NEH & MH
10	STOP-A-BIT RD. DRIVING TRANSECT	OLDER LOGGING	NEH & MH


BOREAL TRANSECTS
1
2
3
4
5
6
7
8
9
10
MARENGO
CHAETURA
MARENGO
PLCGL 90/18
TRANSECT
No.

SURVEY SUMMARY. WALK vs DRIVE TRANSECTS. UNLOGGED.

WALK

TRANSECT 2. SPUR RD. UNLOGGED.

Total Transect Length (metres)	x Perpendicular distance (atrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	no. each Arboreal species/ha transect	no. each species /100ha (ha²)
2,000	15.2	3.24	SG = 8 RIP = 2	SG/NEB = 8 RIP/NEB = 2	NEB = 72.5	50-120	SG = 8 RIP = 2	SG = 246.0 RIP = 61.5

TRANSECT 3. LIBERATION TRAIL. TYPE 163. UNLOGGED CPT 203.

Total Transect Length (metres)	x Perpendicular distance (atrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	no. each Arboreal species/ha transect	no. each species /100ha (ha²)
2,000	11.1	4.44	SG = 23 WHITE SG = 1 RIP = 5	SG/NEB = 20 SG/OHS = 1 WHITE SG/NEB=1 RIP/NEB = 2 RIP/IWO = 1 SG/IWO = 1 SG/STS = 1	NEB = 73.5 OHS = 50.0 IWO = 60.0 STS = 55.0	50 - 120 50 20 - 60 55	SG = 11.5 WHITE SG = 0.5 RIP = 1.5	SG = 513.0 WHITE SG = 22.5 RIP = 67.5

TRANSECT 4. SPUR ROAD. UNLOGGED.

Total Transect Length (metres)	x Perpendicular distance (atrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/ha transect	no. each species /100ha (ha²)
2,000	3.2	1.54	SG = 69	SG/NEB = 6 SG/IWO = 1 RIP/NEB = 1 SG/SEAO = 1	NEB = 101.7 IWO = 67.5	50 - 150 50 - 75	SG = 10.5 RIP = 1.5	SG = 454.5 RIP = 65.0

DRIVE

TRANSECT 1. TYPE 163. UNLOGGED CPT 211.

Total Transect Length (metres)	x Perpendicular Distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/Km transect	No. each species /100ha (km²)
1,513	35.6	7.7	GG : 3	GG/NEB : 5	NEB : 100.0	20 - 100	GG : 6	GG : 114.3

TRANSECT 6. VARIOUS TYPES MAINLY 163. CPTS 180, 198, 200 E.I.S. AREA.

Total Transect Length (metres)	x Perpendicular Distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/Km transect	No. each species /100ha (km²)
5,400	11.5	12.5	GG : 54 WHITE GG : 1 RIP : 2	GG/NEB : 46 GG/IWD : 3 GG/SIS : 1 WHITE GG/NEB=1 GG/OHS : 4 RIP/OAX : 2	NEB : 65.4 IWD : 60.0 SIS : 90.0 OHS : 51.7 OAX : 12.5	35 - 100 40 - 75 90 45 - 55 5 - 20	GG : 10.0 WHITE GG : 0.2 RIP : 0.4	GG : 43.2 WHITE GG : 1.0 RIP : 1.9

TRANSECT 7. PINE CK. TRAIL. TYPE 163, CPTS 195/204. UNLOGGED.

Total Transect Length (metres)	x Perpendicular Distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/Km transect	No. each species /100ha (km²)
5,400	18.2	19.7	GG : [illegible] RIP : [illegible]	GG/NEB : [illegible] RIP NEB : [illegible] GG/IWD : [illegible] GG/NEB : [illegible] GG/SIS : [illegible] GG/OAX : [illegible] RIP/OAX : [illegible]	NEB : 73.6 NEB : 59.1 IWD : 73.3 SIS : 76.1 OAX : 60.0 OAK : 15.0	[illegible]	[illegible]	[illegible]

Drive, mean arboreals/km² = 211.3
Walk, mean arboreals/km² = 525.3

Driving transects unlogged underestimate [illegible] 60% on average.

Logged forests are more open = Arboreals easier to spot.

Unlogged forests = Arboreals harder to see.

These surveys show that

1) Relative density of arboreals in the EIS compartments is 432/km² (10/km of transect). However, relative densities in unlogged areas in vicinity of EIS range from 56-117/km² (2-6/km of transect).

2) Populations of arboreals dominated by greater gliders.

3) Arboreal mammals predominantly occur in New England blackbutt types, with a dbh range 35-100cm.

4) Mean relative density unlogged
= 211.3 + 40% (See Walk vs Drive results)
= 295/km².

SURVEY SUMMARY. UNLOGGED TRANSECT.

TRANSECT 1. TYPE 163. UNLOGGED CPT 211.

Total transect length (metres)	x Perpendicular distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	X dbh for each tree species	Range dbh (cm)	No. each Arboreal species/ha transect	No. each species /100ha (ha²)
1,300	25.5	7.7	GG : 9	GG/NE3 : 9	NE3 : 104.4	52 - 132	GG : 6	GG : 116.3

TRANSECT 6. VARIOUS TYPES MAINLY 163. CPTS 180, 198, 200 E.I.S. AREA.

Total transect length (metres)	x Perpendicular distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	X dbh for each tree species	Range dbh (cm)	No. each Arboreal species/ha transect	No. each species /100ha (ha²)
5,400	11.6	12.5	GG : 54 WHITE GG : 1 RIP : 2	GG/NE3 : 46 GG/TWO : 3 GG/STS : 1 WHITE GG/NE8=1 GG/OHS : 4 RIP/OAK : 2	NE3 : 65.4 TWO : 60.0 STS : 90.0 OHS : 51.7 OAK : 12.5	35 - 100 40 - 75 30 45 - 65 5 - 20	GG : 10.0 WHITE GG : 0.2 RIP : 0.4	GG : 43.2 WHITE GG : 0.8 RIP : 15.0

TRANSECT 7. PINE CK. TRAIL. TYPE 163, CPTS 195/204. UNLOGGED.

Total transect length (metres)	x Perpendicular distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	X dbh for each tree species	Range dbh (cm)	No. each Arboreal species/ha transect	No. each species /100ha (ha²)
5,400	13.2	19.7	GG : 11 RIP : 1	GG/NESS : 1 RIP/NE3 : 1 GG/TWO : 1 GG/NE3 : 3 GG/WIN : 1 GG/QUAD : 1 GG/OAK : 1	NESS : 30.0 NE3 : 59.2 TWO : 17.0 WIN : 70.0 QUAD : 50.0 OAK : 15.0	50 40 - 75 20 70 50 15	GG : 1.2 RIP : 1.0	GG : 55.8 RIP : 5.0

URVEY SUMMARY. LOGGED TRANSECTS.

RIVE

RANSECT 8. ADJACENT TO EIS AREA. CPTS. 179 & 178. RECENTLY LOGGED.

Total transect length (metres)	x Perpendicular distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/km transect	No. each species /100ha (km²)
1,500	23.1	12.9	GG = 41	GG/NEB = 36 GG/TWD = 5	NEB = 32.4 TWD = 72.0	20 - 150 30 - 110	GG = 17.8	GG = 317.3

RANSECT 9. FELLABINDI RD. HIGH S.Q. RECENTLY LOGGED.

Total transect length (metres)	x Perpendicular distance (mtrs)	Area (ha)	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/km transect	No. each species /100ha (km²)
5,600	23.7	26.07	GG = 52 BIP = 2	GG/NEB = 48 GG/BGM = 1 GG/BBX = 1 GG/TWD = 2 BIP/NEB = 2	NEB = 63.4 BGM = 65.0 BBX = 50.0 TWD = 60.0	35 - 140 65 50 60	GG = 9.3 BIP = 0.4	GG = 137.0 BIP = 7.5

RANSECT 10. STOP-A-BIT RD. LOWER S.Q. THAN EIS AREA.
OLDER LOGGING.

Total transect length metres.	x Perpendicular distance mtrs.	Area ha.	% of each species	% each species/ tree species	% dbh for each tree species	Range dbh (cm)	No. each Arboreal species/km transect	No. each species /100ha (km²)
5,000	23.5	23.5	GG = 94 BIP = 6	GG/NEB = 71 GG/BGM = 6 GG/TWD = 5 GG/BBX = 1 GG/BSD = 1 GG/BGG = 3 GG/BBA = 3 BIP = 1	GG = 70.0 BGM = 67.5 NEB = 64.4 TWD = 100.0 BSD = - BGG = 54.7 BBA = 49.0	30 55 - 80 25 - 110 60 - 140 - 60 - 65 40	GG = 4.3 BIP = 0.2	GG = 171.7 BIP = 7.2

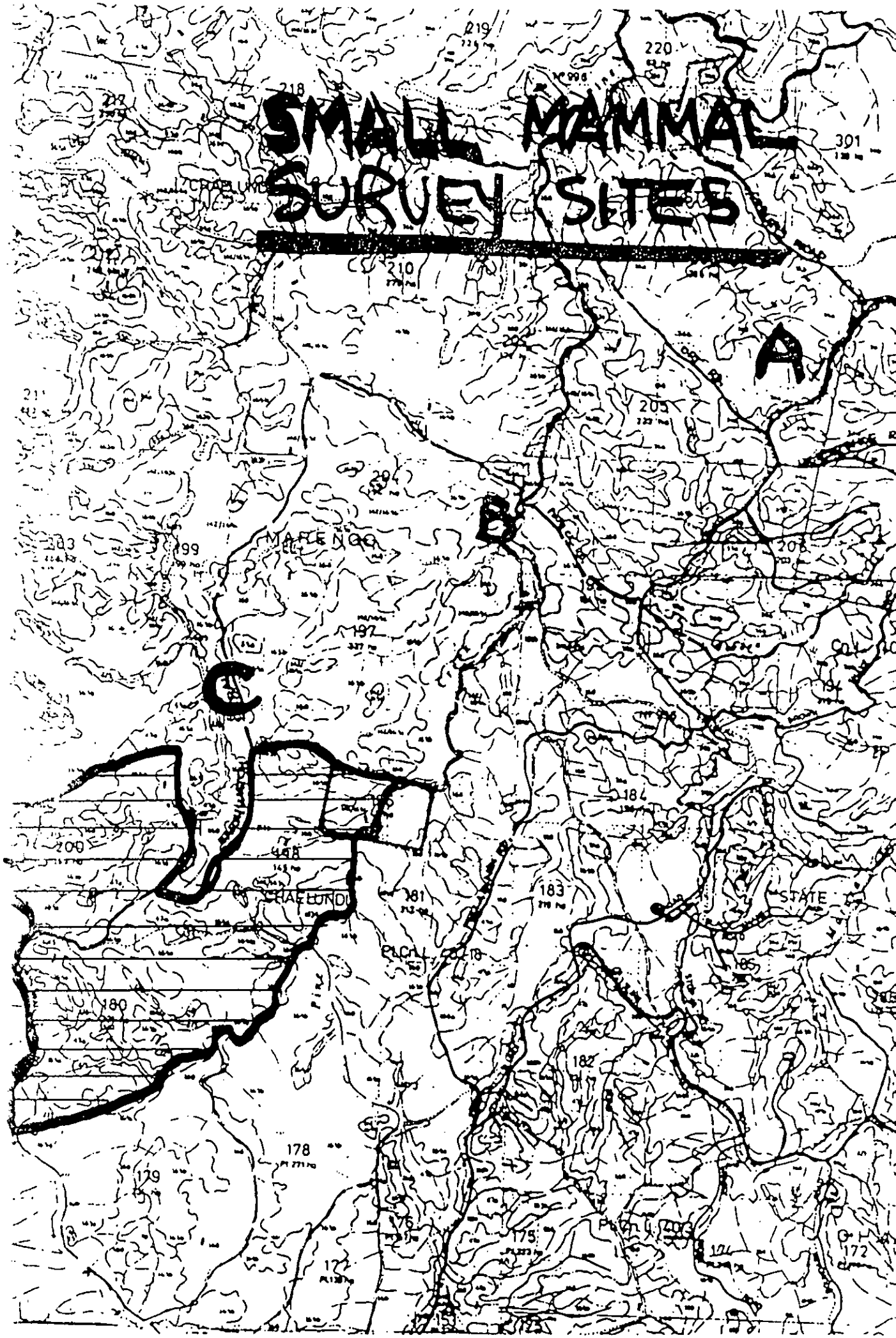
These surveys show that

1) Arboreal mammal relative density in logged areas in the vicinity of the EIS area range from 180-318 mammals/km² (5-18/km of transect).

2) In logged areas arboreal mammals predominantly occur in New England blackbutt with a dbh range of 20-150cm.

3) Arboreal mammal populations are dominated by greater gliders.

4) Mean relative density logged = 234/km².


SMALL MAMMAL
SURVEY SITES
A
B
C
MALENGO
CRAIGLUNDI
STATE

4. SMALL MAMMALS

4.1 *Aim*

The aim of the survey was to compile a list of the small mammals occurring, and determine distribution and abundance in relation to plant communities.

4.2 *Methods*

Trap layout is shown in Table 5. A total of 5,075 trap nights of survey trapping was completed at six (6) sites in the survey area. Forest types sampled are also shown in Table 4.1. Sites were selected on Pseudomys oralis habitat specification. Site location is shown on the map in Appendix 1. Fauna species lists are given in Appendix 3. All sites had a history of logging/burning/grazing disturbance.

Table 4.1. Trap layout by site.

SITE	TYPE	NO. TRAPS	NO. NIGHTS	NO. TRAP NIGHTS
A	74	150	5	750
B	142/163	150	5	750
C	163	200	5	1000
D	74	25	3	75
	74	175	5	875
E	74	175	5	875
F	163	150	5	750
TOTAL		1025		5075

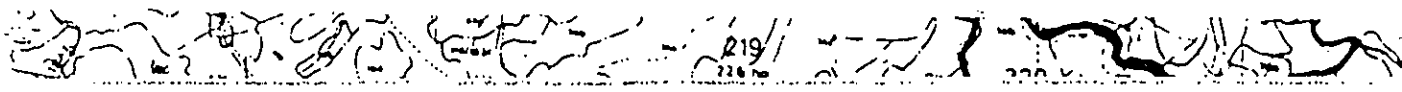
Trap spacing was 5m along the trap lines. Traps were Elliot type 'A' aluminium folding box traps, using a bait of rolled oats and peanut butter.

Trapped mammals were identified, sexed, weighed and the general body condition recorded at each capture. On initial capture they were earmarked for recapture identification.

4.3 *Results*

Five species of small mammal were trapped.

Antechinus stuartii	Brown antechinus	(AS)
Antechinus flavipes	Yellow footed antechinus	(AF)
Rattus fuscipes	Bush rat	(RF)
Melomys cervinipes	Fawn-footed melomys	(MC)
Pseudomys oralis	Hastings River mouse	(PO)



P. oralis was trapped at three new locations. The site D occurrence is significant because of the altitude of 410m ASL - the lowest yet recorded. This brings the total number of known specimens of this species since European settlement to 83.

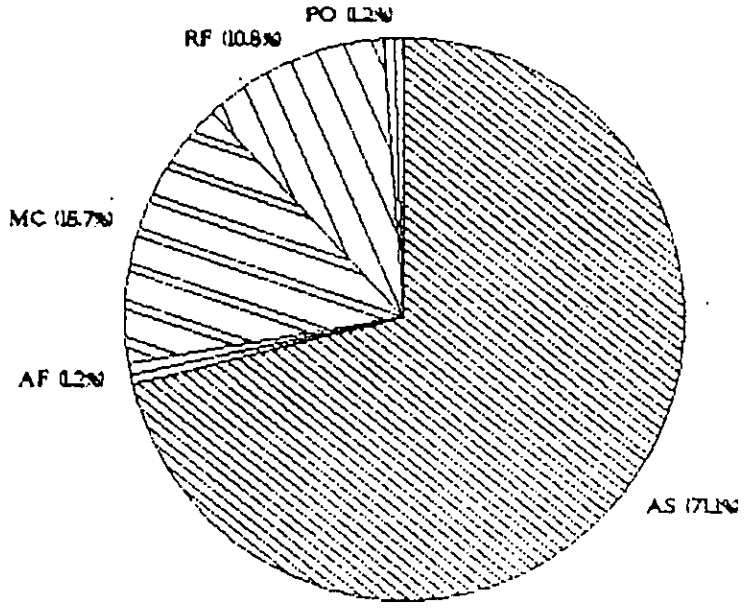
Other mammals trapped are common and widespread in the Region. Table 4.2. summarises captures by site and species. Small mammal populations were dominated by A. stuartii (5.9/100t.n.). Site E supported the highest relative density of small mammals (14.2/100t.n.). Sites D & E were the most species diverse.

Table 4.2. Trap record by Species and Site.

	SITE							
SPECIES	A	B	C	D	E	F	TOTAL	/100tn
AS	11	10	79	45	104	51	300	5.90
AF	1	0	0	0	0	0	1	0.02
MC	0	11	14	16	12	11	64	1.30
RF	0	0	28	10	7	0	45	0.90
PO	0	0	0	1	1	2	4	0.08
TOTAL	12	21	121	72	124	64	414	8.15
PER 100t.n.	1.6	2.8	12.1	7.6	14.2	8.5	t.n. = trap night.	

For every 1,000 trap nights of sampling effort in the survey area you would expect to capture

59 x A. stuartii
<1 x A. flavipes
13 x M. cervinipes
9 x R. fuscipes
1 x P. oralis



Ratio of males:females and mean weights for all species is shown in Table 4.3

Table 4.3. Small Mammal Life Form Data.

	SPECIES				
	AS	AF	PO	MC	RF
No. Males	182	1	1	33	26
No. females	118	0	2	31	19
$\bar{x}$ Weight Males	37.0g	42.0g	93.0g	59.3g	104.8g
$\bar{x}$ Weight Females	21.2g	0	57.0g	58.8g	97.2g

DISCUSSION

Antechinus stuartii

A. stuartii was the most abundant small mammal trapped at a relative density of 5.9/100t.n. Distribution by forest type is shown in Table 4.4. It occurred at all sites sampled, but was most commonly trapped at sites E, C, and F. These sites had a dense ground cover <1m, and frequent fallen logs, in common. Males were very active and aggressive at the time of survey.

Table 4.4. A. stuartii Distribution.

SITE	TYPE	PER 100t.n.
A	74	1.5
B	142/163	1.3
C	163	7.9
D	74	4.7
E	74	11.8
F	163	6.8

Comparative mean captures/100t.n. at Chaelundi (5.9/100t.n.) with other sites sampled in the Region (0.3-7.3/100t.n.) indicate the occurrence of A. stuartii is not significant.

Melomys cervinipes

M. cervinipes was trapped at a relative density of 1.3/100t.n. in the survey area. Distribution by forest type is shown in Table 4.5. It occurred at all sites, except site A - a dry northerly facing ridge with open forest structure and recent fire history. Distribution over the sites was relatively even. Several of the females trapped were in breeding condition.

Table 4.5. M. cervinipes Distribution.

SITE	TYPE	PER 100t.n.
A	74	-
B	142/163	1.5
C	163	1.4
D	74	1.7
E	74	1.4
F	163	1.5

Comparative mean captures/100t.n. at Chaelundi (1.3/100t.n.) with other sites sampled in the Region (0.1-4.4/100t.n.) indicate the occurrence of M. cervinipes at Chaelundi is not significant. The species has a common and widespread distribution in N.E. N.S.W.

Rattus fuscipes

R. fuscipes was trapped at a relative density of 0.9/100t.n. in the survey area. Distribution by forest type is shown in Table 4.6. It occurred on sites C, D, and E only. Comparative mean captures/100t.n. (0.9/100t.n.) with other sites sampled in the Region (0.1 - 21.7/100t.n.) indicate the occurrence of R. fuscipes at Chaelundi is not significant.

Table 4.6. R. fuscipes Distribution.

SITE	TYPE	PER 100t.n.
A	74	-
B	142/163	-
C	163	2.8
D	74	1.0
E	74	0.8
F	163	-

Antechinus flavipes

One individual of A. flavipes was trapped in site A in a moist ferny gully with brushbox overstorey. Although occurring at a relative density of only 0.02/100t.n. in the survey area, it is abundant and has a wide distribution throughout the N.E. Region.

Pseudomys oralis

P. oralis was trapped at a relative density of 0.08/100t.n. This is normal for the species. distribution by forest type is shown in Table 4.7. Of interest was the fact that all sites were on a N.E. aspect.

Table 4.7. P. oralis Distribution.

SITE	TYPE	PER 100t.n.
A	74	-
B	142/163	-
C	163	-
D	74	0.10
E	74	0.11
F	163	0.26

All sites where P. oralis was trapped has past disturbance by logging/burning/grazing. The trapping success indicates the species exists in very low numbers, thinly dispersed in suitable habitat.

5. BIRDS

A list of birds observed during the course of the Earthwatch expedition is appended, together with data on habitat, occurrence and status. Several of the Earthwatch volunteers were keen amateur bird watchers. The list is reasonably definitive for the survey area at the time of survey.

5.1 *Results*

A total of 47 bird species were observed. Five (5) of those species are listed in schedule 12 of the NPWS Act, as follows

STATUS	SPECIES	FOREST TYPES
1 FAUNA OF SPECIAL CONCERN	GREY CROWNED BABBLER WHITE'S THRUSH GLOSSY BLACK COCKATOO	74 74 47,142,163
2 VULNERABLE AND RARE	POWERFUL OWL SOOTY OWL	163 163

NOTES

SLATER - POWERFUL OWL - 'uncommon resident in sclerophyll forest'.

- SOOTY OWL - 'rare resident of rainforest and wet sclerophyll forest'.

- GLOSSY BLACK COCKATOO - 'uncommon to rare in open casuarina woodland'.

- WHITE'S THRUSH - 'common in damp gullies, forest, rainforest'.

- GREY CROWNED BABBLER - 'common in open forest, woodland and scrubland. Rare around settlement'.

HABITAT - as per Forest Types Research Note 17.

OCCURRENCE OF SITINGS -

1 = Rare
2 - 5 = Occasional
6 - 12 = Common
13+= Very Common

MIGRATORY STATUS -

M = Migratory
N = Nomadic
S = Sedentary
V = Vagrant

CONSERVATION STATUS (NPWS Act Schedule 12)

1 = Fauna of special concern
2 = Vulnerable and rare
3 = Threatened fauna
4 = Fauna of iminent danger of extinction

AVIFAUNA OBSERVED

CHAELUNDI E.I.S.

FAMILY	GENUS	COMMON NAME	HABITAT	OCCUR	STATUS N	STATUS C
ACCIPITRIDAE	AQUILA AUDAX	WEDGE-TAILED EAGLE	163	O	V	
TURNICIDAE	TURNIX VARIA	PAINTED BUTTON-QUAIL	74	O		
CUCULIDAE	MACROPYGIA AMBOINENSIS	BROWN CUCKOO-DOVE	47,163,153	C	N	
COLUMBIDAE	LEUCOSARCIA MELANOLEUCA	WONGA PIGEON	47,168	O	N	
CACATUIDAE	CALYPTORHYNCHUS MAGNIFICUS	RED-TAILED BLACK COCKATOO	74	O	N	
CACATUIDAE	CALYPTORHYNCHUS LATHAMI	GLOSSY BLACK COCKATOO	47,142,163	C	N	1
CACATUIDAE	CALYPTORHYNCHUS FUNEREUS	YELLOW-TAILED BLACK COCKATOO	47,74	VC	N	
LORIDAE	TRICHOGLOSSUS HAEMATODUS	RAINBOW LORIKEET	74	O	N	
LORIDAE	TRICHOGLOSSUS CHLOROLEPIDOTUS	SCALY-BREASTED LORIKEET	74,163	VC	N	
PSITTELLIDAE	ALISTERUS SCAPULARIS	AUSTRALIAN KING-PARROT	47,74,163	VC	N	
PLATYCERCIDAE	PLATYCERCUS ELEGANS	CRIMSON ROSELLA	47,74	VC	N	
CUCULIDAE	CUCULUS PYRRHOPHANUS	FAN-TAILED CUCKOO	47,74,163	VC	N	
CUCULIDAE	CHRYSOCOCCYX LUCIDUS	SHINING BRONZE CUCKOO	47	R	M	
STRIGIDAE	NINOX STRENUA	POWERFUL OWL	163	R	S	2
STRIGIDAE	NINOX NOVAESEELANDIAE	SOUTHERN BOOBOOK	163	O	S	
TYTONIDAE	TYTO TENEBRICOSA	SOOTY OWL	163	R	S	2
ALCEDINIDAE	CEYX AZUREA	AZURE KINGFISHER	163	R	S	
ALCEDINIDAE	DACELO NOVAEGUINEAE	LAUGHING KOOKABURRA	74,47,163	C	S	
MENURIDAE	MENURA NOVAEHOLLANDIAE	SUPERB LYREBIRD	168,47,53	C	S	
HIRUNDINIDAE	HIRUNDO NEOXENA	WELCOME SWALLOW	74,168	C	M	
MUSCICAPIDAE	ZOOTHERA DAUMA	WHITE'S THRUSH	74	R	S	1
MUSCICAPIDAE	PETROICA ROSEA	ROSE ROBIN	74	O	M	
MUSCICAPIDAE	EOPSALTRIA AUSTRALIS	EASTERN YELLOW ROBIN	163,168	C	S	
MUSCICAPIDAE	MICROECA LEUCOPHAEA	JACKY WINTER	74	O	S	
MUSCICAPIDAE	TREGELLASIA CAPITO	PALE-YELLOW ROBIN	47	R	S	
MUSCICAPIDAE	PACHYCEPHALA PECTORALIS	GOLDEN WHISTLER	53,74,168	C	S	
MUSCICAPIDAE	COLLURICINCLA HARMONICA	GREY SHRIKE-THRUSH	74,163	O	S	
MUSCICAPIDAE	MYIAGRA INQUIETA	RESTLESS FLYCATCHER	74	R	M	
MUSCICAPIDAE	RHIPIDURA FULIGINOSA	GREY FANTAIL	47,74,153,163	VC	S	
EPTHONYCHIDAE	PSOPHODES OLIVACEUS	EASTERN WHIPBIRD	273,47,163	VC	S	
EPTHONYCHIDAE	CINCLOSOMA PUNCTATUM	SPOTTED QUAIL-THRUSH	74	C	M	
TIMALIIDAE	POMATOSTOMUS TEMPORALIS	GREY-CROWNED BABBLER	74	O	S	
MALURIDAE	MALURUS CYANEUS	SUPERB FAIRY-WREN	163	O	S	
PARDALOTIDAE	SERICORNIS FRONTALIS	WHITE-BROWED SCRUBWREN	163	O	S	
CLIMACTERIDAE	CLIMACTERIS LEUCOPHAEA	WHITE-THROATED TREECREEPER	74,142,163	VC	S	
CLIMACTERIDAE	CLIMACTERIS ERYTHROPS	RED-BROWED TREECREEPER	74	R	S	
CLIMACTERIDAE	CLIMACTERIS PICUMNUS	BROWN TREECREEPER	74	C	S	
MELIPHAGIDAE	PHILEMON CORNICULATUS	NOISY FRIARBIRD	74	VC	N	
MELIPHAGIDAE	MANORINA MELANOPHRYS	BELL BIRD	74	C	S	
MELIPHAGIDAE	MELIPHAGA LEWINII	LEWIN'S HONEYEATER	168	VC	S	
MELIPHAGIDAE	LICHENOSTOMUS CHRYSOPS	YELLOW-FACED HONEYEATER	74	C	N	
DICAEIDAE	DICAEUM HIRUNDINACEUM	MISTLETOE BIRD	74	O	N	
PARDALOTIDAE	PARDALOTUS PUNCTATUS	SPOTTED PARDALOTE	74	O	S	
PLOCEIDAE	ENBLEMA TEMPORALIS	RED-BROWED FIRETAIL	47,163	VC	N	
PARADISEIDAE	PTILONORHYNCHUS VIOLACEUS	SATIN BOWERBIRD	47,163,168	C	N	
CORCORACIDAE	CORCORAX MELANORHAMPHOS	WHITE-WINGED CHOUGH	74	O	N	
CRACTICIDAE	STREPERA GRACULINA	PIED CURRAWONG	47,74	VC	S	

6. MAMMALS

A list of mammals observed during the course of the Earthwatch expedition is appended, together with data on habitat, occurrence and status.

6.1 *Results*

A total of 16 species of mammal were observed. Two (2) of these species are listed in schedule 12 of the NPWS Act, as follows:

STATUS	SPECIES	FOREST TYPES
FAUNA IN IMMINENT DANGER OF EXTINCTION	P. oralis	74, 92, 163
FAUNA OF SPECIAL CONCERN	D. maculatus	163, 142/163

P. oralis

Dr David Read - 'the species exists in very low numbers, thinly dispersed in suitable habitat.'

- 'the species appears to have a specialised diet and ... may also require specific habitats'.

- 'in time, with further searching ... the Hastings River Mouse will not be regarded as rare'.

Dr Wayne Braithwaite - Logging/burning/grazing ... 'such disturbance possible does not adversely affect the species'.

D. maculatus

R. Edgar Status : Common-rare. Land clearance removed habitat.

Three (3) individuals observed in the 12 day period of survey (2 trapped).

CONSERVATION STATUS UNDER SCHEDULE 12
N.P.W.S. ACT 1974.

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1 = Fauna of Special Concern

2 = Vulnerable and Rare Fauna

3 = Threatened Fauna

4 = Fauna in iminent danger of extinction.

FAUNA OBSERVED

CHAELUNDI E.I.S.

FAMILY	GENUS	COMMON NAME	HABITAT TYPE	OCCUR
DASYURIDAE	ANTECHINUS FLAVIPES	YELLOW-FOOTED ANTECHINUS	153	O
DASYURIDAE	ANTECHINUS STUARTII	BROWN ANTECHINUS	47,74,53,153,153,53,142/1 53	VC
DASYURIDAE	DASYURUS MACULATUS	TIGER QUOLL (TIGER CAT)	163b,142/153	O
PHALANGERIDAE	TRICHOSURUS VULPECULA	COMMON BRUSHTAIL POSSUM	74,153	VC
PETAURIDAE	PETAURUS AUSTRALIS	YELLOW-BELLIED GLIDER (FLUFFY GLIDER)	47,153	O
PETAURIDAE	PSEUDOCHEIRUS PEREGRINUS	COMMON RINGTAIL POSSUM	153,142/153,153	VC
PETAURIDAE	PETAUROIDES VOLANS	GREATER GLIDER	142/153,74,47,53,153,153	VC
MACROPODIDAE	AEPYPRYMNUS RUFESCENS	RUFOUS BETTONG	142/153,153,153,74	C
MACROPODIDAE	MACROPUS GIGANTEUS	EASTERN GREY KANGAROO (FORESTER)	74	O
MACROPODIDAE	MACROPUS RUFOGRISEUS	RED-NECKED WALLABY (BRUSH KANGAROO)	47,153	O
MACROPODIDAE	WALLABIA BICOLOR	SWAMP WALLABY (BLACK WALLABY)	153,168,47	VC
MURIDAE	MELOMYS CERVINIPES	FAWN-FOOTED MELOMYS	74,47,53,153,142/153,168	VC
MURIDAE	PSEUDOMYS ORALIS	HASTINGS RIVER MOUSE	74,92,163b	O
MURIDAE	RATTUS FUSCIPES	BUSH RAT	47,53,74,142/153,153,168	VC
FELIDAE	FELIS CATUS	CAT	153,168	VC
BOVIDAE	BOS TAURUS	EUROPEAN CATTLE	74,153.47,142/153,5/23,15 8	VC

New South Wales Government

Forestry Commission of N.S.W.

Research Section,
P.O. Box J19,
COFFS HARBOUR JETTY.
N.S.W. 2450.

Phone : (066) 528900
Fax : (066) 528468

DATE : 31-8-90

FAX TO : RAY MARGULES

FAX NO. : (06) 2952803

FOR ATTENTION :

SENDER : G. WATTS. RESEARCH

PHONE : (066) 528172

NO. OF PAGES : 7 FOLLOW

MESSAGE : HEREWITH DATA ON 2. VEGETATION. IMPORTANT STAND DATA ON THE LOGGED FOREST STILL TO COME THIS P.M.

WATTS
RESEARCH
31/8

2. VEGETATION

The aims of the vegetation survey were to:

(i) describe and characterise plant communities and determine their distribution in the study area.

(ii) compile a flora inventory for the plant communities surveyed.

(iii) identify sites of botanical significance.

Results

Species diversity by plot is shown in Table 2.1. The most diverse types are the depauperate subtropical rainforest type 6/23, and tallowood/blue gum type 47. The ecotone between types 47 and 6/23 forms the most diverse habitat in the study area.

Table 2.1. Species Diversity.

PLOT	TYPE	NO. SPECIES
1	74	35
2	163	54
3	47	64
4	142/163	47
5	168	43
6	6/23	64

A total of 163 plant species, comprising 1 moss species, 1 conifer, 15 pteridophytes, 25 monocotyledons and 121 dicotyledons. Only one species of introduced plant was observed. One species observed in type 47, Hibbertia villosa is listed on the NPWS Rare Plants database.

A composite plant species list is appended.

CHAELUNDI E.I.S.

COMPOSITE SPECIES LIST.
MOSS.

[illegible]	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74a	TYPE 153	TYPE 47	TYPE 6/23	TYPE 163a	TYPE 163b	TYPE 142/163	TYPE 153
[illegible]	Dawsonia superba	Giant Moss			-	-	-	+	-	-	-	+	-

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COMPOSITE SPECIES LIST.
PTERIDOPHYTES.

FAMILY	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74a	TYPE 163	TYPE 47	TYPE 5 23	TYPE 153a	TYPE 153c	TYPE 142/143	TYPE 168
Adiantaceae	Adiantum aethiopicum	Common Maidenhair Fern	F	C	-	-	-	-	-	-	-	+	-
Adiantaceae	Adiantum hispidulum	Rough Maidenhair Fern	F	C	+	-	-	+	-	-	-	+	-
Dicksoniaceae	Lastreopsis decomposita	Trim Shield Fern	F	C	-	-	-	-	-	-	-	-	-
Aspleniaceae	Asplenium australasicum (nicus)	Birds-nest Fern	F	C	-	-	-	-	-	-	-	-	-
Blechnaceae	Blechnum cartilagineum	Gristle Fern	F	VC	-	+	-	-	+	+	-	-	+
Dennstaedtiaceae	Doodia aspera	Rasp Fern	F	C	+	+	+	+	-	-	-	-	+
Cyatheaceae	Cyathea australis	Rough Tree Fern	F	O	-	-	+	+	+	+	-	-	+
Dennstaedtiaceae	Pteridium esculentum	Bracken Fern	F	VC	-	+	+	-	-	-	+	+	-
Dennstaedtiaceae	Culcita dubia	False Bracken	F	VC	-	+	+	+	-	+	-	+	-
Lomariopsidaceae	Arthropteris tenella	Climbing Fish-bone Fern	F	C	-	-	-	-	+	-	-	-	-
Polypodiaceae	Dictymia brownii	Strap Fern	F	VC	-	-	-	-	+	-	-	-	-
Polypodiaceae	Microsorium scandens	Fragrant Fern	F	VC	-	-	-	-	+	-	-	-	-
Polypodiaceae	Platycerium bifurcatum	Elk Horn Fern	F	R	-	+	-	-	-	-	-	-	-
Polypodiaceae	Pyrrosia rupestris	Rock Felt Fern	F	VC	-	-	-	-	+	-	-	-	-
Pteridaceae	Pellaea falcata	Sickle Fern	F	VC	+	-	-	-	-	-	-	-	-

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COMPOSITE SPECIES LIST.
MONOCOTYLEDONS.

FAMILY	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74a	TYPE 163	TYPE 47	TYPE 6/23	TYPE 163a	TYPE 163b	TYPE 142/153	TYPE 153
Laxaceae	Cordyline stricta	Erect Palm Lily	S	C	-	-	-	-	+	-	-	-	-
Restionaceae	Gymnostachys anceps	Settler's Flax	S	R	-	-	+	+	+	+	-	+	-
Cyperaceae	Lepidosperma monostachyas	Midginbil	S	VC	-	-	-	-	-	-	-	-	-
Cyperaceae	Carex appressa	Tall Sedge	H	VC	-	-	-	-	-	-	-	-	-
Cyperaceae	Gahnia melanocarpa	Black-fruit Saw Sedge	S	C	-	-	-	+	-	+	-	-	-
Dioscoreaceae	Dioscorea transversa	Yam	V	O	-	-	-	-	-	+	-	-	-
Iridaceae	Patersonia sericea	Silky Purple Flag	H	R	+	-	-	-	-	-	-	-	-
Juncaceae	Juncus continuous	Juncus	S	VC	-	-	-	-	-	-	-	-	-
Liliaceae	Dianella caerulea	Rough Flax Lily	H	C	+	+	-	+	-	+	+	+	+
Liliaceae	Drymophila moorei	Orange-berry Drymophila	H	VC	-	-	-	+	-	+	-	-	-
Orchidaceae	Caladenia sp.		H	O	+	-	-	-	-	-	-	-	-
Orchidaceae	Cymbidium suave	Snake Orchid	H	R	+	-	-	-	-	-	-	-	-
Orchidaceae	Dendrobium pugioniforme	Dagger Orchid	O	O	-	-	-	-	+	-	-	-	-
Phormiaceae	Eustrephus latifolius	Orange Vine	V	VC	+	+	+	-	-	+	+	+	+
Phormiaceae	Geitonoplesium cymosum	Scrambling Lily	V	O	-	-	+	-	-	+	-	-	-
Poaceae	Echinopogon caespitosus	Tufted Hedgehog Grass	H	VC	-	-	-	-	-	-	-	+	-
Poaceae	Entolasia stricta	Wiry Panic Grass	H	VC	-	-	-	-	-	-	-	-	-
Poaceae	Imperata cylindrica var major	Blady Grass	H	VC	+	+	+	-	-	-	+	+	+
Poaceae	Poa labillardieri (caespitosa)	Tussock Grass	H	VC	+	+	+	-	-	-	+	+	+
Poaceae	Themeda australis	Kangaroo Grass	H	VC	+	-	-	-	-	-	+	+	-
Smilacaceae	Smilax australis	Prickly Supple-jack	V	C	-	-	-	+	+	-	-	-	+
Smilacaceae	Smilax glyciphylla	Sarsaparilla	V	O	-	-	+	-	-	+	-	-	-
Xanthorrhoeaceae	Lomandra filiformis ssp. filiformis	Wattle Mat Rush	H	O	-	-	-	-	-	-	-	-	-
Xanthorrhoeaceae	Lomandra longifolia ssp. longifolia	Spiny-headed Mat Rush	H	O	-	-	+	-	+	-	-	-	-
Xanthorrhoeaceae	Lomandra spicata	Jungle Mat Rush	H	O	+	+	-	-	-	+	-	-	+

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COMPOSITE SPECIES LIST.
DICOTYLEDONS.

FAM	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74a	TYPE 163	TYPE 47	TYPE 5/23	TYPE 152a	TYPE 163b	TYPE 142/163	TYPE 158
Apiaceae	Alexia lucens	Turnipwood	T	O	-	-	-	-	+	-	-	-	-
Myrtaceae	Alangium villosum	Black Muskheart	T	C	-	-	-	-	+	-	-	-	-
Apiaceae	Hydrocotyle geraniifolia	Forest Pennywort	H	VC	-	-	-	-	-	-	-	-	-
Loganiaceae	Parsonsia induplicata	Thin-leaved Silkpod	V	C	-	-	-	+	-	-	-	-	-
Loganiaceae	Parsonsia straminea	Ivy Silkpod	V	C	-	-	-	+	-	-	-	-	-
Apiaceae	Cephalaralia cephalobotrys*	Climbing Panax	V	C	-	-	+	+	+	-	-	-	-
Araliaceae	Polyscias (Tieghemopanax: sambucifolia	Ornamental Ash	S	VC	-	+	+	+	-	-	-	-	+
Apiaceae	Polyscias elegans	Celery Wood	T	O	-	-	-	+	-	+	-	-	-
Scrophulariaceae	Marsdenia rostrata	Stalked Doubah	V	O	-	-	-	+	-	-	-	-	-
Asteraceae	Helichrysum diosmifolium	Tick Bush	S	O	-	-	-	+	-	-	+	-	-
Asteraceae	Senecio amygdalifolius	Almond leaved Groundsel	S	VC	-	+	+	+	-	+	-	-	+
Asteraceae	Taraxacum officinale *	Dandelion	H	VC	-	-	-	-	-	-	+	+	-
Lauraceae	Daphnandra micrantha	Socketwood	T	O	-	-	-	-	+	-	-	-	-
Lauraceae	Doryphora sassafras	Sassafras	T	O	-	-	-	-	+	-	-	-	-
Bignoniaceae	Pandorea pandorana	Wonga Wonga Vine	V	C	-	-	-	-	+	+	-	+	-
Casuarinaceae	Allocasuarina littoralis (suberosa)	Black She-Oak	T	VC	-	-	-	-	-	-	-	-	-
Casuarinaceae	Allocasuarina torulosa	Forest She-Oak	T	O	+	+	-	-	-	+	-	-	+
Celastraceae	Cassine australe	Red Olive Berry	T	R	-	-	-	+	+	-	-	-	+
Celastraceae	Maytenus bilocularis	Orangebark	S	O	+	+	+	-	-	-	-	+	+
Celastraceae	Maytenus silvestris	Narrow-leaved Orangebark	S	R	-	-	-	-	-	-	-	-	+
Cunoniaceae	Caldcluvia paniculosa	Corkwood	T	C	-	-	-	-	+	+	-	-	-
Cunoniaceae	Ceratopetalum apetalum	Coachwood	T	C	-	-	-	-	+	-	-	-	-
Cunoniaceae	Schizomeria ovata	Crab Apple	T	VC	-	-	-	-	+	+	-	-	-
Dilleniaceae	Hibbertia dentata	Twining Guinea-flower	V	VC	-	+	+	+	-	+	-	-	-
Dilleniaceae	Hibbertia scandens (volubile)	Snakevine	V	VC	+	+	+	+	-	+	-	-	-
Dilleniaceae	Hibbertia villosa **(on NPWS Rare Plants	Base 1994)	S	C	-	-	-	+	-	-	-	-	-
Ebenaceae	Diospyros australis	Yellow Persimmon	T	C	-	-	-	-	-	-	-	-	-
Ebenaceae	Diospyros pentamera	Grey Persimmon	T	O	-	-	-	-	+	-	-	-	-
Elaeocarpaceae	Aristotelia australasica	Wine Berry	S	O	-	-	-	-	+	-	-	-	-
Elaeocarpaceae	Elaeocarpus reticulatus (cyaneus)	Lily-of-the-Valley Tree	T	O	-	-	+	+	-	-	-	-	-
Elaeocarpaceae	Sloanea woollsii	Yellow Carabeen	T	C	-	-	-	-	+	-	-	-	-
Epacridaceae	Leucopogon lanceolatus	Lance Beard Heath	S	C	-	+	+	-	-	-	-	-	-
Epacridaceae	Trochocarpa laurina	Tree Heath	T	O	-	+	+	-	+	+	-	-	-
Escalloniaceae	Polyosma cunninghamii	Featherwood	T	C	-	-	-	-	-	-	-	-	-
Euphorbiaceae	Breynia oblongifolia	Dwarf's Apples	S	O	-	+	+	+	-	+	-	-	-
Euphorbiaceae	Claoxylon australe	Brittlewood	T	O	-	-	-	-	-	-	-	-	-
Euphorbiaceae	Omalanthus populifolius	Native Poplar	T	O	-	-	-	+	-	-	-	-	-
Euphorbiaceae	Phyllanthus gasstroemii	Forest Phyllanthus	S	C	-	-	-	+	-	+	-	-	-
Euphorbiaceae	Pseudanthus laurina	Soiwarra	S	VC	-	-	-	+	+	+	-	-	-
Fabaceae	Glycine clandestina	Twining Glycine	V	VC	+	+	+	-	-	-	-	-	-
Fabaceae	Goodia lotifolia	Golden Tip	S	VC	-	-	+	+	-	-	-	-	-
Smilacaceae	Hardenbergia violacea	False Sarsaparilla	V	VC	+	+	-	-	-	-	-	-	+
Fabaceae	Indigofera australis var. minor	Australian Indigo	S	VC	-	+	-	-	-	-	-	-	-

CHAELUNDI E.I.S.

COMPOSITE SPECIES LIST.
DICOTYLEDONS.

FAMILY	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74a	TYPE 153	TYPE 47	TYPE 5/23	TYPE 163a	TYPE 163b	TYPE 142/163	TYPE 152
[illegible]ceae	Kennedia rubicunda	Soldier Vine	V	VC	+	+	+	-	-	-	-	+	+
[illegible]ceae	Pennantia cunninghamii	Brown Beech	T	O	-	-	-	+	+	-	-	-	-
[illegible]aceae	Plectranthus parviflorus	Cockspur Flower	H	C	-	-	-	-	-	-	-	-	+
[illegible]aceae	Cinnamomum oliveri	Oliver's Sassafras	T	R	-	-	-	-	-	-	-	-	-
[illegible]aceae	Cryptocarya microneura	Murrogun	T	O	-	-	-	-	+	-	-	-	-
[illegible]aceae	Cryptocarya rigida (obtentinervis)	Rose Maple	T	C	-	-	+	+	+	+	-	-	-
[illegible]aceae	Endiandra muelleri	Mueller's Walnut	T	O	-	-	-	-	+	-	-	-	-
[illegible]aceae	Endiandra sieberi	Hard Corkwood	T	O	-	-	-	+	-	+	-	-	-
[illegible]aceae	Litsea reticulata	Bolly Gum	T	O	-	-	-	-	+	-	-	-	-
[illegible]aceae	Dysoxylum fraseranum	Rosewood	T	O	-	-	-	-	+	+	-	-	-
[illegible]aceae	Synoum glandulosum	Scentless Rosewood	T	O	-	+	+	+	+	+	-	-	-
[illegible]spermaceae	Sarcopetalum harveyanum	Big-leaf Vine	V	R	-	+	-	-	-	-	-	-	-
[illegible]spermaceae	Stephania japonica var. discolor	Tape Vine	V	O	-	-	-	-	-	+	-	-	-
[illegible]mosaceae	Acacia binervata	Two-veined Hickory	T	VC	-	+	-	-	-	-	-	-	+
[illegible]mosaceae	Acacia falcata	Falcate Wattle	T	VC	-	-	+	-	-	-	-	-	+
[illegible]mosaceae	Acacia fimbriata	Fringed Wattle	T	VC	-	-	-	-	-	-	+	-	-
[illegible]mosaceae	Acacia irrorata ssp. irrorata	Blue Skin Wattle	T	VC	-	-	-	-	-	-	-	+	-
[illegible]mosaceae	Acacia mearnsii (mollissima)	Black Wattle	T	VC	-	-	-	-	-	+	-	-	-
[illegible]mosaceae	Acacia melanoxylon	Blackwood	T	O	-	-	-	+	-	+	-	-	+
[illegible]minaceae	Palmeria scandens	Anchor Vine	V	VC	-	-	-	-	+	+	-	-	-
[illegible]minaceae	Wilkiea huegeliana	Wilkiea	T	O	-	-	-	-	+	-	-	-	-
[illegible]aceae	Streblus brunonianus	Whalebone Tree	T	O	-	-	-	-	+	-	-	-	-
[illegible]rsiaceae	Rapanea howittiana	Howitt's Muttonwood	S	O	-	-	+	-	+	-	-	-	-
[illegible]rsiaceae	Rapanea variabilis	Variable Muttonwood	S	R	-	-	-	+	-	-	-	-	-
[illegible]rtaceae	Acmena smithii	Lilly Pilly	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Angophora floribunda (intermedia)	Rough-barked Apple	T	O	+	+	-	-	-	-	-	-	-
[illegible]rtaceae	Angophora subvelutina	Broad-leaved Apple	T	C	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Archirhodomyrtus beckleri	Rose Myrtle	S	C	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus andrewsii ssp. andrewsii ~~Eastern~~ campanulata	~~Eastern~~ New England Blackbutt	T	C	+	+	+	-	-	+	-	-	-
[illegible]rtaceae	Eucalyptus caliginosa	Broad-leaved Stringybark	T	VC	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus cameronii	Diehard Stringybark	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus deanei	Round-leaved Gum	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus laevopinea	Silver-top Stringybark	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus maculata	Spotted Gum	T	VC	-	+	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus microcorys	Tallowwood	T	C	-	-	+	-	-	-	-	-	-
Myrtaceae	Eucalyptus obliqua	Messmate	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus propinqua	Small-fruited Grey Gum	T	O	+	+	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus quadrangulata	Coastal White Box	T	R	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus saligna	Sydney Blue Gum	T	O	-	-	-	-	-	-	-	-	-
[illegible]rtaceae	Eucalyptus umbra ssp. umbra	Bastard Mahogany	T	C	+	-	-	-	-				-
[illegible]rtaceae	Lophostemon confertus	Brush Box	T	R	-	-	-	-	-				-
[illegible]rtaceae	Rhodamnia rubescens	Brush Turpentine	T	VC	-	-	-	-	-	-			-
[illegible]rtaceae	Syzygium australe	Brush Cherry	T	O	-	-	-	-	-	-	-	-	-

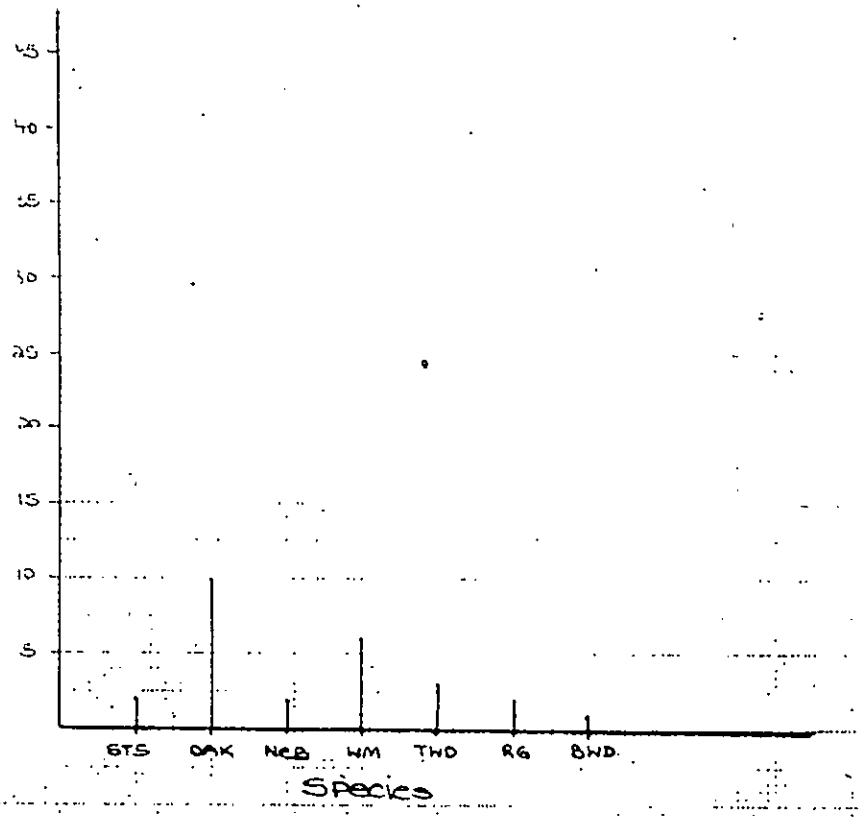
CHAELUNDI E.I.S.

COMPOSITE SPECIES LIST.
DICOTYLEDONS.

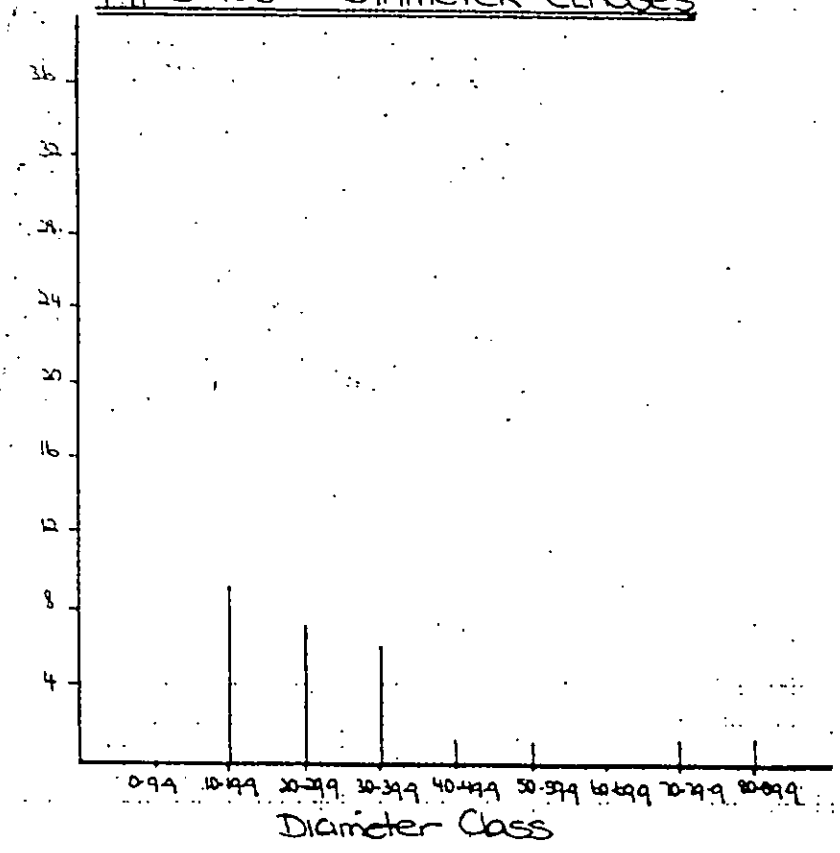
Family	SPECIES	COMMON NAME	HABIT	OCCUR	TYPE 74a	TYPE 74e	TYPE 163	TYPE 47	TYPE 5/23	TYPE 183a	TYPE 1535	TYPE 142/153	TYPE 183
[illegible]aceae	Notelaea longifolia	Large Mock Olive	T	O	-	-	+	-	+	-	+	-	+
[illegible]tosporaceae	Billardiera scandens	Common Apple-berry	V	O	+	-	+	+	-	+	-	+	-
[illegible]tosporaceae	Bursaria spinosa	Blackthorn	S	O	-	-	-	+	-	-	-	-	-
[illegible]tosporaceae	Citriobatus pauciflorus	Orange Thorn	S	VC	-	-	-	-	+	-	-	-	-
[illegible]tosporaceae	Hymenosporum flavum	Native Frangipani	T	R	-	-	+	-	-	-	-	-	-
[illegible]tosporaceae	Pittosporum revolutum	Yellow Pittosporum	S	R	+	-	-	-	-	+	-	-	-
[illegible]oteaceae	Aomatia silaifolia	Wild Parsley	S	VC	-	-	-	-	-	-	+	+	-
[illegible]oteaceae	Orites excelsa	Prickly Ash	T	VC	-	-	-	-	+	-	-	-	-
[illegible]oteaceae	Persoonia attenuata (P. media)	Scrub Geebung	S	O	+	-	-	-	-	+	+	+	-
[illegible]oteaceae	Stenocarpus salignus	Scrub Beefwood	T	R	-	-	-	-	+	-	-	-	-
[illegible]anunculaceae	Clematis aristata	Traveller's Joy	V	O	+	-	+	+	-	+	-	+	-
[illegible]mnaceae	Alphitonia excelsa	Red Ash	T	R	+	-	-	-	-	-	-	-	-
[illegible]aceae	Acaena novae-zelandiae	Bidgee Widgee	H	VC	-	-	-	-	-	-	-	+	-
[illegible]aceae	Rubus hillii (moluccanus)	Queensland Bramble	V	VC	-	-	-	+	-	+	-	-	-
[illegible]osaceae	Rubus moorei	Greenleaf Bramble	V	C	-	-	-	+	+	+	-	-	-
[illegible]osaceae	Rubus parvifolius	Native Raspberry	V	VC	+	+	+	-	-	-	-	+	+
[illegible]aceae	Rubus rosifolius	Roseleaf Bramble	V	C	-	-	+	+	-	-	-	-	+
[illegible]biaceae	Morinda jasminoides	Jasmine Morinda	V	O	-	-	-	+	+	-	-	-	-
[illegible]biaceae	Psychotria loniceroides	Hairy Psychotria	S	C	-	+	+	+	+	+	-	-	+
[illegible]aceae	Acronychia oblongifolia	White Lilly-Pilly	T	VC	-	-	-	+	-	-	-	-	-
[illegible]taceae	Euodia micrococca	White Euodia	T	O	-	-	-	+	+	-	-	-	-
[illegible]taceae	Zieria smithii	Sandfly Zieria	S	O	-	-	+	-	-	-	-	-	-
[illegible]rtaceae	Exocarpos stricta	Pale-fruited Cherry	S	R	+	-	-	-	-	-	+	-	-
[illegible]minaceae	Dioclogiottis australis	Tamarind	T	O	-	-	-	-	+	-	-	-	-
[illegible]minaceae	Sarcopteryx stipata	Steelwood	T	C	-	-	-	-	+	-	-	-	-
[illegible]aceae	Planchonella australis	Black Apple	T	C	-	-	-	-	+	-	-	-	-
[illegible]rassulaceae	Crassula helmsii	Pigmy Weed	H	VC	-	-	-	-	-	-	-	-	-
[illegible]aceae	Solanum densevestitum	Hairy Nightshade	S	VC	-	+	+	+	-	+	-	-	+
[illegible]euphoriaceae	Argyrodendron actinophyllum	Black Booyong	T	VC	-	-	-	-	+	-	-	-	-
[illegible]rcuriaceae	Brachychiton acerifolius	Flame Tree	T	R	-	-	-	-	+	-	-	-	-
[illegible]ymelaeaceae	Pimelea ligustrina var. ligustrina	Tall Riceflower	S	C	-	-	-	+	-	-	-	-	-
[illegible]rticaceae	Dendrocnide excelsa (Laportea gigas)	Giant Stinging Tree	T	O	-	-	-	-	+	-	-	-	-
[illegible]taceae	Cissus antarctica	Simple Water Vine	V	R	-	-	+	+	-	+	-	-	-
[illegible]taceae	Cissus hypoglauca	White-leaved Water Vine	V	O	-	-	+	+	+	-	-	-	-
[illegible]anthaceae	Tasmannia (Drimys) insipida (lanceolata)	Tasteless Pepper Bush	S	VC	-	-	-	-	+	-	-	-	-

Chaelundi E.I.S.

TYPE 168 - Species Frequency



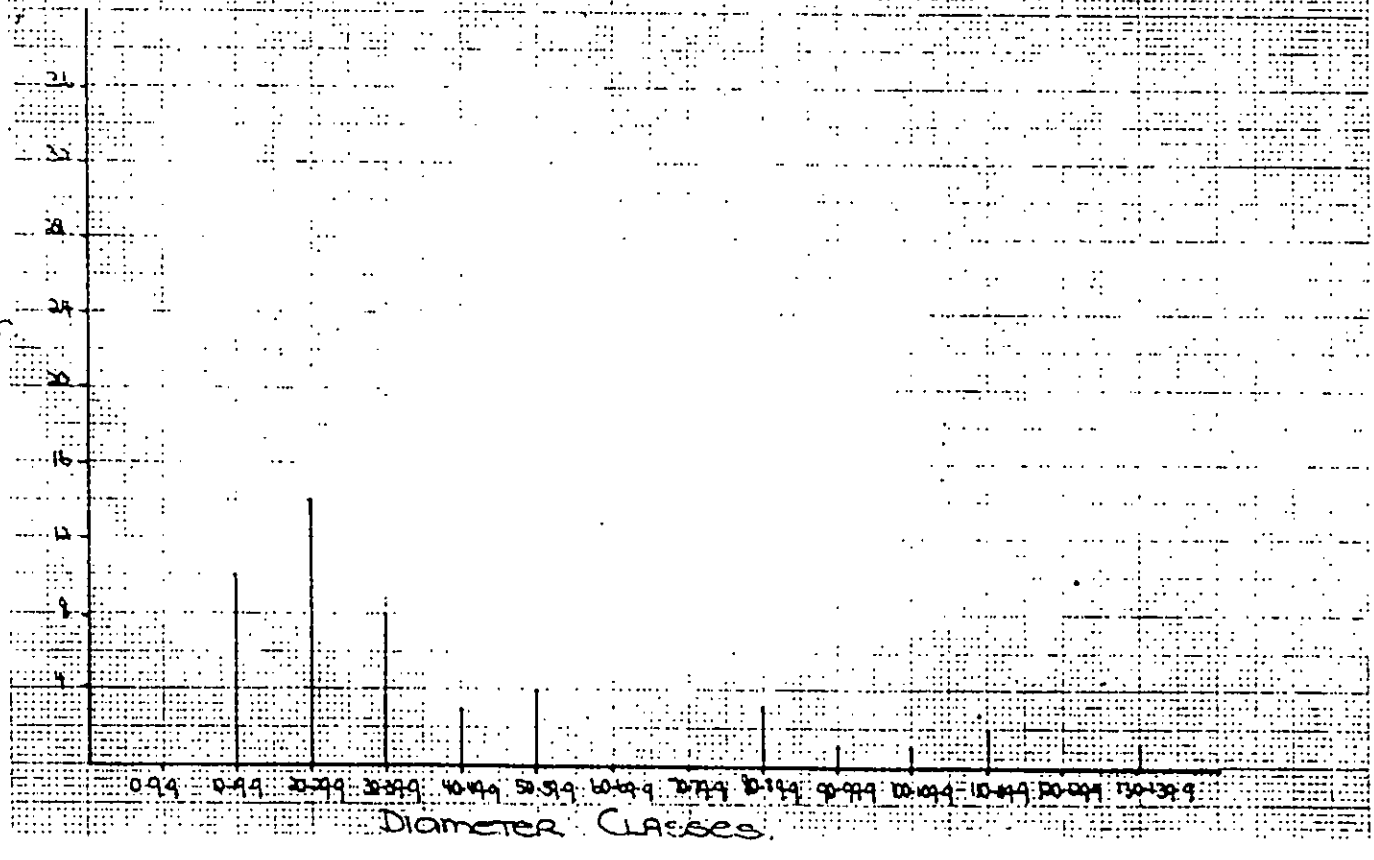
TYPE 168 – Diameter Classes



Chaelundi E.I.S

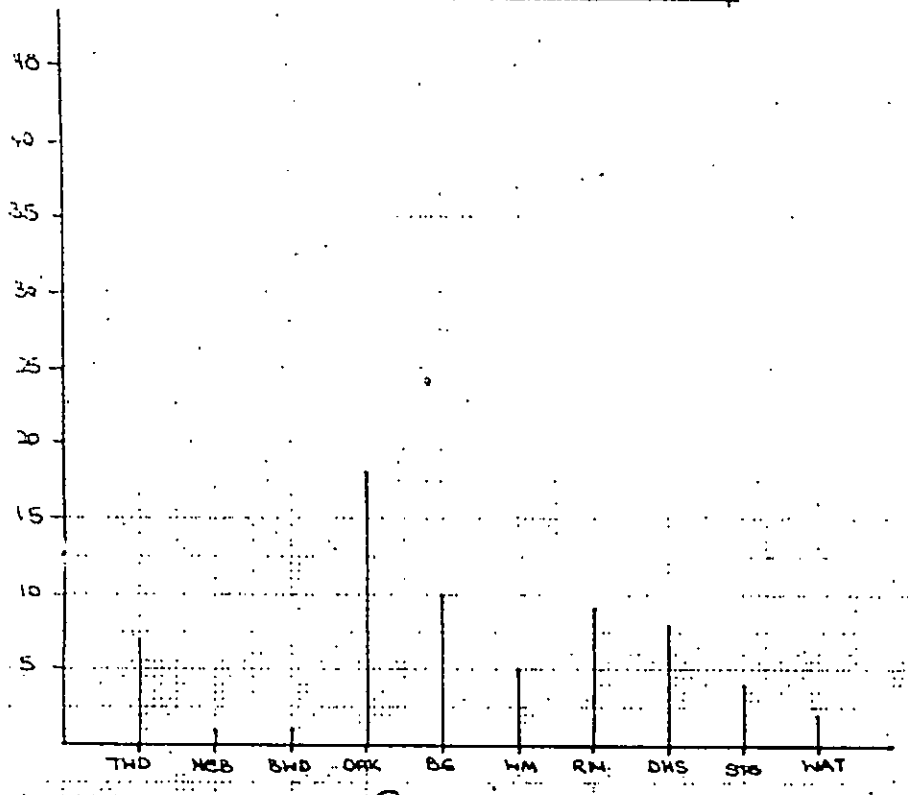
TYPE 163 - SPECIES FREQUENCY

TYPE 163 - DIAMETER CLASSES

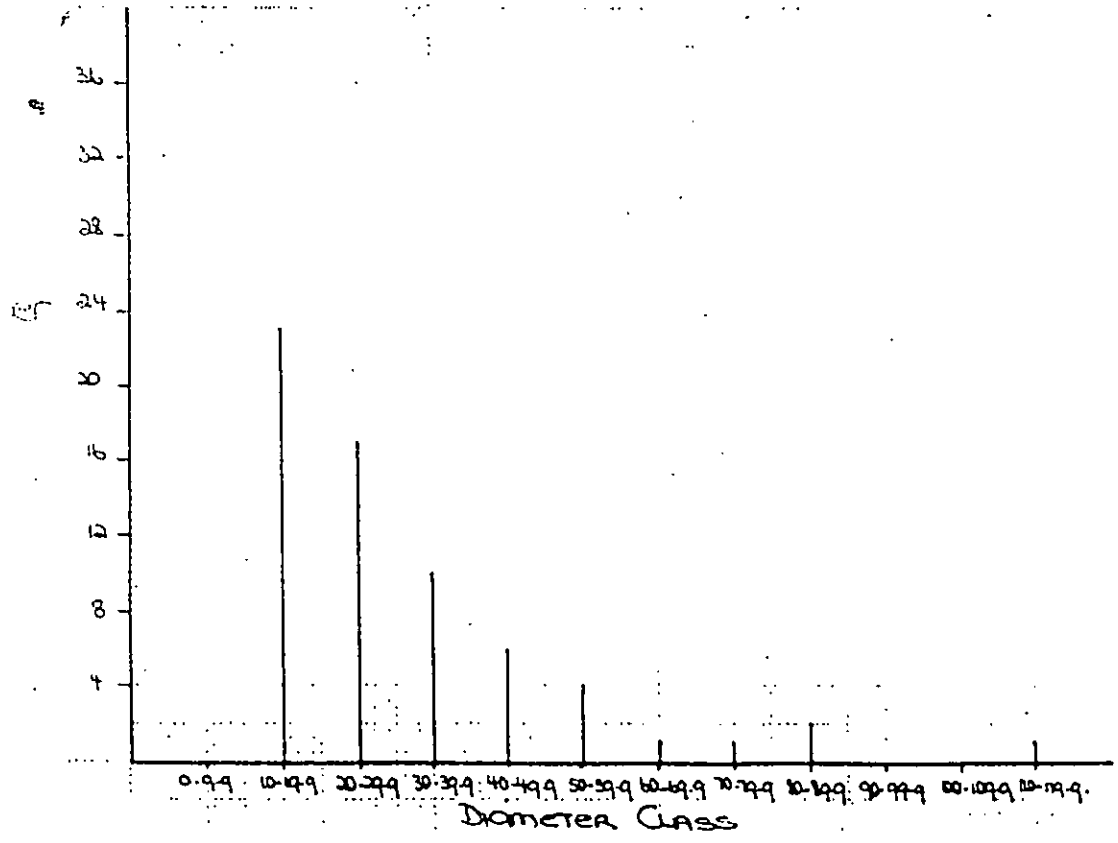


Craelundi EIS.

TYPE 47 – SPECIES FREQUENCY

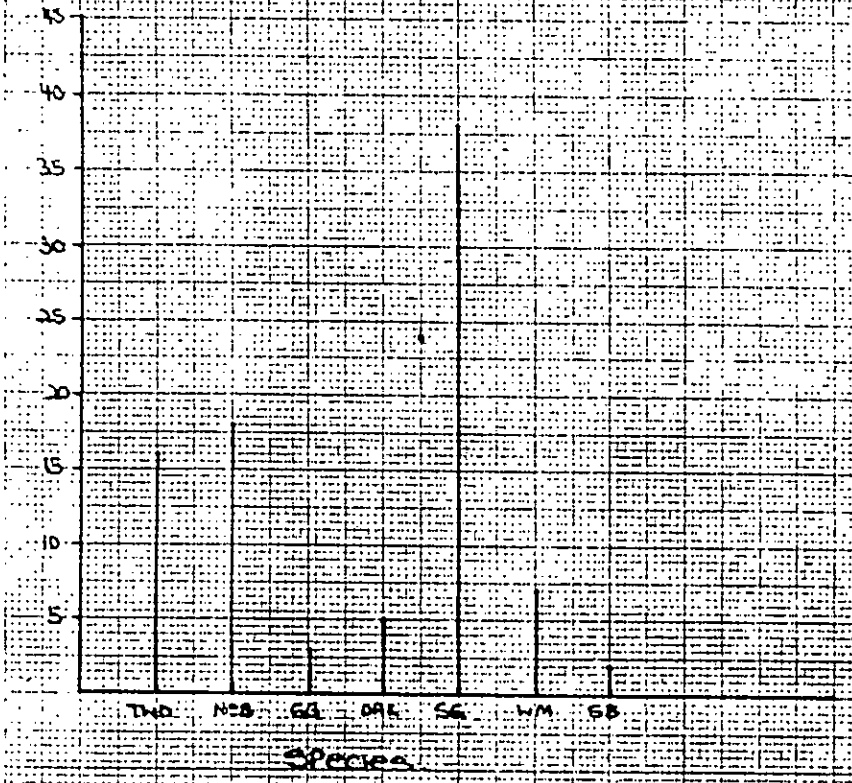


TYPE 47 – DIAMETER CLASSES

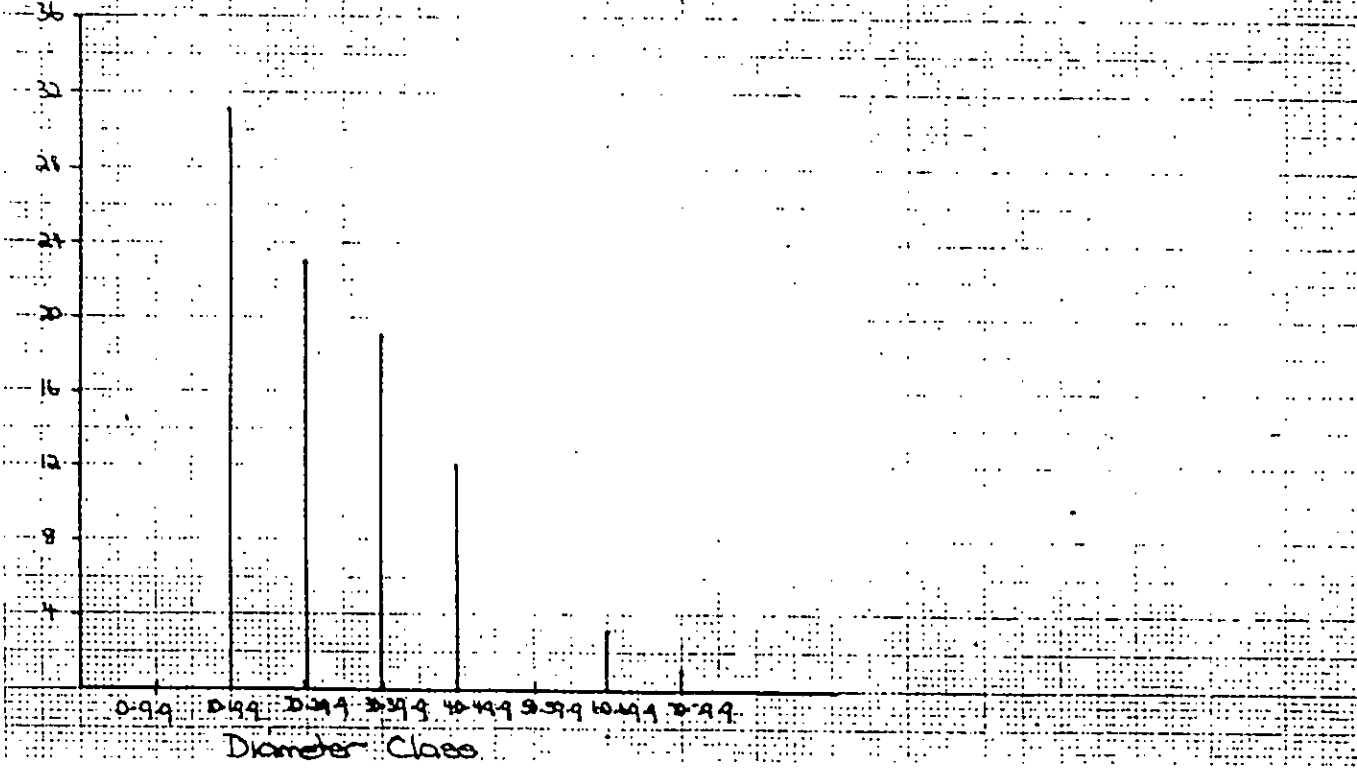


Chaelundi F.I.S.

TYPE 74 - Species Frequency



TYPE 74 - Diameter Classes



FAX to Margulas - Parthers
06% 295 2903.

Earthwatch Study.

There is an error in material FAXed you on 31/8/90.

See Walk Transect 2 Spur Road Unlogged:
The right hand column should read GG 246·0 rather than 24·61.

John Bruce.
Coffs Harbour.
6/9/90.

APPENDIX 8.

FCNSW Arboreal mammal surveys summary –
Chaelundi Group of Forests

2.6.

FORESTRY COMMISSION, N.S.W.

DISTRICT OFFICE
Research, COFFS HAR
No. 03/12.5#1.

J.WATTS:LC

LC 1400

ARBOREAL MAMMAL SURVEYS - SUMMARY
CHAELUNDI GROUP OF FORESTS
R.O. ?

INTRODUCTION

Arboreal mammal surveys were undertaken in the Chaelundi Group of forests, Dorrigo M.A. in the period October 1978 to February 1981 as part of an extensive sampling program in the Coffs Harbour Region.

Appended are separate reports on surveys completed in each of the three forests in the Group vis: Hyland S.F., Marengo S.F., and Chaelundi S.F.

The following is a summary of the findings in these reports.

STUDY AREA

Physiography

The Chaelundi Group of forests comprises the following State Forest Areas

	AREA
Hyland S.F. 659	5,049
Marengo S.F. 318	10,894
Chaelundi S.F. 996	36,779
TOTAL	52,722ha

which is approximately 64% of the total dedicated State Forest in the Dorrigo M.A. (Anon 1985). A location map is given in Appendix 1.

Altitude is 1,000 metres A.S.L. ranging from 600 metres to 1434 metres A.S.L. (at Mt Hyland).

The plateau landform has an undulating topography, with steep falls into major watercourses.

F.T.

file

Climate

The climate is classified as warm temperate, with wet summers and dry winters. Rainfall is 1,000 - 1,500 mm p. annum. Frosts are frequent.

Geology and Soils

Geology in Chaelundi and Hyland S.F.'s is palaeozoic sediments, giving rise to stable red and yellow podsolic clay soils of moderate fertility. Geology of Marengo S.F. is upper Permian granitic intrusions of gabbro, granodiorite and diorite, giving rise to deep granitic soils of moderate fertility, but prone to erosion.

A map in Appendix 2 depicts the geology of the area.

Vegetation

Representative distribution of forest type groups in th. Chaelundi group of forests is:

	PERCENT COVER			
S.F.	RF	MH	DH	NEH
HYLAND S.F.	7	-	-	93
MARENGO S.F.	2	1	44	53
CHAELUNDI S.F.	3	7	25	65
MEAN	4%	3%	23%	70%

Forest type group descriptions for

RF - Rainforest
MH - Moist Hardwood
DH - Dry Hardwood
NEH - New England Hardwood

A forest type map is depicted in Appendix 3.

Study Methods

Permanent driving transects were set out along roads an. fire trails within the Chaelundi group of forests. The locati- of the transects is depicted in Appendix 4.

Transects were traversed on the following occasions:

S.F.	DATES
HYLAND S.F.	9/ 5/79, 9/ 2/81
MARENGO S.F.	4/10/78, 25/ 8/80
CHAELUNDI S.F.	25/ 8/80, 26/ 8/80

Total traverse length was:

S.F.	LENGTH
HYLAND S.F.	14.7km
MARENGO S.F.	16.7km
CHAELUNDI S.F.	19.5km
TOTAL	50.9km

During each traverse the species, odometer distance, perpendicular distance, habitat and stand condition were recorded for each mammal sighted.

Traverse sampling by forest type group was

	FOREST TYPE GROUP				
S.F.	RF	MH	DH	NEH	TOTAL
HYLAND	1.3			13.4	14.7
MARENGO	3.2	1.8	3.4	8.3	16.7
CHAELUNDI			5.7	13.8	19.5
TOTAL	4.5	1.8	9.1	35.5	50.9
TRAVERSE %	8.8	3.6	17.9	69.7	
FOREST %	4.0	3.0	23.0	70.0	

From the information gathered density and distribution of arboreal mammals in the Chaelundi group of forests were determined.

In addition, site factors were measured at representative mammal observation sites, and for comparison, at random sites along the transect.

Sample Area

The formula of Overton (1971) was used to determine the sample area:

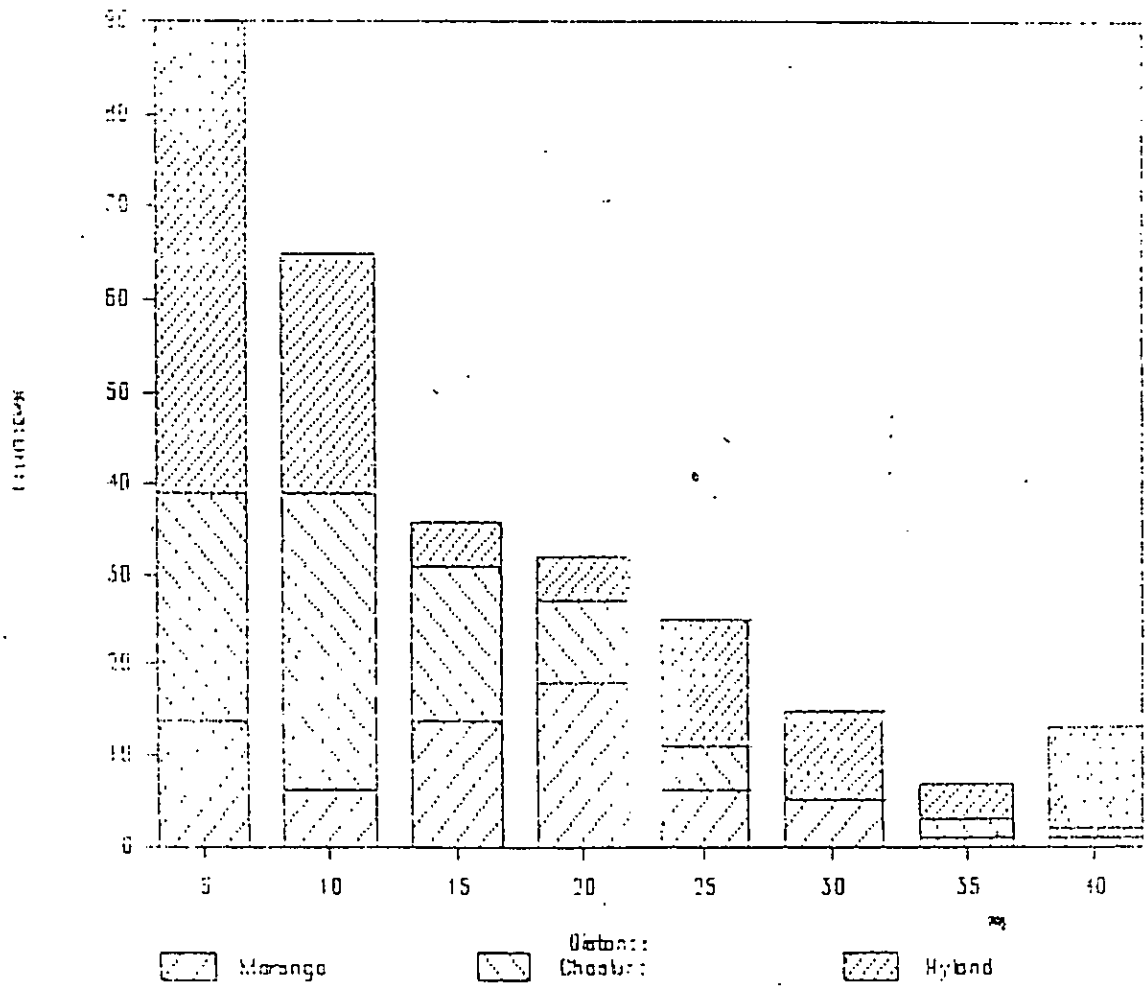
$A = 2L\bar{Y}$ where A = census area
L = transect length
$\bar{Y}$ = mean right angle distance.

Mean right angle distance from the traverse line to mammals sighted was:

S.F.	Y(m)	L(km)	A(ha)	S.F.%
HYLAND S.F.	13.2m	14.7km	38.8	0.8%
MARENGO S.F.	14.5m	16.7km	48.4	0.4%
CHAELUNDI S.F.	10.2m	19.5km	39.7	0.1%
TOTAL	-	50.9km	126.9	
MEAN	12.6m	-	-	

Fig 1 shows the variation in number of mammals sighted with right angle distance from the transect.

Figure 1



Overton (1971) states that the use of this formula implies an underestimate of mammal population. Population figures are, however, of value in indicating trends, or in estimating minimum densities for comparative purposes.

RESULTS

ARBOREAL MAMMALS

Overall arboreal mammal density in the study areas of the Chaelundi group of forests was:

S.F.	DENSITY	PER KM²
HYLAND S.F. MARENGO S.F. CHAELUNDI S.F.	1 per 0.27ha 1 per 0.73ha 1 per 0.41ha	370/km² 137/km² 244/km²
MEAN	1 per 0.47ha	250/km²

Localities are depicted on the map in Appendix 5. Distribution of arboreal mammals observed by forest type group is shown in Table 1.

Table 1

	TYPE GROUP					
S.F.	RF	MH	DH	NEH	TOTAL	%OF TOTAL
HYLAND S.F.	4	-	-	137	141	46.5%
MARENGO S.F.	3	10	7	46	66	21.8%
CHAELUNDI S.F.	10	-	-	86	96	31.7%
TOTAL	17	10	7	269	303	
% OF TOTAL	5.6%	3.3%	2.3%	88.8%		

Relative densities of arboreal mammals by forest type group are shown in Table 2.

Table 2

	FOREST TYPE GROUP							
	RF		MH		DH		NEH	
	ha	km²	ha	km²	ha	km²	ha	km²
HYLAND S.F.	1/0.85	118	-	-	-	-	1/0.25	400
MARENGO S.F.	1/3.10	32	1/0.52	192	1/1.4	71	1/0.52	192
CHAELUNDI S.F	1/3.97	25	-	-	-	-	1/0.46	217
MEAN	1/2.64	58.3	1/0.52	192	1/1.4	71	1/0.41	265.5

Table 3. Mean Site Details for Greater Glider sites (by State Forest).

STATE FOREST	LARGE TREE STOCK	LARGE TREE BASAL AREA	HOLLOW TREE STOCK	HOLLOW TREE BASAL AREA	ASPECT	SLOPE	CANOPY COVER			LARGE TREE DBH	LARGE TREE HGT	HOLLOW TREE DBH	HOLLOW TREE HGT	UNDERSTOREY COVER %				
							10-20	20-40	40+					ROCK	LITTER	GRASS	BARE	SCL
EYLAND	9.7	8.9	10.1	7.7	120°	10.8	60	62	-	98.7	27.8	96.3	26.1	23	28	63	14	3
ARENGO	9.2	10.1	6.4	6.2	131°	15.7	50	67	4	99.0	30.8	105.1	34.5	20	36	24	6	1
CHAELUNDI	10.9	11.6	13.8	10.7	127°	9.4	47	64	5	107.3	33.0	88.9	29.5	5	45	38	5	1

Table 4. Mean Random Site Details (by State Forest).

STATE FOREST	LARGE TREE STOCK	LARGE TREE BASAL AREA	HOLLOW TREE STOCK	HOLLOW TREE BASAL AREA	CANOPY COVER			LARGE TREE DBH	LARGE TREE HGT	HOLLOW TREE DBH	HOLLOW TREE HGT	UNDERSTOREY COVER					
					10-20	20-40	40+					ROCK	LITTER	GRASS	BARE	SCLEROPH	MOSS
EYLAND	9.5	10.1	10.9	10.9	70	54	-	121	29	102	26	-	36	74	11	88	10
ARENGO	7.1	6.8	3.6	3.7	54	63	6	95	33	108	34	13	25	18	6	86	11
CHAELUNDI	8.1	8.1	5.2	5.3	50	65	9	113	34	107	34	3	45	35	8	48	11

FIG 3. Diameter Distribution of Trees

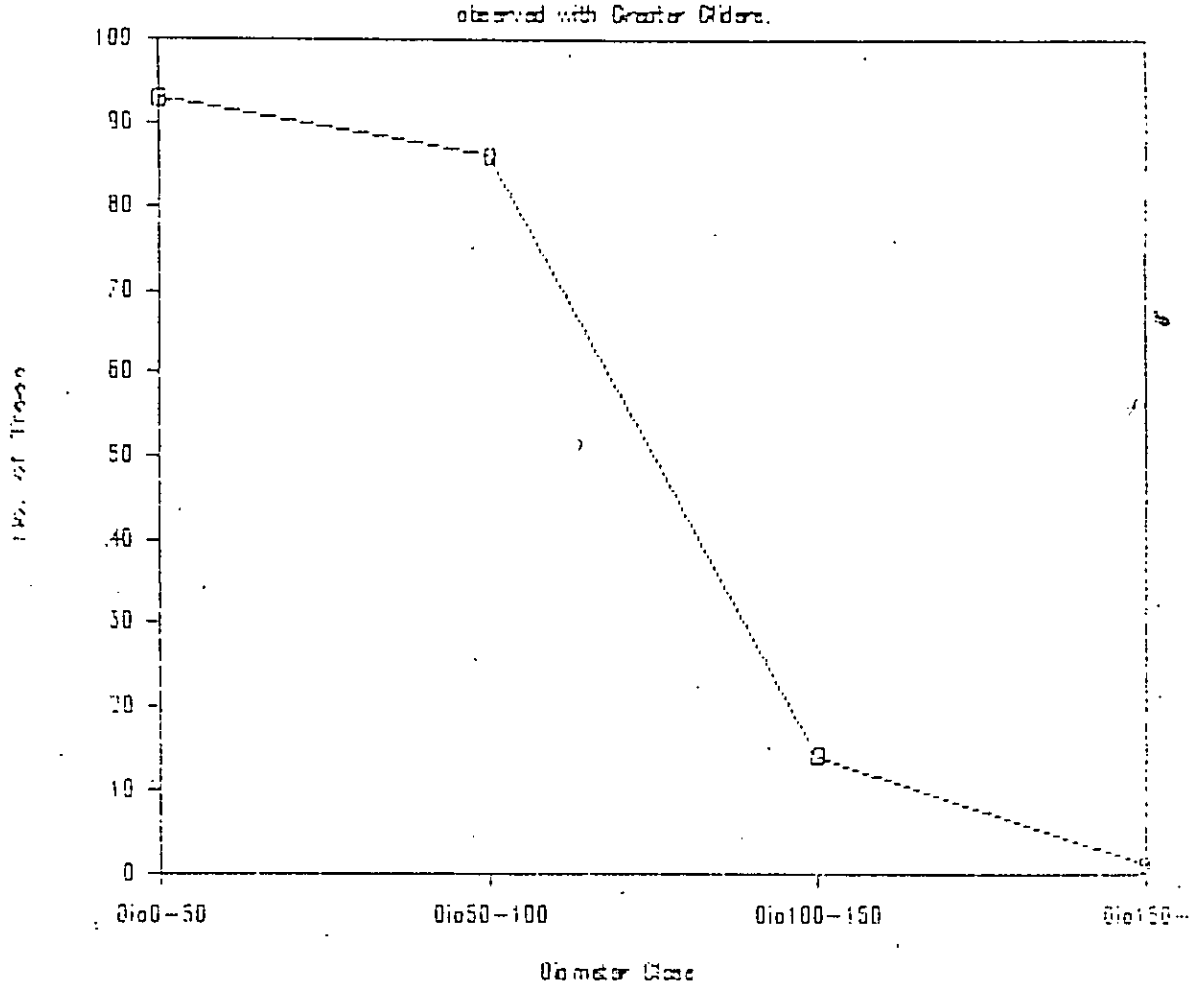
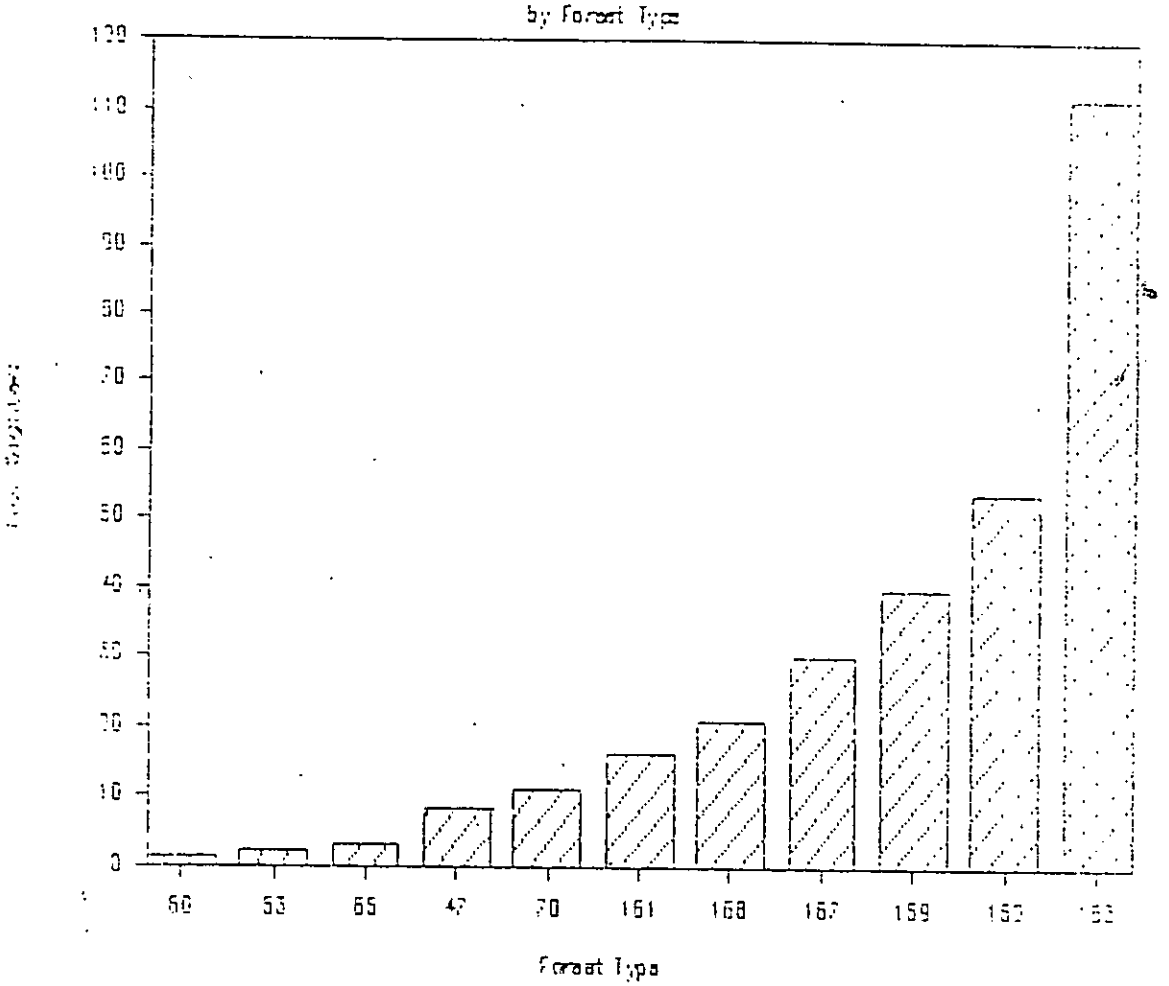


FIG 4. Distribution of Greater Gliders



Greater Gliders

The occurrence of greater gliders was very common in all the forests sampled. Average density of greater gliders by State Forest was:

S.F.	HA	KM²
HYLAND S.F.	1 per 0.29ha	345/km²
MARENGO S.F.	1 per 0.76ha	132/km²
CHAELUNDI S.F.	1 per 0.44ha	227/km²

Greater gliders were most common in the New England Hardwood forest types (mean 290/km²) on all State Forests in the Chaelundi group. On Hyland State Forest they were restricted to this forest type group.

Greater gliders also occurred in dry hardwood types on Marengo and Chaelundi S.F.'s (mean 68/km²) in moist hardwood on Marengo S.F. (mean 192/km²), and also in rainforest on Marengo S.F. (mean 22/km²).

Mean diameter of trees observed with greater gliders was 52.5cm dbh, ranging from 15cm to 160cm.

Fig 3 shows the diameter distribution of trees observed with greater gliders.

Mean nest tree diameter was 81.5cm. All nests were observed in New England Blackbutt trees.

Fig 4 shows distribution of greater gliders by forest type in Chaelundi group forests. New england blackbutt was the preferred type (37.6% of total).

Mean site details by State Forest for greater glider sites are shown in Table 3. Mean random site details by State Forest are shown in Table 4.

Site details indicate a positive correlation between hollow tree stocking/basal area, and mean largest tree diameter, and the relative density of greater gliders. Also indicated was a negative correlation between percent rock cover and greater glider relative density.

Yellow-bellied Gliders

Yellow-bellied gliders were only observed on Chaelundi S.F. Average density was 10 per km² (1 per 9.9ha). They were only observed in the new england hardwood forest type group.

Koalas

The koala was only observed on Marengo S.F. Average density was 2 per km². The koala was only observed in the dry hardwood forest type group.

Common Brushtail Possums

Common brushtail possums were observed on Marengo S.F. only. Average density was 2 per km². They were observed in the dry hardwood forest type group only.

Mountain Brushtail Possum

Mountain brushtail possums were observed on Hyland and Marengo S.F.'s. Average density was

S.F.	HA	KM²
HYLAND S.F.	1 per 12.9	8/km²
MARENGO S.F.	1 per 48.4	2/km²

Mountain brushtail possums were most common in moister New England Hardwood and Rainforest types on Hyland S.F. and occurred specifically in Rainforest types on Marengo S.F.

Ringtail Possum

The Ringtail Possum was only observed on Hyland S.F. It occurred mainly in Rainforest types, but was also observed in moister New England Hardwood types. Average density was 10 per km².

Sugar Glider

The Sugar Glider was only observed on Chaelundi S.F. in New England Hardwood forest types. Average density was 2.5/km².

DISCUSSION

Fundamental to effective wildlife conservation and management is knowledge of the distribution and abundance of animals and the underlying relationship of animals to their habitat.

From the foregoing it can be seen that arboreal mammal populations in the Chaelundi group of forests are dominated by occurrences of greater gliders. Also of note is the occurrence of Yellow-bellied Gliders on Marengo S.F.

Kavanagh (1987) suggests that wildlife management objectives might best be directed primarily towards mapping and measuring the distribution of the preferred habitat of the yellow-bellied glider and ..... greater glider. Sugar gliders, feathertail gliders, and possums use and probably require components of mature forest, but appear to be less demanding of mature forest requirements. Delineation of areas of high wildlife value should therefore be based largely on the criteria of <u>abundance</u> (particularly of GG and YBG) and <u>species richness</u>.

Forests differ in their suitability for animals. Areas which are important to wildlife must be identified, and then have management prescriptions applied to maintain the fauna.

Kavanagh (1987) states that techniques for the effective conservation and management of arboreal mammals fall into two categories based on the intensity of harvesting. Present harvesting intensity in the Chaelundi group of forests indicates the technique of "management for the maintenance of mature forest components" is the most appropriate i.e. maintenance of sufficient trees with hollows. He identified a need to find the <u>minimum</u> number of trees with hollows to maintain arboreal mammal populations. Of importance is maintaining mature forest that has the capacity to support significant populations of animals.

Reports for each State Forest in the Chaelundi Group make recommendations for the "maintenance of mature forest components" based on site descriptions for greater glider sites. These recommendations are for the maintenance of <u>existing</u> habitat components, trees with hollows per hectare being identified as the limiting factor. Further research is required to identify the <u>minimum</u> number of trees with hollows to maintain arboreal populations.

The recommended retention specification for trees with hollows is:

S.F.	HOLLOW TREES
CHAELUNDI	10 per ha
MARENGO	6 per ha
HYLAND	10 per ha

in sites favoured by greater gliders.

New England Hardwood types on an east to southeast aspect with moderate (10°-15°) slope.

Trees to be retained should be well structured habitat trees with a number of suitable hollows and reasonable crown. Retention of trees in groups and a range of diameter classes is suggested.

Comparison with the present management prescription indicates the present prescription is inadequate to maintain existing population levels.

Where not already retained in harvesting, including incorporated unlogged areas, additional mature and overmature trees of value for wildlife habitat, shall be retained to provide an average frequency of one per hectare. These should be preferably in clumps of up to five trees scattered throughout the harvesting area. Additional trees of potential habitat value should be retained as necessary for future recruitment and continuity.

SIGNIFICANCE OF THE STUDY AREA

As previously stated, delineation of areas of high wildlife value should be based on the criteria of abundance and species richness.

Abundance

The Chaelundi Group of forests carried the highest relative density of arboreal mammals for all of the State Forests in Coffs Harbour Region sampled.

Kavanagh (1987) reports 'significant' occurrences of greater gliders in Coolangubra S.F. (Eden Region) at densities of 84/km^2, equal to or higher than those occurring elsewhere. Thydale-Biscoe et.al (1969) reports 'significant' occurrences of greater gliders in Bucceleuch S.F. (Albury Region) of 40-86/km^2.

By comparison the densities of greater gliders on Hyland S.F. (345/km^2), Chaelundi S.F. (227/km^2) and Marengo S.F. (132.km^2) are extremely significant in terms of abundance.

Species Richness

Arboreal populations on the Chaelundi Group of forests are not as significant in terms of species diversity. Populations are dominated by greater gliders.

Kavanagh (1987) records eight (8) arboreal species occurring in a 100ha study site in Coolangubra S.F.

In the study areas of the Chaelundi Group of forests the highest species diversity was on Marengo S.F. where four (4) arboreal mammal species occurred in the sample area.

In application of retention specifications a balance must be drawn between retention of arboreal habitat in areas with a preferred management priority of timber harvesting OR the extent of harvesting in areas with a preferred management priority for retention of arboreal habitat.

Forestry Commission Wildlife Policy states:

'Suitable habitat conditions will be maintained throughout the native forest estate. Areas of special value will be identified to form the core of a conservation strategy and managed with priority for wildlife values. Critical areas will be reserved free from adverse disturbance'.

The arboreal mammal populations on the Chaelundi Group of forests are of 'special value' in terms of abundance and should be managed accordingly.

G. WATTS,
District Forester,
Research.
9th May, 1989.

The Regional Forester,
COFFS HARBOUR.

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Anon (1985) Management Plan for Dorrigo Management Area. Forestry Commission of N.S.W.

Kavanagh, R.P. (1987) Floristic and phenological characteristics of a eucalypt forest in relation to its use by arboreal marsupials. M.Sc. thesis. Australian National University.

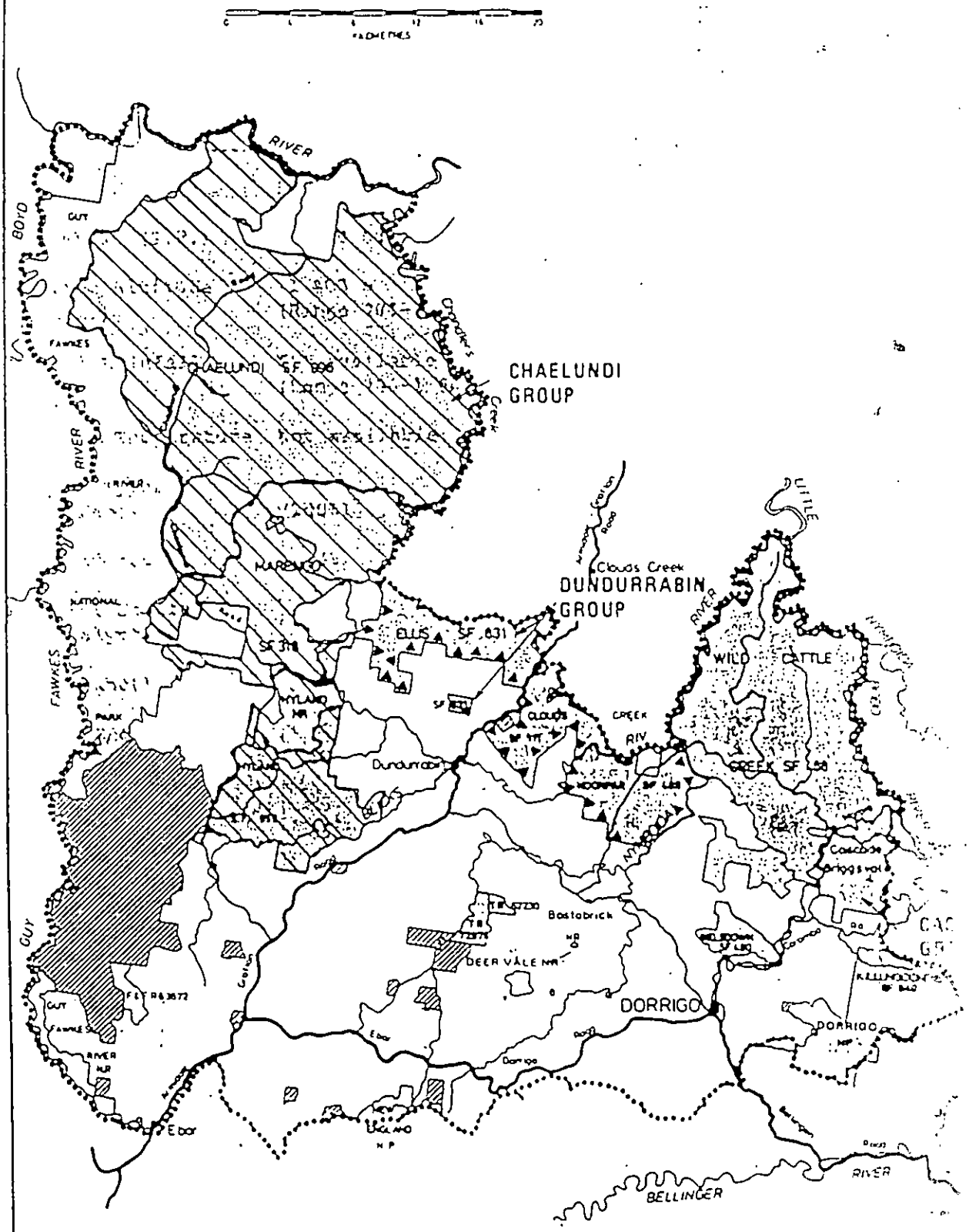
Overton, W.S. (1971). Estimating the numbers of animals in Wildlife populations in Wildlife Management Techniques. Ed. by R.H. Giles. Publ. The Wildlife Society, Washington.

Tyndale-Biscoe et.al. (1969) Studies on the marsupial glider, Schoinobates valans. III Response to habitat destruction. J. Anim. Ecol. 38 : 651-659.

DORRIGO MANAGEMENT AREA

Locality Map

Appendix



Forest Group

Management Area Limits

Major Public Access Road

Minor Public Road

Major Forestry Access Road

State Forest - Timber Reserve

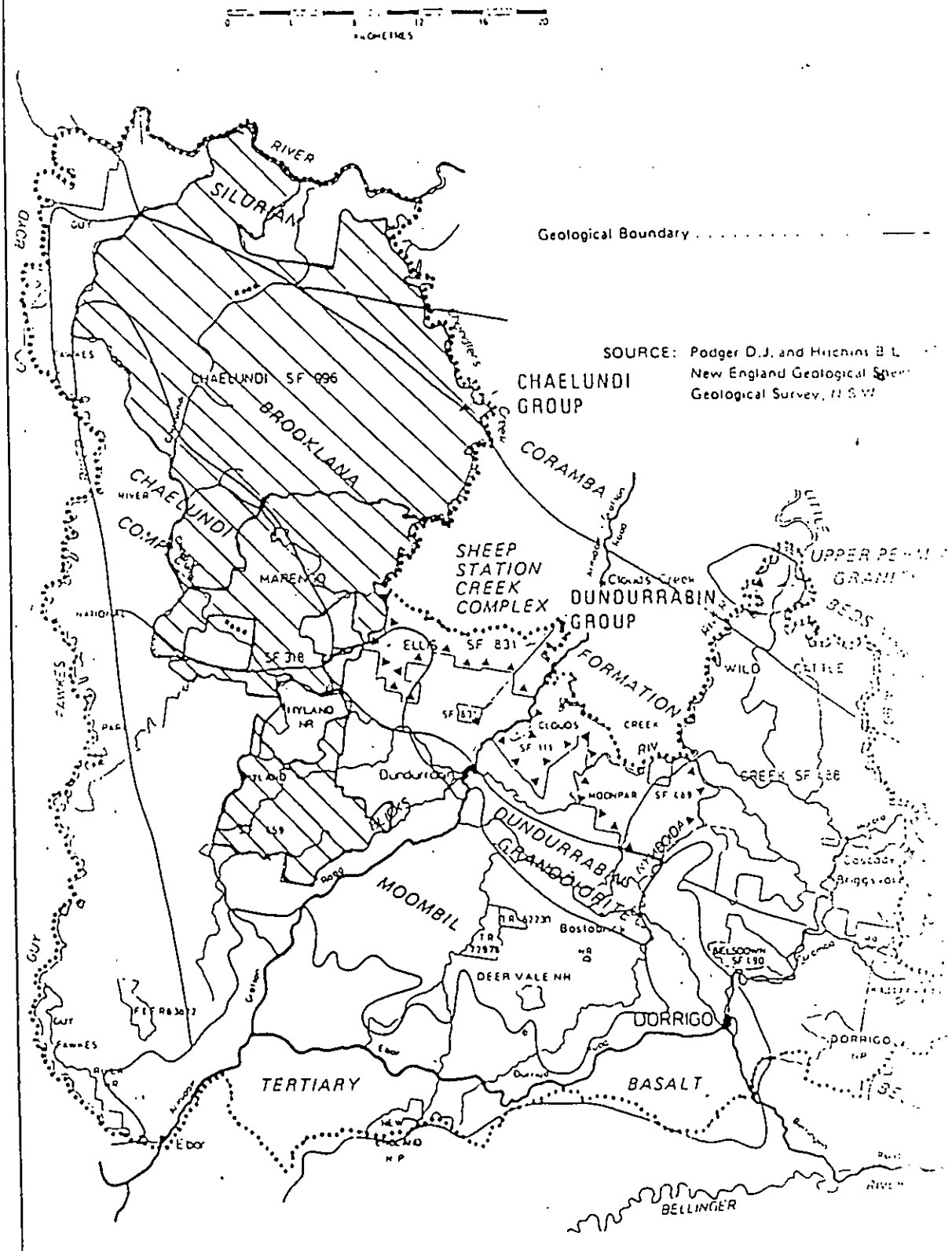
National Park-Nature Reserve

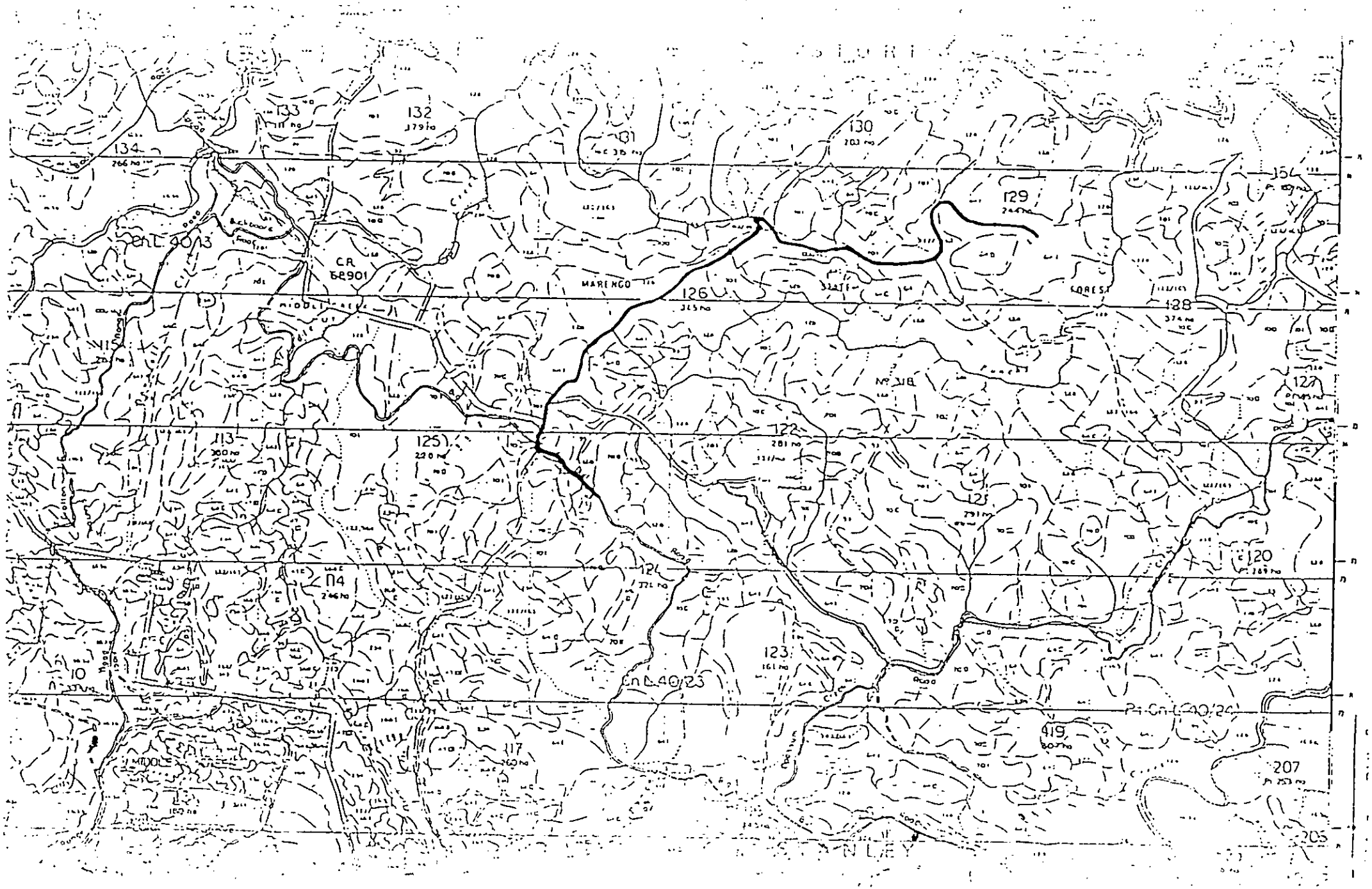
Other Crown-timber Land

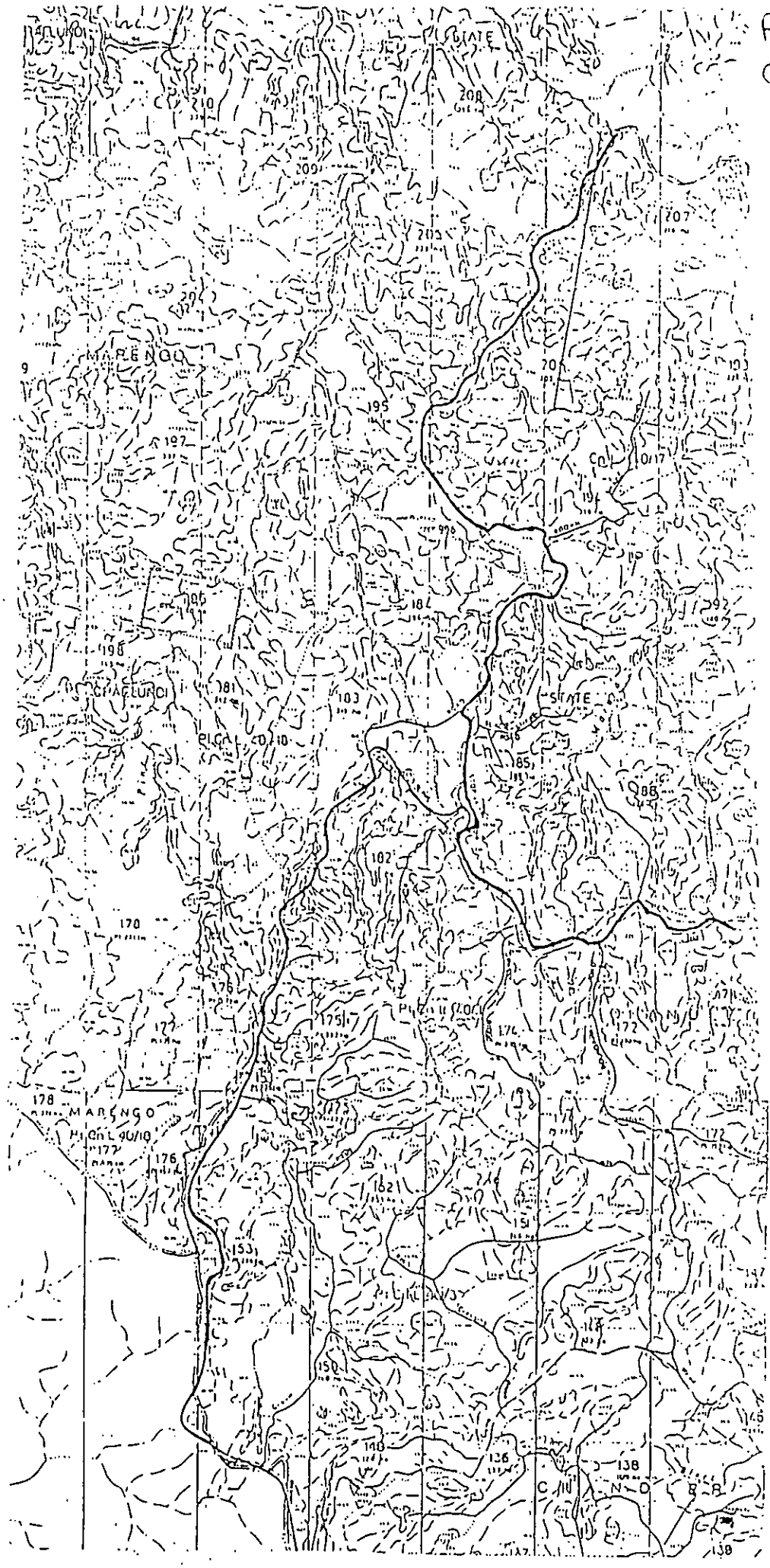
Appendix

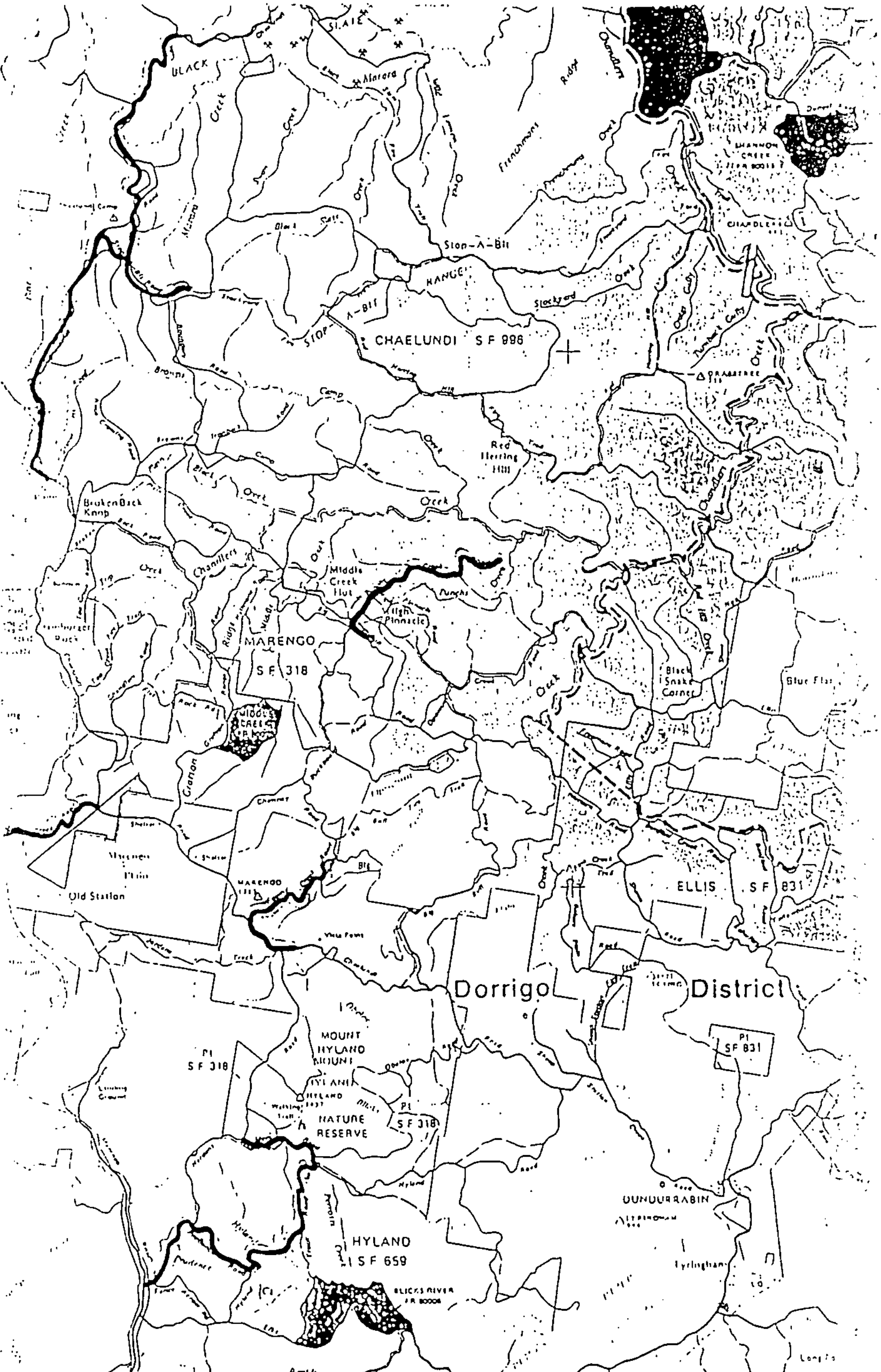
DORRIGO MANAGEMENT AREA

GEOLOGY MAP

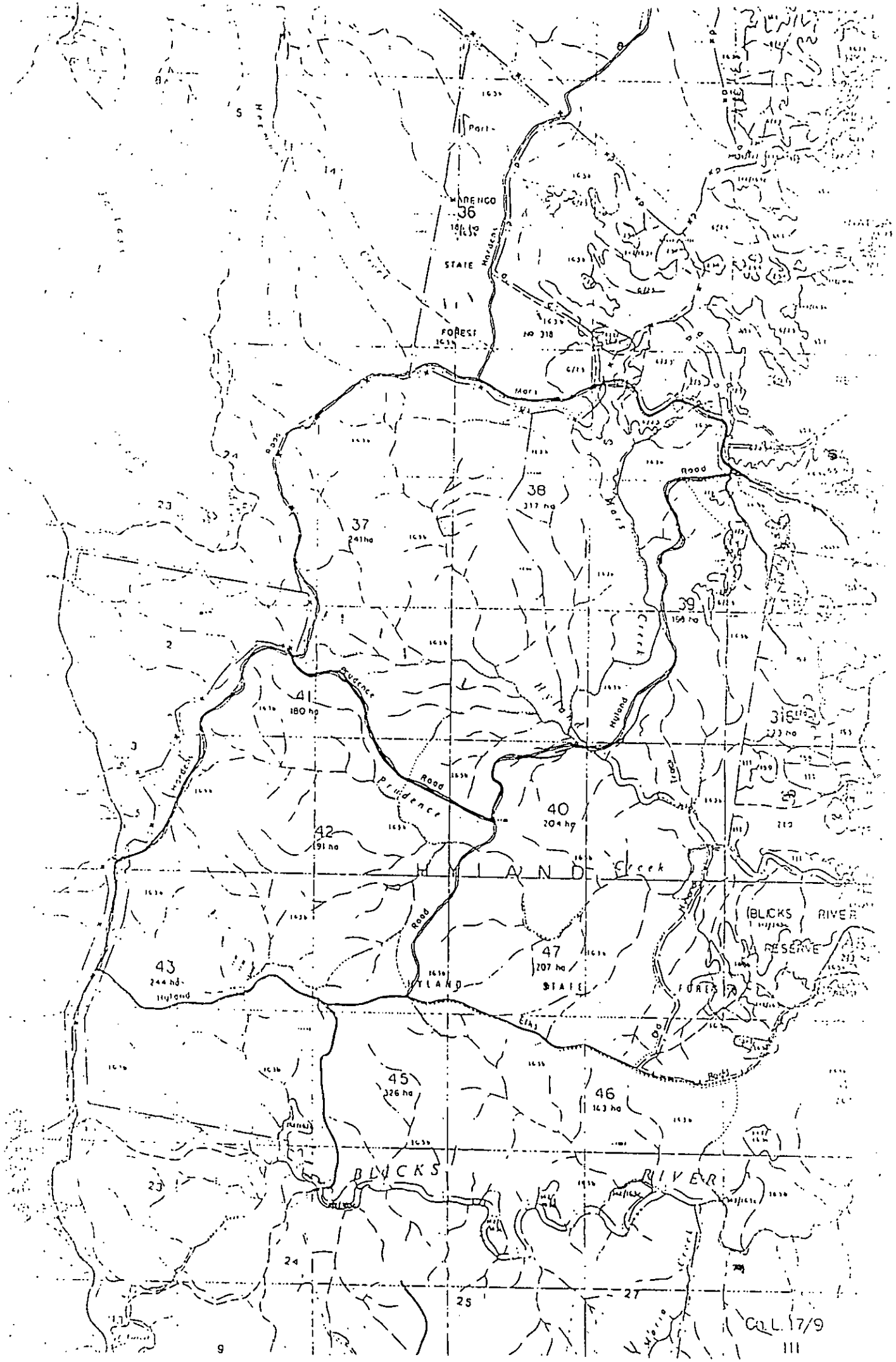



CR 68901
MARENGO
Cn L 40/23
Pa Cn L 40/24
MIDDLE
N LIEY
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
119
117
114
113
207
205


MARENGO
MARENGO
CASTELLAZZO
CASTELLAZZO
STATE
STATE



BLACK
SLATE
Stop-A-Bit
RANGE
STOP-A-BIT
CHAELUNDI S F 996
Red Herring Hill
Broken Back Knob
Middle Creek Hut
High Pinnacle
MARENGO
S F 318
Black Snake Corner
Blue Flat
Old Station
MARENGO
ELLIS S F 831
Dorrigo District
P1
SF 831
MOUNT
HYLAND
P1
S F 318
NATURE
RESERVE
P1
S F 318
DUNDURRABIN
HYLAND
S F 659
Tyringham
BLICKS RIVER


Port-
MARENGO
36
STATE
FOREST
No 318
Mara
Road
38
317 ha
37
241ha
39
156 ha
41
180 ha
Prudence
Road
Hyland
40
204 ha
42
91 ha
HYLAND
Creek
BLACKS
RIVER
RESERVE
47
207 ha
STATE
FOREST
43
244 ha
45
226 ha
46
143 ha
BLACKS
RIVER
Col. 17/9

APPENDIX 6

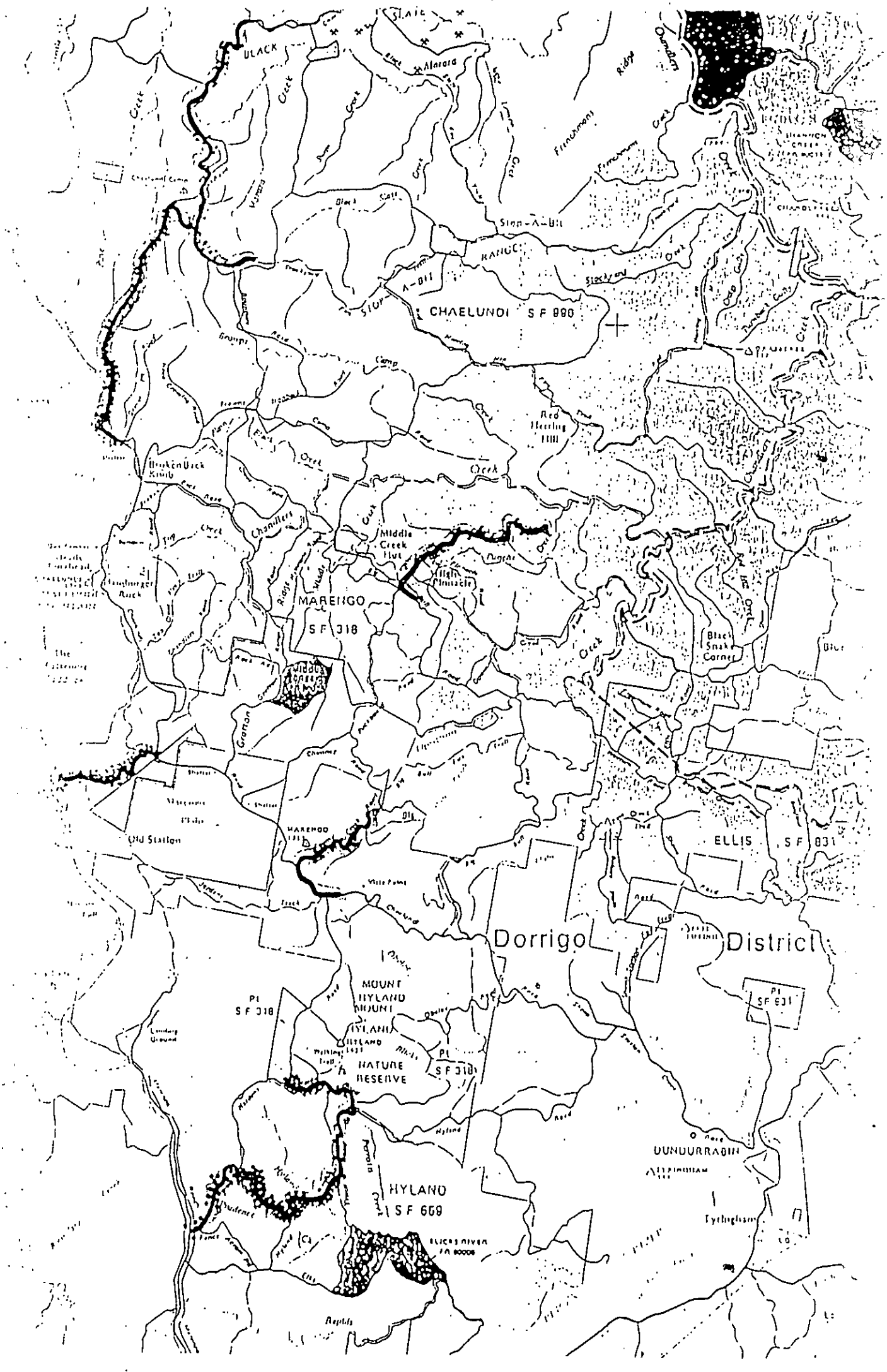
SPECIES LISTS

Composite list by State Forest. i.e.

SPECIES NAME	COMMON NAME	DENSITY	ABUND
HYLAND S.F.			
FAMILY PHALANGERIDAE			
Trichosaurus caninus	Mountain Brushtail possum	8/km²	VC
FAMILY PETAUROIDAE			
Petauroides volans	Greater Glider	345/km²	VC
FAMILY LEPORIDAE			
Lepus capensis	European Hare	-	-
FAMILY MACROPODIDAE			
Macropus rufogriseus	Red-necked Wallaby	-	-
MARENGO S.F.			
CHAELUNDI S.F.			
FAMILY PETAUROIDAE			
Petauroides volans	Greater Glider	227/km²	VC
Petaurus australis	Yellow-bellied glider	10/km²	VC
Petaurus breviceps	Sugar glider	2.5/km²	C
FAMILY MACROPODIDAE			
Macropus giganteus	Eastern grey kangaroo	-	-
Wallabia bicolor	Swamp wallaby	-	-
Macropus rufogriseus	Red-necked Wallaby	-	-
FAMILY CANIDAE			
Canis familiaris dingo	Dingo - Wild Dog	-	-

AVIFAUNA

HYLAND S.F.			
MARENGO S.F.			
CHAELUNDI S.F.			
Podargus strigoides	Tawny Frogmouth	-	-
Alectura lathami	Brush Turkey	-	-
Menura novae hollandiae	Lyrebird	-	-
Aquila audax	Wedgetail eagle	-	-


CHAELUNDI S F 880
MARENGO S F 318
Dorrigo
District
ELLIS S F 031
MOUNT HYLAND NATURE RESERVE
HYLAND S F 609
DUNDURRABIN
Pl S F 318
Pl S F 631
Pl S F 318
Old Station
Red Hearing Hill
High Pinnacle
Middle Creek Hut
Black Snake Corner
Stop-A-Bit
Ridge
Creek

APPENDIX 9.

FCNSW Arboreal mammal surveys summary –
Coffs Harbour Region

KEY GG = Greater Glider
YBG = Yellow Bellied Glider
SqG = Squirrel Glider
SG = Sugar Glider
FTG = Feathertail Glider
Koala = Koala
BTP = Brushtail Possum
MP = Mountain Brushtail Possum
RTP = Ringtail Possum

DISTRICT	STATE FOREST	TRANSECT DRIVE	LENGTH WALK	GG	YBG	SqG	SG	FTG	KOALA	BTP	MP	RTP	Σ SPECIES	TOTAL	Σ HA/HA / KM
MURWILLUMBA	Big Scrub	0.0	3.5	1							1		2	2	0.57
	Mt Jerusalem	3.5	1.0									1	1	1	0.22
	TOTAL	3.5	4.5	1							1	1			
TAMWORTH	Ben Halls Gap	12.7	0.0	79								1	2	80	6.30
	Nundle	9.6	0.0	24					2	3		2	4	31	3.23
	Terrible Billy	3.6	0.0	37									1	37	10.28
	Tomalla	5.0	0.0	22					1				2	23	4.60
	Tuggolo	5.6	0.0	46									1	46	8.21
	TOTAL	36.5	0.0	208					3	3		3			
URBENVILLE	Capeen & Duck Ck	16.3	15.55	8	3				3		8	2	5	24	0.75
	Mt Clunie	0.0	2.0									1	1	1	0.50
	Richmond Range	5.0	2.8	1	2						3	2	4	8	1.03
	Tooloom Scrub F.R.	9.5	7.6	28					4		2	5	4	39	2.28
	TOTAL	30.8	27.95	37	5				7		13	10			
URUNGA	Bellinger River	4.9	9.8	45	4		1	3				1	5	54	3.67
	Newry	80.0	1.0	7	3		1		3	3	3		6	20	0.25
	Pine Ck	20.9	0.0	2					1				2	3	0.14
	TOTAL	105.8	10.8	54	7		2	3	4	3	3	1			

DISTRICT	STATE FOREST	TRANSECT DRIVE	LENGTH WALK	GG	YBG	SqG	SG	FTG	KOALA	BTP	MP	RTP	Σ SPECIES	TOTAL	Σ MAMMALS / KM
GLEN INNES	London Bridge F.P.	1.4	0.0	12									1	12	8.57
	London Bridge S.F.	14.3	0.0	143									1	143	10.00
	TOTAL	15.7	0.0	155											
GRAFTON	Boundary Ck & Marara	47.3	7.2	81	5					5		2	4	93	1.71
	Cangai	24.2	0.0	52							2	4	3	58	2.40
	Clouds Ck	56.7	0.0	75							7	4	3	86	1.52
	Dalmorton	111.6	21.4	175					3	5	31	34	5	248	1.86
	Fortis Creek	18.1	4.2	4									1	4	0.18
	Glenugie	106.1	0.0	14	2			1	1	21			5	39	0.37
	Glenugie Peak	0.0	2.1		3		1			3			3	7	3.33
	Grange	27.6	3.6	79	5		2			3			4	89	2.85
	Nymboida	10.6	1.2	13			1			6			3	20	1.69
	Pinebrush & Candole	98.8	0.0	6	5	1	1			5			5	18	0.18
	Ramornie	12.7	3.4	4			2	1			1		4	8	0.50
	Sheas Nob	13.1	5.1	20	3		2						3	25	1.37
	Washpool	8.5	5.5	59	6		4				4	34	5	107	7.64
	TOTAL	535.3	53.7	582	29	1	13	2	4	48	45	78			
INVERELL	Mt Topper	20.2	0.0			2				7		2	3	11	0.54
	TOTAL	20.2	0.0			2				7		2			

SUMARY OF ARBOREAL MAMMAL SURVEYS.

ISTRICT	STATE FOREST	TRANSECT DRIVE	LENGTH WALK	GG	YBG	SqG	SG	FTG	KOALA	BTP	MP	RTP	Σ SPECIES	TOTAL	Σ MAMMALS / KM
RMIDALE	Cedar Pit	1.9	1.3	12							1	1	3	14	4.38
	Enmore	2.65	1.6							1			1	1	0.24
	TOTAL	4.55	2.9	12						1	1	1			
A.SINO	Selection Flat	0.0	3.5		2					6			2	8	2.29
	Steel Box	0.0	0.9	1									1	1	1.11
	TOTAL	0.00	4.4	1	2					6					
:OFFS HARBOUR	1260 FR	38.0	15.2	61	14			1		1	8		5	85	1.60
	Boambee	4.7	0.0	3				2	1				3	6	1.28
	Conglomerate	190.2	0.0	1							1		2	2	0.01
	Kangaroo Creek	131.1	4.0	74	3	2	1			13	8	2	7	103	0.76
	Lower Bucca	32.8	0.0	3					1		2		3	6	0.18
	Nana Ck & Orara West	194.1	0.0	29	1			1	5		7	1	6	44	0.23
	Newfoundland	213.2	12.0	81	19		1			5	4		5	110	0.49
	Orara East	33.0	0.0	12						1	5		3	18	0.55
	Orara West	105.0	2.3	13					2		4	7	4	26	0.24
	Waihou F.R.	14.6	0.0										0	0	0.00
	Wild Cattle Ck	90.6	0.0	37	1	2			1	1	6	6	7	54	0.60
	TOTAL	1053.7	33.9	314	38	4	2	4	10	21	45	16			
)ORRIGO	Cascade	67.0	2.5	72	8	1			1		2	5	6	89	1.28
	Chaelundi	19.5	2.3	97	4		2						3	103	4.72
	Hyland	22.0	0.0	212						11	3	3	4	229	10.41
	Marengo	16.7	1.0	66					1	3	1		4	71	4.01
	Moonpar	75.7	5.1	59	3	3	2		1	1	3	3	8	75	0.93
	Wild Cattle Ck	0.0	2.5	1								1	2	2	0.80
	TOTAL	200.9	13.4	507	15	4	4		3	15	9	12			

APPENDIX 10.

Hines, H. – Affidavit describing fauná

species under the National Parks and Wildlife Act, 1974 schedule 12:-

Fauna of Special Concern
Spotted-tailed Quoll
Glossy-black Cockatoo
White-throated Needletail
Cicadabird
White's Thrush
Crested Shrike-tit
Rufous Fantail

Protected Amphibians
Fletcher's Frog

Murray's Skink is considered threatened by Kennedy and Burton 1986, A Threatened Species Conservation Strategy for Australia, Scofund Australi Sydney.

5. In addition to these species I located an apparently large pop of the recently described rare Beech Skink Leiolopisma sp. This spe montane specialist, and prior to this survey where it was found in a hardwood forest it was only known from rainforest areas particularly Beech. It is known from less than ten other localities from Styx Riv Forest in the south to Cunninghams Gap in the North. Two long apsed were sighted in an area within Chaelundi State Forest to the north-e area surveyed. This threatened species (Schedule 12 NPW Act, 1974) almost certainly occurs in the survey area as there is a large amount of suita habitat present. Two other species, Fawn-footed Melomys (threatened by Kennedy and Burton 1986) and Carpet Python (Fauna of Special Concern - 1974, schedule 12) were detected in compartment 201 immediately adjacen compartment 200. Habitat suited to these two species occurs widely in compartments 180, 198 and 200.

6. The survey I carried out was conducted over a short period of in generally poor weather conditions and so can only be viewed as a preliminary survey. I am aware that other organisations have conducte extensive surveys of birds, arboreal mammals, and small ground dwellin mammales in the area. Although all this data will need to be collate determine a list of priorities for further research in the area I am of opinion that additional surveys are required, prior to logging opera follows:-

(i) a comprehensive bat survey;

(ii) a trapping survey of all areas of suitable habitat for Hastings River Rat;

(iii) a survey for rare macropods to determine the distri potoroos, and Parma Wallabies, as much of the area ap to support habitat suited to these species; and

(iv) a survey for the endangered Rufous Scrub-Bird.

7. Based on discussions with professional colleagues, reviews of literature and my knowledge of the forest, I am of the opinion that proposed roading, logging and burning activities in compartment 180, 200 will have a highly significant impact on the faunal communities, b direct injury or death, habitat destruction, habitat alteration, or

the floristic composition of the Forest and its understorey as a result of spread of weeds and changes in fire regimes. Until extensive surveys of all faunal groups are completed, it is difficult to determine the full extent of the impacts of the proposed ~~operations~~. These surveys need to be conducted prior to any logging or roading operations.

Affirmed and declared

Before me at Armidale

this 13 day of June, 1990)

.....

~~Solicitor~~/Justice of the Peace

APPENDIX 11.

Braithwaite, L.W. – Affidavit describing fauna

IN THE LAND AND
ENVIRONMENT COURT OF NEW
SOUTH WALES
No. 40052 of 1990

JOHN ROBERT CORKHILL
Applicant

FORESTRY COMMISSION OF NEW
SOUTH WALES
Respondent

AFFIDAVIT

Deponent: L.W. Braithwaite
Affirmed: 29th day of June
1990

H.K. ROBERTS
Crown Solicitor
S-12 Chifley Square
Sydney. N.S.W. 2000

D.X. 19, Sydney

Tel: 228 7357
(Mr Peter Bowe)

I, Lionel Wayne Braithwaite of the CSIRO Division of Wildlife and Ecology, Canberra, Australian Capital Territory do solemnly, sincerely and truly affirm and declare as follows.

1. I am a Principal Research Scientist and Acting Program Leader of the Ecological Systems Program, a group of 26 scientists and technicians, within the CSIRO Division of Wildlife and Ecology (DWE). A summarised curriculum vitae is appended. Since 1977, and as a result of a request to the CSIRO Chairman from the Australian Forestry Council, I have been directed to conduct research into the effects of forestry operations on wildlife in forests. The research is primarily field oriented,

concentrating from 1977 to 1987 on fauna in the south-east of New South Wales (Eden and Batemans Bay Forestry Regions - Forestry Commission of New South Wales (FCNSW)) and since 1987, the forests of north-east New South Wales, principally those of the Coffs Harbour Forestry Region which includes the Chaelundi State Forest. I am the principal CSIRO representative on Research Working Group No. 10 (Wildlife) of the Australian Forestry Council (AFC), a technical committee that advises, through the AFC, State and Commonwealth Authorities responsible for wildlife conservation management in forests utilised for timber production. I am currently the committee member responsible for wildlife matters in a multi-disciplinary group of specialists, the Expert Advisory Committee, brought together to advise on forest management to the Department of Conservation and Environment, Victoria. I also act as external supervisor or examiner of a number of postgraduate research projects, mostly to do with research on forest wildlife, within Sydney University, Australian National University, University of New England and Charles Sturt University.

A main thrust of the research on forest wildlife in the Division of Wildlife and Ecology and of the post graduate research projects I supervise is to do with the determination of the environmental correlates of broadscale (forest regions of 10,000 km^2+) density distribution patterns of fauna (arboreal and ground mammals and birds). The general finding is that forest fertility is the principal factor determining the abundance and species richness of forest fauna, which may help explain the occurrence of many conflicts between forestry and environmentalist interests. The more fertile forests tend to be similarly important for both wildlife conservation and timber production. Relative to areas of less fertile native forests, smaller areas of the more fertile types remain

today because of our history, since European settlement, of selectively clearing the more fertile to farmland.

The general and priority problem of conservation management of forest wildlife is thus seen to be one of land use. What remains largely unresolved is the question of the response of wildlife populations in native forests to the disturbance of logging and other forest management practices. The topic has only received some degree of attention in Australia in about the past 20 years. Because fauna populations may be quite different in a forest in an early, as compared to a late phase of regrowth in a logging management cycle, a critical information requirement has been for the likely long term (100-150 years+) response of the different animal species populations to logging. No definitive statement is available on this issue because of its complexity and the relative lack of research. The complexity of what is involved is indicated by the number of factors to consider. There is the long term time frame. The number of animal species is large; about 160 species of native mammals and birds recorded so far in the surveys by CSIRO-DWE staff. The large number of different types of forests. Animal populations differ in the different forests. The FCNSW recognizes some 150 types of forests for example, which is possibly about one half the number of tree associations an ecologist can recognize for research purposes. Each association can be typified by the range of climate, soil features, etc. of the localities in which the association is characteristically found. The forest management regime will have an effect; the various regimes differing according to the forest type and invariably changing over time.

Having regard for the above complexity, I have examined the issue of the likely effect of logging operations on wildlife in the Chaelundi State Forest. I have taken into account the CSIRO-DWE information on the occurrence of wildlife in these forests as well as data provided by the Commission, particularly that on the arboreal mammal fauna in the Washpool National Park and the Moonpar State Forest (Commission File Numbers 03/12.9 and 03/12.10).

Two principal issues have been put as to why logging should not proceed in compartments 180, 193, 198, 200 and 207 of the Chaelundi State Forest. These are, first, the occurrence in compartments 193 and 207 of a rare species of small mammal, the Hastings River mouse, *Pseudomys oralis*. Secondly, in compartments 180, 198 and 200, the general faunal richness, in particularly of arboreal mammal species. I will comment on these separately.

With regard to the occurrence in compartments 193 and 207 of the Hastings River mouse. I have inspected four field sites at which the species has been recorded, the two in compartments 193 and 207 and two others in forests of the Dorrigo District, one recorded in the CSIRO-DWE survey but elsewhere in the Chaelundi State Forest, the second by FCNSW staff in the Wild Cattle Creek State Forest. In all four instances the habitat at these localities showed evidence from ground cover vegetation, fire scars or the occurrence of sawn tree stumps, of a history of frequent disturbance from fire and/or logging. The use of fire in all localities had evidently served mainly to provide graze for cattle or as a means of fire hazard control adjacent to a major road. In the CSIRO-DWE surveys in the Chaelundi State Forest, cattle were commonly observed in the vicinity of the localities in which the animal was trapped. The Hastings River

mouse was not recorded at any of a number of trapping sites that appeared relatively undisturbed by burning, logging or cattle grazing activities. On that evidence my view is that such disturbance possibly does not adversely affect the species. To the contrary, the vegetation conditions created by the disturbance may be to its favour.

With regard to the general faunal richness of the forest of compartments 190, 198 and 200 of the Chaelundi State Forest, particularly the richness of arboreal mammal species. On the available data the evidence is that:

a) The richness and high density of arboreal mammals of a certain species, namely the greater glider, in the Chaelundi State Forest is exceptional, but not unique. Washpool National Park, to the north, supports similar faunal species and populations and,

b) The forests of north-eastern New South Wales, in general and in both logged and unlogged forest, support good populations of most species, though in varying population densities depending on the animal species, forest type and phase of forest regrowth from past logging.

In compartments 190, 198 and 200 I think that logging according to the current management plans and prescriptions will cause a reduction, possibly a permanent reduction, in the number of at least several species of arboreal mammals and in particular of the greater glider, the most abundant species. The effect would apply in particular to the areas actually logged, compared to those areas reserved as part of routine forest management. Populations of gliders in areas reserved from logging may however, also not remain unaffected if the general effect is to change predation pressures from the large owls that occur there. Possibly, arboreal animal species favoured by the regrowth forest 5 or

more years after the initial logging may be the koala, common ringtail possum and the sugar glider. My inference is that the survival of any animal species is unlikely to be affected by logging operations in compartments 190, 198 and 200 in the Chaelundi State Forest. For the reasons outlined above I regard as open; questions of the effect(s) of logging on the numbers (density) of populations of individual animal species. The possibility exists that, as noted above in the circumstance of the New Holland mouse, the disturbance effects of logging and other forest management practices on many species of native forest wildlife may not necessarily all be adverse. To the contrary, the effects may be beneficial depending on the species.

5. From the foregoing I see three points of emphasis. The first is that I believe it highly unlikely that logging operations in the Chaelundi State Forest according to current plans and practices poses a serious threat to the survival there of the animal species that presently occur. The second is that I would expect that the numbers of at least some of the individual species of animals that occur there will be reduced as a consequence of logging. Put another way, I consider it highly probable that the logging will reduce the 'carrying capacity' of the Chaelundi State Forest to support populations of at least some species of gliders. But that any reduction in carrying capacity, in this instance, would be most unlikely to result in the disappearance of any species from the logged portion of forest. The area is exceptional in terms of the density of greater gliders present. The strong possibility is that this exceptional characteristic will be lost from the logged areas, though not necessarily from those areas reserved from logging. The third point of emphasis is that a great deal remains to be learnt about environmental effects in general, and effects on the fauna in particular, of

logging in native forests. In view of that lack of knowledge I consider it prudent to ensure the facility is always available to evaluate, through research, any issues or problems that may arise as a consequence of logging activities. I stress that issues exist that warrant investigation and that may demonstrate the desirability of maintaining certain timber production activities to the general benefit of fauna conservation management. The obvious pre-requisite in any evaluation procedure is to have permanently available, undisturbed by such activities, an adequate range of the forest tree associations that occur. As the Chaelundi State Forest adjoins the Guy Fawkes National Park, extensive areas of the tree associations that comprise the areas presently in dispute in the Chaelundi State Forest may already be held in reserve in the Park. I stress the importance of conducting the appropriate surveys to ascertain this.

AFFIRMED AND DECLARED at Canberra
on the day and year first mentioned.
Before me:

Lionel Wayne Braithwaite

A justice of the Peace/Solicitor