FOREST ECOSYSTEM CLASSIFICATION AND MAPPING FOR UPPER AND LOWER NORTH EAST CRA REGIONS

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FOREST ECOSYSTEM CLASSIFICATION AND MAPPING FOR THE UPPER AND LOWER NORTH EAST CRA REGIONS

CRA UNIT, NORTHERN ZONE NATIONAL PARKS AND WILDLIFE SERVICE

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

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The project has been overseen and the methodology has been developed through the Environment and Heritage Technical Committee which includes representatives from the New South Wales and Commonwealth Governments and stakeholder groups.

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Disclaimer

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PROJECT SUMMARY

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

Project objective/s

The scope of this work, as approved by the NSW CRA/RFA Environment and Heritage Technical Committee (EHTC), was to ‘’. Workshops involving EHTC and stakeholders were conducted at various key stages in the project and the methodology was subject to independent peer review.

Methods

Forest ecosystem classification in the north-east followed an approach recommended by a Forest Ecosystem Workshop convened by the Environment and Heritage Technical Committee in July 1997. Different approaches were approved by EHTC for three distinct biogeographic regions which are present within the north-east regions: the area south of the Hunter Valley, the area west of the New England highway, and the north-east area north of the Hunter Valley and east of the New England highway. An outline of the approach used in the southern area is provided in a separate report. For the north-east area, the approach entailed:

- the derivation of a forest ecosystem classification by splitting and amalgamation of existing SFNSW forest types based on analysis of variation between field survey plots in relation to environmental variables
- mapping of derived ecosystems within the existing mapped extent by use of decision rules relating variation to abiotic environmental variables
- predictive mapping of derived ecosystems across unmapped forest and cleared land based on modelling of the relationship between the mapped distribution of the ecosystem and abiotic variables

For the western area, the approach entailed:

- the derivation of a forest ecosystem classification by subjecting floristic data from field survey plots to numerical cluster analysis
- predictive mapping of derived ecosystems based on modelling of the relationship between the classified plots and abiotic environmental variables

A seamless vegetation coverage across the three distinct biogeographic areas was derived by expert integration of the disparate classifications.

One hundred and fifty-seven forest ecosystems were classified and mapped for the north-east area, including 141 dominated by eucalypts, and 16 dominated by non-eucalypt vegetation. Ninety-eight of the eucalypt dominated ecosystems were derived from splitting and amalgamation of forest types and descriptions of each of these ecosystems is provided in this report. The remaining 43 ecosystems comprised SFNSW forest types on which no splitting or amalgamation was conducted. Descriptions of these ecosystems is available in FCNSW (1989). A further 22 forest ecosystems were classified and mapped for the western area, including 21 dominated by eucalypts, and one shrubland ecosystem.

Key results and products

The resultant pre-1750 layer was refined in relation to historical data compiled from parish portion plans. The forest ecosystem map is available under licence from the NSW National Parks and Wildlife Service.

1. INTRODUCTION

1.1 COMPREHENSIVE REGIONAL ASSESSMENT

As part of the Regional Forest Agreement (RFA) process, a Comprehensive Regional Assessment (CRA) was carried out to evaluate the economic, social, cultural, environmental and heritage values of the Upper North East and Lower North East CRA regions. The CRA provided scientific information needed to develop a comprehensive, adequate and representative (CAR) forest reserve system, the establishment of which is an agreed outcome of RFAs and a commitment of the National Forest Policy Statement (Commonwealth of Australia 1992). Regional Forest Agreements will also establish a regime of Ecologically Sustainable Forest Management for all forest tenures in New South Wales, as well as a framework for agreed social and economic outcomes on forest use.

Components of CRAs involving environmental and heritage values including biodiversity are overseen in New South Wales by the Environment and Heritage Technical Committee. The conservation status of biodiversity will be assessed against conservation criteria at several agreed levels including ecosystems, species, wilderness and old growth (JANIS 1997).

Biodiversity criteria to be used in the NSW CRA/RFA process are specified in a report prepared by the Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS), *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia (1997).*

The JANIS report places considerable emphasis on using 'forest ecosystems' as a general surrogate for biodiversity. The role of forest ecosystems in forest reserve planning is introduced in Section 3.1 of the report:

> *'Forest ecosystems, forest types and forest vegetation communities, together with their environmental descriptors, are commonly used as surrogates for biodiversity and as a basis for planning a comprehensive reserve system. However, these terms have different meanings across Australia. For the purposes of this document they have been grouped under the term "forest ecosystems". These differences in definition mean that the surrogates used to assist with establishing the CAR reserve system will need to be determined on a regional basis.'*

The report's glossary defines a forest ecosystem as:

> *'An indigenous ecosystem with an overstorey of trees that are greater than 20% canopy cover. These ecosystems should normally be discriminated at a resolution requiring a map-standard scale of 1:100 000. Preferably these units should be defined in terms of floristic composition in combination with substrate and position within the landscape.'*

The glossary in turn defines an ecosystem as:

> *'The aggregate of plants, animals and other organisms, and the non-living parts of the environment with which these organisms interact.'*

Section 6.1.1 of the report specifies additional requirements relating to the derivation and use of forest ecosystems in the CRA/RFA process:

'Forest ecosystems need to be recognisable in the field, be able to be mapped and able to have their pre-1750 distribution modelled or mapped.'

JANIS (1997) provides criteria for the recognition of rare, endangered and vulnerable ecosystems as follows:

- an endangered ecosystem is one where its distribution has contracted to less than 10% of its former range or the total area has contracted to less than 10% of its former area, or where 90% of its area is in small patches which are subject to threatening processes and unlikely to persist.
- a rare ecosystem is one where its geographic distribution involves a total range of generally less than 10,000ha, a total area of generally less than 1000ha or patch sizes of generally less than 100ha, where such patches do not aggregate to significant areas.
- a vulnerable ecosystem is one which is approaching a reduction in areal extent of 70% within a bioregional context and which remains subject to threatening processes or [which is] not depleted but subject to continuing and significant threatening processes which may reduce its extent.

JANIS (1997) also specifies minimum benchmarks for the proportion of each forest ecosystem which should be protected in the CAR reserve system as follows:

- As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system
- Where forest ecosystems are recognised as vulnerable, then at least 60% of their remaining extent should be reserved
- All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable.
- To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem, by sampling the range of environmental variation typical of its geographic range.

The aim of this project was to prepare a classification and map of forest ecosystems for the Upper North East and Lower North East CRA regions which was consistent with the JANIS requirements for a biodiversity surrogate and to which the JANIS criteria for minimum reservation benchmarks could be applied.

1.2 PROJECT OBJECTIVES AND APPROACH

The objectives of the project were....

The NSW CRA/RFA Environment and Heritage Technical Committee (EHTC) convened a Forest Ecosystem Workshop in July 1997 (Canberra) attended by representatives of all relevant State and Commonwealth agencies and stakeholders, and a small number of invited experts. The workshop identified two alternative approaches to classifying and mapping forest ecosystems in north-east NSW which were presented to the EHTC. The EHTC identified three distinct biogeographic subregions in the north-east CRA regions and chose to apply different approaches in these different subregions. The biogeographic subregions so identified were; the area south of the Hunter Valley, the area west of the New England highway, and the north-east area north of the Hunter Valley and east of the New England highway. These areas differ significantly with regard to the availability of existing mapping and site data and this significantly influenced the approaches which were chosen.

An outline of the approach used in the southern area is provided in a separate report. For the north-east area, the approach entailed:

- the derivation of a forest ecosystem classification by splitting and amalgamation of existing SFNSW forest types based on analysis of variation between field survey plots in relation to environmental variables

- mapping of derived ecosystems within the existing mapped extent by use of decision rules relating variation to abiotic environmental variables
- predictive mapping of derived ecosystems across unmapped forest and cleared land based on modelling of the relationship between the mapped distribution of the ecosystem and abiotic variables
- utilisation of historical portion plan data to refine predicted pre-1750 distributions over cleared land

For the western area, the approach entailed:

- the derivation of a forest ecosystem classification by subjecting floristic data from field survey plots to numerical cluster analysis
- predictive mapping of derived ecosystems based on modelling of the relationship between the classified plots and abiotic environmental variables
- utilisation of historical portion plan data to refine predicted pre-1750 distributions over cleared land

1.3 PROJECT IMPLEMENTATION

The project was comprised of the following stages:

1. Data audit and collation: data was collated for an additional 950 full floristic survey sites and all available fine scale vegetation mapping was collated and the vegetation type attribution of each mapping project was expertly converted to an analagous SFNSW RN17 forest type (FCNSW 1989)
2. Site selection and field survey: sites were selected using environmental gap analysis techniques developed by NPWS GIS Research and Development Unit and field survey was then conducted resulting in the completion of 820 full floristic sites including 48 sites west of the New England Highway and approximately 200 sites in remnants outside areas with existing mapping
3. Database development and data storage: an ACCESS 97 database was specifically designed for storage, entry and manipulation of CRA systematic flora data and all pre-existing data, collated data and CRA survey data was included in this database and subjected to a sequence of manual and automatic checking procedures
4. Methodological development: the analytical technique which was chosen to implement the forest ecosystem derivation is known as Analysis of Similarities (ANOSIM). Software was specifically designed by the NPWS GIS Research and Development Unit to implement ANOSIM as an extension within the ARCVIEW GIS package.
5. Exploratory analysis: exploratory analysis of floristic and environmental variation within each forest type was undertaken by applying numerical classification to each type and then plotting the resultant groups against environmental variables as two-way scatterplots and deriving classification tree models for each type
6. Derivation of classification for the eastern area: ANOSIM was undertaken to identify splits and amalgamations of existing RN17 forest types based on an analysis of full floristic variatin between field survey plots in relation to environmental variables.
7. Derivation of classification for the western area: numerical classification of full floristic cover-abundance data was undertaken for the western area and the PATN output groups were reviewed with reference to other existing published classifications to inform the interpretation of the dendrogram and derive the final classification.
8. Peer review: the initial methodological approach was identified at an EHTC and expert workshop and the ANOSIM methodological approach was reviewed by Dr Mike Austin and Dr Mark Burgman. The derived forest ecosystems were subject to an EHTC and expert finalisation workshop. Expert knowledge was used as much as

possible to inform the derivation of forest ecosystems and to verify the floristic and ecological integrity of the results.

9. Ecosystem mapping in areas with existing fine scale mapping: the ecosystems derived from the analysis were mapped for all areas with existing fine scale mapping by iterative application of binary divisions of environmental variables.

10. Pre-1750 ecosystem modelling: logistic regression models relating the probability of presence of each forest ecosystem to abiotic environmental and geographical variables were fitted using generalised additive modelling (Yee and Mitchell 1991). These fitted models were then used to extrapolate the distribution of forest ecosystems across all unmapped forest and cleared areas.

11. Derivation of the pre-150 map layer: the individual ecosystem models were integrated into a single coverage and the eastern and western coverages were assessed for analagous types and these were merged while distinct types were maintained to create a complete coverage. Historical data from parish portion plans was utilised to restrict the pre-1750 distribution of eucalypt ecosystems.

12. Derivation of the extant map layer: Mapping of non-eucalypt subformations from Aerial Photograph Interpretation (API) across all tenures were incorporated into the map layer and the layer was cut to extant forest as delineated from API in the Upper North East region and from Landsat TM in the Lower North East region.

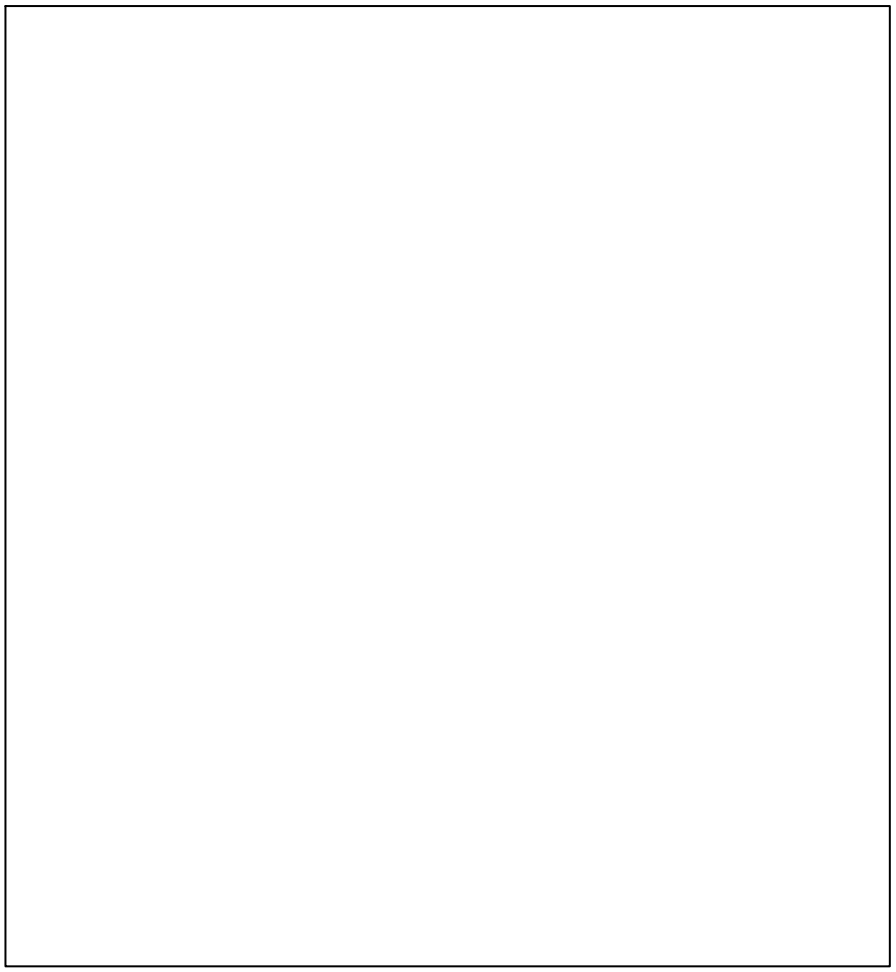
1.4 THE STUDY AREA

The Upper North East and Lower North East study areas north of the Hunter Valley encompass 8,282,280 hectares of land across a variety of geographical land systems. The regions extend from the New England Tablelands in the west, through dry rugged gorges of the great escarpment and then moist escarpment ranges, east across coastal foothills and lowlands, to the sea. Geologically, the regions vary from the volcanic formations of the Macpherson Ranges and Focal Peak/Mt Warning Shields in the north, through the characteristic sandstones of the Clarence Moreton Basin, and then south through coastal metasediments which dominate from the Nambucca to the Hunter Valleys. (Figure 1.1)

This land system variability has resulted in a concomitant ecosystem diversity which is strongly patterned in relation to geological and climatic variation in the region. The region is also considered unique because of its location at the distributional overlap of many tropical and temperate species (NPWS 1994).

The north-east region has recently been identified by the World Heritage panel as one of the two major peaks of eucalypt species richness in Australia (Record of the World Heritage Panel meeting: Western Australia, New South Wales and Queensland). It contains the largest number of tall eucalypt species of any bioregion in Australia and a unique diversity of eucalypt subgenera (NPWS 1994). Four of the five major rainforest subformations all have significant occurrences in the region (Floyd 1990). The spatial interaction between eucalypt and rainforest ecosystems forms a complex mosaic which further typifies the unique character of the region.

Eg



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2. METHODS FOR DERIVING FOREST ECOSYSTEMS

2.1 DATA AUDIT AND COLLATION

2.1.1 Fine scale vegetation mapping

Existing forest type mapping

Approximately 1,510,000 ha of the area east of the New England Highway and north of the Hunter River is covered by 1:25,000 forest type mapping based on the SFNSW Research Note 17 forest type classification. This coverage represents approximately 35% of the total area of extant forest in the region and 84% of the forest on public land (most of the mapping is within State Forests with some additional coverage of National Parks and other public land tenures). This forest type mapping was imported to ARCVIEW as a shape file coverage for stitching to other layers.

Other fine scale vegetation mapping

Some additional areas within the region have been mapped at a similar spatial and classification resolution to forest type mapping but using vegetation classes other than forest types. Where practicable such mapping was obtained in digital form and converted to forest type mapping by applying conversion tables (prepared by experts) assigning vegetation classes from other classifications to forest types. The mapped datasets which have been obtained, combined, and converted to RN17 forest types where required, are presented in Table 1. The total area of mapping generated by combining these other sources with existing forest type mapping is approximately 1,800,000 ha, covering 42% of all extant forest and 92% of forest on public land.

All available finescale vegetation mapping was conducted at a scale of 1:25 000 or finer. The vegetation mapping of Torrington State Recreation Area was conducted at a scale of 1:50 000. Areas with fine scale vegetation mapping have an estimated positional accuracy of map polygon boundaries of within 25m. All finescale vegetation mapping was imported into ARCVIEW as shape files and the vegetation type attribution of each mapping project was expertly converted to an analagous SFNSW RN17 forest type classification. The imported shapefiles were converted to ARCVIEW grids at a 50m resolution and merged into a single layer.

Table 1 Fine scale vegetation mapping which was collated for the CRA process

Data Set Source:	Upper		Lower	
	Eastern	Western	Eastern	Western
SFNSW Forest Typing and Royal Milli Typing	x		x	
Natural Resources Audit Council Multi-attribute Mapping	x			
Coffs Harbour Council Vegetation Mapping	x			
Henry James Tweed Vegetation Mapping	x		x	
Department of Land and Water Conservation Nambucca Vegetation Mapping			x	
National Parks and Wildlife Service Coastal Vegetation Mapping	x		x	
Vegetation mapping of Torrington State Recreation Area		x		

2.1.2 Floristic survey plots

A relatively large set of existing floristic field survey data was available for the region. Analyses of floristic variation within and between forest types is based on data from 0.1 ha plots within which the cover abundance (Braun-Blanquet index) of all vascular plant species has been recorded. Plot data of this type have been accumulated from a number of previous projects including the NPWS North East Forest Biodiversity Study, the NRAC Upper North East Regional Audit and the SFNSW EIS program. These data were further supplemented by extensive data collation in the CRA process. A list of all the floristic site data which was compiled and utilised in the CRA forest ecosystem derivation project is provided in Table 2.

The environmental and geographical spread of sites is generally good because much of the survey work has been specifically designed to stratify site locations in relation to major environmental and geographical gradients. Sites are also well distributed in relation to mapped forest types.

Table 2 Full floristic data collated for use in forest ecosystem derivation

Data Set Source:	Data Management	Numberof Plots	Type ofData	Plot Size	Reference
Flora Survey of Ben Halls Gap State Forest	Entered during NEFBS	21	Full floristics with abundances	20x20	Benson & Andrew 1990
Flora Survey of Broadwater National Park	Entered during NRAC	62	Full floristics with abundances and plot and structural data	20x20 and 10x10	Griffith 1985
Flora survey of Bundjalung National Park	Entered during NRAC	205	Full floristics with abundances and plot data	No fixed plot size	Griffith 1983
Flora Survey of the Coffs Harbour Local Government Area	Entered during CRA	108	Full floristics with cover abundance	20x50	Fisher & Gill 1996

Flora Survey of Demon Nature Reserve	Entered during CRA	39	Full floristic nested quadrats with frequency data converted to cover abundance	10 quadrats nested to 22.5mx22.5m	Hunter 1997
Eucalyptus dunnii survey	Entered during NEFBS	31	Full floristics with abundances	20x20	Benson & Hager 1993
John Hunter Granite Surveys	Entered during CRA	521	Full floristic nested quadrats with frequency data converted to cover abundance	10 quadrats nested to 22.5mx22.5m	Hunter 1997
Mount Neville Vegetation Survey	Entered during NEFBS	21	Full floristics with cover abundance	20X20	
Vegetation Survey of Myall Lakes National Park	Entered during CRA	34	Full floristics with cover abundance	20x20	NPWS 1997b
North East Forests Biodiversity Study Flora Sites	Entered during NEFBS	698	Full floristics with abundances and plot, physical and structural data	20x20 within 20x50	NPWS 1994
Natural Resources Audit Council Flora Survey	Entered during NRAC	418	Full floristics with abundances and plot, physical and structural data	20x20 within 20x50	NPWS 1995
Joint Old Growth Project Flora data	Entered during CRA	148	Full floristics with cover abundance; plot, physical and structural data	20x20 within 20x50	NPWS & SFNSW 1996
Hunter Valley Remnant Surveys	Entered during CRA	16	Full floristics with cover abundance	20x20	Peake & Robertson 1998
Royal Botanic Garden Vegetation Data for the Guyra Mapsheet	Entered during NRAC	312	Full floristics with abundances; plot and structural data	20x20	Benson Ashby 1996
State Forest Environmental Impact Study and Monitoring Team flora data	Entered during NEFBS, NRAC and CRA	1,494	Full floristics with abundances; plot and structural data	20x20 within 20x50	Binns 1992; York, Binns & Shields 1991
Tomaree National Park Vegetation Survey	Entered during CRA	35	Full floristics with cover abundance	20x20	NPWS 1997a
Tweed Coast Vegetation Survey	Entered during NEFBS	53	Full floristics with abundances; plot and structural data	20x20 and 10x10	Pressey & Griffith 1992
Yuraygir National Park Flora Survey Sites	Entered during NEFBS and NRAC	186	Full floristics with abundances; plot and structural data	20x20 and 10x10	Griffith 1984

Eastlink Flora Survey	Entered during CRA	127	Full floristics nested quadrats with frequency data converted to cover abundance	10 quadrats nested to 32mx32m	Clarke *et al* 1995
Torrington State Recreation Area Vegetation Survey	Entered during CRA	201	Full floristics nested quadrats with frequency data converted to cover abundance	10 quadrats nested to 32mx32m	Clarke *et al* 1995
Total		4,730			

2.1.3 Abiotic environmental GIS layers

Complete regional GIS coverage were available for a large number of abiotic environmental variables, generally at a scale of 1:25,000 or 1:200,000. Abiotic environmental variables which were available for use in the analyses are presented in Table 3. For the eastern area, the majority of these variables were available at a 25m resolution. The coarsest variable was the geological layer which was infrequently used in the analysis. Latitude (northing) and longitude (easting) were also considered as additional explanatory variables in the analyses. For the purposes of analysis, all variables were re-sampled and used at 50m. The availability of environmental data for the western region was very restricted.

Table 3 Resolution of environmental variables available for the two bioregions

Environmental Variables	**Resolution in Eastern Area (m)**	**Resolution in Western Area (m)**
Mean annual rainfall	25	250
Mean Temperature	25	250
Minimum Temp of the Coldest Month	25	250
Ruggedness Indices	25	Not available
Slope	25	Not available
Solar Radiation Index	25	Not available
Topographic Indices	25	Not available
Topographic Wetness Index	25	Not available
Soil Moisture Index	200	Not available
Rainfall in the Driest Quarter	200	Not available
Soil Depth	200	Not available
Soil Fertility	200	200
Geological Classes	250	Not available
Topographic Position	25	Not available
Easting	25	25
Northing	25	25

2.1.4 Historical data

Historical data from parish portion plans was collated by SFNSW and is documented in a separate report. It involved collecting historical information on vegetation cover from a sample of original portion plans within parishes in the Upper North East and Lower North East regions. The utility of such data had been shown previously in work done by Ryan and Stubbs (1996) for an area comprising seven parishes in the County of Richmond in which it was concluded that "where the destruction of the vegetation has been complete, the historical record, and in particular the conditional purchase plans, is indispensable in reconstructing the pre-settlement pattern of vegetation". Information that was collected for each portion plan included the map sheet name, parish name, portion number, plan number, date of record, notation on vegetation type and topography, point data on corner trees used to fix survey points, comments or notes and grid references of corner survey points.

2.2 SITE SELECTION AND FIELD SURVEY

2.2.1 Site Selection

The environmental and geographical spread of the existing sites was generally good because much of the survey work had been specifically designed to stratify site locations in relation to major environmental and geographical gradients. Sites were also relatively well distributed in relation to mapped forest types. Survey work conducted by this CRA project was designed to fill environmental and/or geographical gaps in the coverage of sampling within each forest type, as well as major environmental and/or geographical gaps in sampling across parts of the region not covered by forest type mapping.

Automated gap analysis software designed by NPWS GIS Research and Development Unit was utilised to select sites (reference). Approximately 400 sites were selected by conducting gap analysis on a forest type by forest type basis. For each forest type the process would involve the use of the software to identify the most poorly sampled geographical/environmental envelope and to select a site in that envelope, and then to re-run the software to identify the next most poorly sampled envelope assuming that the previous selected site was to be surveyed. This process was conducted iteratively and at least 5 sites and up to 20 sites were placed in any given forest type depending on the level of sampling and extent of the type. Some very restricted types did not have any sites placed in them.

A further 200 sites were selected by conducting gap analysis across the entire region at once and iteratively implementing the process as described above. These sites were implemented to provide a sample of parts of the region not covered by forest type mapping. A further 48 sites were selected by conducting gap analysis on the western area only.

A further 51 sites were conducted in Barrington National Park and a total of 145 sites were conducted in total in Guy Fawkes, Chaelundi, Bellinger River and Nymboi-Binderay National Parks. These sites were implemented in conjunction with NPWS district offices who were undertaking Fire Management Planning and contracted the CRA Unit to conduct floristic surveys. Gap analysis was conducted on Barrington in isolation and the four Dorrigo National Parks as a whole and site selection implemented as described above.

2.2.2 Field Survey

The field survey methodology which was utilised followed the approach to plot-based sampling used in the North East Forests Biodiversity Study (NPWS 1994) and the Natural Resources Audit Council Vegetation Survey as outlined in NPWS (1995). The survey approach includes collection of floristic, structural, and physical data at a 20x20m plot nested within a 20x50m plot. Floristic data which is recorded includes all vascular plant species present at the plot and a visual estimation of the cover abundance of each species according to a modified Braun-Blanquet system of cover abundance classes (Mueller-Dombois in NRAC 48). Structural data includes the identification of the vegetation strata present in the plot and the predominant growth form, height range, percentage crown cover and three most dominant species within each stratum as well as diameter at breast height measurements and identification of the 12 upper stratum stems closest to the plot centre. Physical data which was recorded included

altitude, slope, aspect, horizon elevation, soil depth and type, mapped geology and field geology and landform element. Other information which was collected included information on disturbance history and the overall condition of the site. For more detailed descriptions of the plot methodology and proformas refer to NPWS (1995).

A total of 820 full floristic plots were conducted during the CRA field surveys. This total was comprised of 576 in the north-east area, 48 plots in the western area, 145 plots in National Parks in the Dorrigo region and 51 plots in Barrington NP.

2.3 DATABASE DEVELOPMENT AND DATA CHECKING

2.3.1 Database development

An ACCESS 97 database was specifically designed for the storage, entry and manipulation of all CRA systematic flora data.

A data entry interface was developed to resemble the site proformas. These data entry forms were designed to constrain the type of data which could be entered in each field to only those options specified on the field proformas. For the majority of fields drop down boxes were used to constrain entry to a specified list of codes only. Other fields were constrained to the appropriate data type such as numeric or alphanumeric and restricted to a specified data range (such as >0.1 and <5). These constraints were designed to minimise data entry errors and in combination with systematic manual checking, proved to be effective in producing a quality, error free data entry process.

The database design was based on the Advanced Revelation (AREV) database which had been utilised by NPWS for the North East Forests Biodiversity Study (NPWS 1994) and the Natural Resources Audit Council Vegetation Survey as outlined in NPWS (1995). ACCESS 97 was preferred to AREV because it provided a friendlier user interface and more flexible approach to data manipulation, extraction and checking.

The database stored survey data in nine separate which were titled Sites, Vegetation Structure, Canopy Structure, Physical Attributes, Floristics, Disturbance Information, Environmental Variables, Survey Identification, and Recorders.

The database also included three libraries which related information held in codes in the tables to names and associated information. These libraries were a CAPS library (which related the Census of Australian Vascular Plant Codes to species names), a MAP library (which related 1:25,000 map codes and 1:100,000 map codes to map names) and an area library (which related area codes to National Park and State Forest names). These libraries were derived from the AREV database and the CAPS library was rigorously updated with reference to NPWS Head Office to account for recent changes in taxonomy and nomenclature.

2.3.2 Data checking

A series of manual and automatic checking procedures were undertaken on the complete collated database.

All imported and collated datasets were subject to the following checking procedures: taxonomic updates to ensure most recent nomenclature was used, automatic checks to ensure all records had species information; identification and rectification of all duplicate records as well as sites and modification of cover abundance information where required. The accuracy of grid references were checked by automatically comparing the 1:25,000 mapsheet number recorded in the field for a site, with that derived from the sites grid reference in the GIS. All anomalies were further checked and AMGs corrected where necessary.

Further checks were conducted to ensure that no species were duplicated in the floristics table, that all sites had complete information in each of the floristics table, vegetation structure table, canopy structure table, physical attributes table and modifications table. Checks were also conducted to ensure that all species in the floristics table had a cover abundance value and that all species codes in the floristics, vegetation structure and canopy tables were valid CAPS codes present in the CAPS library.

All site localities from the SFNSW data were manually checked against hard copy localities as presented in the EIS reports (where available) in addition to the automatic checking described above. Discrepancies were identified and corrected where possible or quarantined from analysis.

All State Forest grid references were checked in the GIS to ensure that they fell within State Forest boundaries. All sites which were outside State Forest boundaries were identified, checked and corrected or quarantined.

All NRAC sites were cross-referenced in a GIS to ensure that they fell within the designated reserve or parcel of land identified in the reserve area field. Anomalies were checked and corrected or quarantined from analysis.

2.3.3 Completed database

The completed database contained a total of 5,532 full floristic survey sites with abundance information which were utilised for the analysis described below. The database contained a further 835 rainforest sites conducted using a bounded irregular traverse which were not utilised in this project. The database also contained a further 2,270 floristic sites at which canopy only data or full floristics data without abundance information had been collected. These sites were derived from a number of sources with different plot specifications and were not utilised in the analysis for this project.

2.4 METHODOLOGICAL DEVELOPMENT

2.4.1 Analytical approach

The basic aim of this analysis was to use floristic survey data to guide decisions on splitting or amalgamating existing SFNSW forest types to yield a forest ecosystem classification suitable for use in CRA/RFA assessments. Forest types needed to be split and/or amalgamated in such a way that resulting forest ecosystems were relatively homogeneous in terms of floristic composition, and that this level of homogeneity was reasonably consistent across all derived forest ecosystems. A further requirement was that splits within a forest type were able to be mapped, and therefore were associated with variation in mapped abiotic environmental variables.

Any analysis of floristic variation between survey sites must be based on some objective measure of difference in floristic composition or 'compositional dissimilarity' (Faith *et al*. 1987). The measure used in the current analyses is the Bray-Curtis index, demonstrated by Faith *et al*. to be a robust measure of compositional dissimilarity (and therefore ecological distance). The first step in all of the current analyses involves calculating the Bray-Curtis dissimilarity index for all possible pairs of sites being analysed. For example, if four sites are being analysed then the index is calculated for all 6 possible pairs of sites, namely Site 1 vs Site 2, Site 1 vs Site 3, Site 1 vs Site 4, Site 2 vs Site 3, Site 2 vs Site 4 and Site 3 vs Site 4. This procedure yields a 'sites by sites' dissimilarity matrix.

The approach adopted groups sites by considering both floristic and environmental data simultaneously. This new technique can therefore be thought of as a type of 'constrained' or 'canonical' numerical classification. In the same way that canonical ordination techniques (e.g. Canonical Correspondence Analysis, ter Braak 1986) fit an ordination to floristic data such that the ordination axes are functions of environmental variables, the classification technique employed here uses floristic data to divide sites into groups such that this grouping is also defined in terms of decision rules based on environmental variables.

Consider an example in which we wish to analyse the potential for a forest type to be split into two or more sub-types (or 'forest ecosystems'). Floristic data have been collected at a number of plots scattered environmentally and geographically throughout the mapped distribution of the forest type, and these data have been used to derive a dissimilarity matrix containing floristic dissimilarities (Bray-Curtis index) between all possible pairs of sites. The adopted strategy is to search through the set of all possible binary environmental splits for that split which maximises a measure of floristic difference between the two resulting groups of sites, relative to the floristic variation exhibited within these groups. Each binary environmental split is defined in terms of a cutpoint, such as 'soil moisture index = 0.75' (this cutpoint would divide

survey sites into two groups, those with a soil moisture index less than 0.75 and those with an index greater than or equal to 0.75).

The floristic difference between the two groups formed by a split is measured using the statistic:

$$D = \overline{d}_B - \overline{d}_W$$

where $\overline{d}_B$, the average 'between group' dissimilarity, is defined as the average dissimilarity between pairs of sites on opposite sides of the environmental cutpoint (i.e. one site in group 1 and the other site in group 2) and $\overline{d}_w$, the average 'within group' dissimilarity, is defined as the average dissimilarity between pairs of sites on the same side of the cutpoint (i.e. either both sites in group 1 or both sites in group 2). The statistical significance of D is estimated using a Monte Carlo randomization procedure (Manly 1991) in which D is repeatedly calculated after randomly permuting the assignment of sites to groups. The value of D obtained using the real grouping of sites is then compared to the distribution of D obtained using random permutations. In the simplest form of this test the null and alternative hypotheses (H_0 and H_1) are:

$$H_0: D = 0$$

$$H_1: D > 0$$

This approach to measuring, and testing the significance of, differences between groups based on inter-site dissimilarities closely resembles the ANOSIM procedure described by Clarke and Green (1988) and Clarke (1993), which in turn appears to be an unattributed reinvention of an approach originally described by Mielke *et al*. (1976). The approach to significance testing employed by these authors has been generalised in the currrent analysis to allow testing of a wider range of hypotheses of the form:

$$H_0: D \leq D_t$$

$$H_1: D > D_t$$

where D_t is a specified parametric value (or threshold) with which we wish to compare the observed value of D. We are therefore testing whether the observed value of D is greater than the specified threshold by estimating the probability (Type I error) that the true value of D is actually less than or equal to the threshold (Sokal and Rohlf 1981). By assigning D_t a value greater than zero splitting of types will occur only where the floristic difference between resulting groups is significantly greater than the specified threshold, not just significantly greater than zero. This helps to overcome the problem that a type containing a large number of survey sites may be split into groups exhibiting a floristic difference significantly greater than zero yet this difference is inconsequentially small.

The splitting procedure just described can be applied iteratively. Each group of sites formed by splitting can itself be subjected to further splitting. Iterative splitting generates a hierarchical classification of floristic groups in which each division in the hierarchy is defined in terms of an environmental decision rule. This strategy effectively combines elements of divisive polythetic classification (e.g. Lance and Williams 1975) with elements of decision tree modelling (e.g. Moore *et al*. 1991).

The approach to significance testing described above can also be used to investigate potential amalgamations of forest types or sub-types formed by initial splitting of different forest types. Floristic data from sites within the two groups being considered for amalgamation are used to calculate D, thereby providing a measure of floristic difference between the groups. Significance testing in this case requires a different configuration of null and alternative hypotheses than that used for splitting types. The appropriate hypotheses are:

$$H_0: D \geq D_t$$

$$H_1: D < D_t$$

In other words, we are testing whether the observed value of D is significantly less than a specified threshold by estimating the probability that the true value of D is actually greater than or equal to the threshold.

The new analytical approach represents a major improvement over the approach used to split and amalgamate north-east NSW forest types during the Interim Forest Assessment (NPWS 1996). Specific advantages of the new technique are:

- The technique provides an explicit and objective basis for making decisions on splitting or amalgamating forest types.
- The technique incorporates rigorous statistical significance testing.
- The technique considers floristic and environmental data simultaneously in a single integrated analysis. Emphasis is therefore placed on ensuring that splits within forest types are not only meaningful in terms of floristic variation but can also be defined in terms of environmental variation, and thereby mapped. The technique effectively filters out floristic variation which cannot be accounted for in terms of available environmental variables, and therefore cannot be mapped. (Some of this unexplained variation may relate to fine scale environmental variation not captured in the GIS layers while some may simply be random 'noise' reflecting the small size of survey plots used in these analyses.)

2.4.2 Software

The analytical methodology described in the previous section was applied using software developed specifically for this purpose by the NPWS GIS Research and Development Unit. The software was implemented as an extension within the ArcView GIS package, coded using the Avenue scripting language with calls to external C++ functions, where necessary, to perform intensive mathematical processing.

By implementing the software within a GIS package direct access was provided to all required GIS layers including existing forest type mapping, abiotic environmental layers and floristic survey sites with associated species abundance data. Derived splits within forest types were also able to be readily mapped by applying environmental decision rules.

The software was used to apply and analyse both splits and amalgamations. To analyse a potential amalgamation of two forest types (or any two sub-types previously derived by splitting existing types) the user first nominates the two types to be compared. The software then identifies all survey sites falling within the two types and calculates floristic dissimilarities between all possible pairwise combinations of sites. These dissimilarities are then used to calculate *D* and perform significance testing. The parametric threshold and number of Monte Carlo permutations used in this significance testing are user defined.

To analyse potential splits within a forest type (or a sub-type derived in a previous split) the user first nominats the type to be investigated. The software identifies all survey sites falling within the type and calculates all pairwise dissimilarities between these sites. The user can then either allow the software to conduct an automated search for an optimum split, or can nominate a split based on knowledge external to the system. Automated searching is performed by sorting the survey sites in relation to each of the environmental variables in turn and then trialing all possible binary splits within each variable. Each binary split is defined in terms of an environmental cutpoint midway between two adjacent sites, after ordering sites in relation to the variable concerned. Environmental variables considered in this search can be nominated by the user. The relative significance of all evaluated splits can be plotted graphically. The user can either elect to use the most significant split or can override this selection if another potential split is deemed to make better ecological sense.

As indicated above the user can also bypass automated searching completely and nominate a split based on knowledge external to the system (e.g. expert knowledge or results of pattern analysis or modelling performed in other systems). Unlike splits derived from automated searching, user-nominated splits can be defined in terms of decision rules involving more than one environmental variable and can generate more than two groups. Regardless of how a split is derived, floristic differences between resulting groups are always measured in terms of *D* and subjected to significance testing based on a user defined parametric threshold and number of Monte Carlo permutations.

Once a split has been defined, the distribution of resulting sub-types is mapped by applying the associated decision rule using environmental layers held in the GIS. For example, if the analysis indicates that a particular forest type should be split into two sub-types based on a soil moisture index cutpoint of 0.75 then the GIS is used to divide the mapped area of this type into

two mapped sub-types, one covering those areas with a soil moisture index of less than 0.75 and the other covering areas with an index greater than of equal to 0.75. These mapped sub-types can then themselves be submitted to further analysis and potential splitting.

The software reports on the distribution of individual species across derived groups of sites to assist in the interpretation and field recognition of these groups. For each species these reports include statistics on the proportion of sites in which the species was recorded within each group, the mean abundance (+/- 95% confidence limits) of the species within each group and a Kruskal-Wallis test of significance (Daniel 1990) of the difference in abundance of the species between groups.

The software also provides a cross-validation capability in which sites occurring within a type are randomly divided into two equally sized samples prior to analysis and splitting. One sample is used to derive splits while the other sample is used to evaluate the reliability of the splits.

2.5 EXPLORATORY ANALYSIS

Exploratory analyses were conducted for each forest type which had greater than 10 sites. Numerical classification was applied to each of the forest types with greater than 10 sites using the 'PATN' pattern analysis package (Belbin 1993). Classifications were conducted using species cover-abundance data. Matrices of sites by all species with cover abundances were input to PATN using the modules 'PRAM' (data parameters definition) and 'DATN' (data input-output). The module 'ALOB' was selected as the non-heirarchical clustering procedure.

The PATN groups produced for each forest type were then plotted against all environmental variables as two-way scatterplots in S-plus to identify trends in relation to environmental variation. Decision tree or classification tree models were also derived for each forest type in S-plus using the PATN groups as the factor response variable and all environmental variables input as predictor variables.

2.6 DERIVATION OF CLASSIFICATION IN THE EASTERN BIOREGION

The techniques described in the previous two sections were used to split and amalgamate forest types in north-east NSW in accordance with an explicit and rigorous analytical strategy (see Figure 2). As depicted in Figure 2, the strategy involved three main phases comprised of initial amalgamation, splitting and then post-splitting amalgamation.

2.6.1 Identification of forest types for which analysis would be conducted

The starting point for the process was a complete set of all forest types mapped in north-east NSW. This set included 'mixed' types that had been assigned to polygons containing a mixture of elements of two or more forest types. These 'mixed' types are often considered to be the result of 'decision fatigue' on the part of Aerial Photograph Interpreters and many have a very restricted or idiosyncratic mapped extent. There was a total of 465 unique map units contained within the existing forest type coverage which included approximately 350 'mixed' types. An initial processing stage was required to simplify this map coverage prior to analyses being conducted.

To this end, the following pre-processing steps were conducted to incorporate 'mixed' types within the 'pure' types to which they were floristically and ecologically similar:

- All mixed types containing 10 or more survey sites within the mapped extent was treated as unique forest types in all subsequent analyses.
- All mixed types with less than 10 survey sites were compared with each of the 'pure' types in the mix using the ANOSIM statistical technique described above and amalgamated with the type with which they were most similar.
- All mixed types greater than 100ha in size and which did not contain any survey sites were assigned to either type on the basis of an environmental profile. The rainfall and temperature range of each mixed type was assessed in relation to the same variables for the 'pure' types on either side of the mix and the mixed type was amalgamated with the type whose environmental profile it most closely approximated.

- All mixed types less than 100ha in size and which did not contain any survey sites were randomly assigned to one type on either side of the mix, except when one type in the mix was rare or unique in which case the mix was assigned to that type.

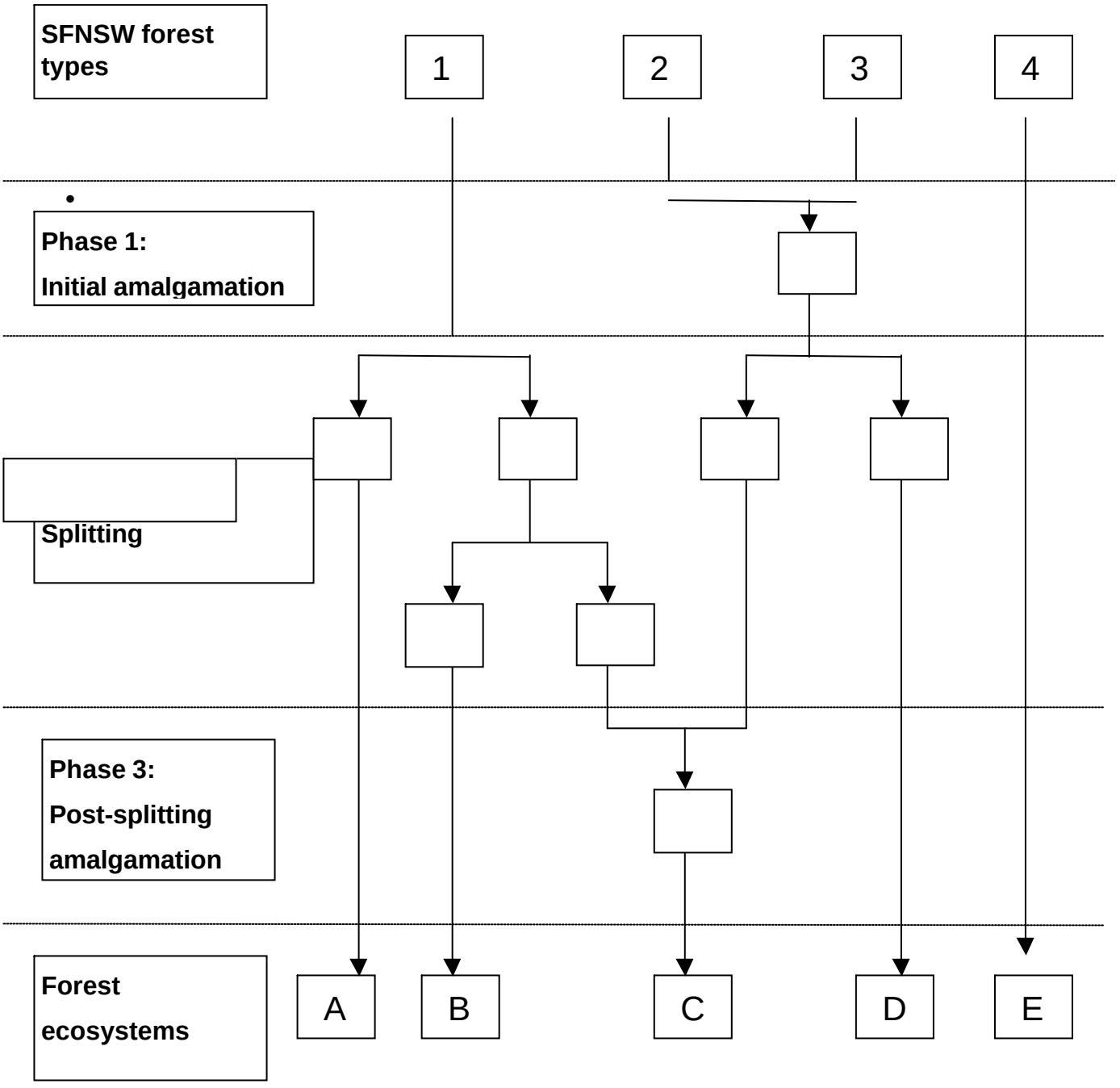
2.6.2 Initial amalgamation

Initial amalgamation of types was performed according to the following rules:

- A pure type containing less than 10 survey sites was not considered as a candidate for amalgamation.
- A pure or mixed type with 10 or more survey sites was compared to all other types (with > 10 records) in the same forest league, using the statistical technique described above. The two types compared were amalgamated if the observed value of *D* was found to be significantly less than a parametric threshold of 0.01 based on a probability cutoff of 0.05 (in other words, the probability that the true value of *D* is equal to or greater than 0.01 is less than 5%).

Initial amalamation analyses were based on canopy data only. Canopy data was chosen for use in this phase because the forest classification is based on canopy composition and it was thought appropriate to test it on the basis from which it was derived. The table of amalgamations which were tested and the value of the measure *D*, the standard deviation and the significance of each results are presented in Appendix 3.

Figure 2. Phases in deriving a forest ecosystem classification for north-east NSW from the existing SFNSW forest type classification (illustrated splits and amalgamations are examples only)



On the basis of the tests that were conducted, 24 of the initial types were identified for amalgamation. In several cases, the tests revealed that three and sometimes four types should be amalgamated into a single type. The types which were identified for amalgamation are listed below:

- Type 36, Type 37 and Mixed Type 36/37: Moist Blackbutt, Dry Blackbutt and Mixed Moist/Dry Blackbutt
- Type 80, Type 82 and Type 85: Grey Ironbark/Grey Box, Grey Box and Grey Box/Forest Red Gum
- Type 117 and Type 119: Scribbly Gum and Scribbly Gum-Silvertop Ash
- Type 40 and Type 41: Blackbutt-Scribbly Gum and Blackbutt-Bloodwood/Apple
- Type 60, Type 61, Type 62 and Mixed Type 62/74: Narrowleaved White Mahogany, Broadleaved White Mahogany, Grey Gum-Grey Ironbark-White Mahogany and Mixed Grey Gum-Grey Ironbark-White Mahogany/Spotted Gum-Grey Gum-Grey Ironbark
- Type 168 and Type 169: Silvertop Stringybark-Gum and Yellow Stringybark
- Type 65, Type 92, Mixed Type 31/92 and Mixed Type 62/65: Forest Red Gum-Grey Gum-Grey Ironbark, Forest Red Gum, Mixed Paperbark/Forest Red Gum, Mixed Grey Gum-Grey Ironbark-White Mahogany/Forest Redgum-Grey Gum-Grey Ironbark
- Type 39 and Type 76: Blackbutt-Spotted Gum and Spotted Gum-Blackbutt
- Type 70 and Type 74: Spotted Gum and Spotted Gum-Grey Gum-Grey Ironbark

2.6.3 Splitting

Each forest type (or amalgamated type generated in Phase 1) containing more than 10 or more survey sites was then evaluated for potential splitting based on analysis of full floristic data. The software's automated searching capability was used to identify the binary environmental split which best partitioned floristic variation within the type. In some cases the results of the exploratory analysis were used to identify environmental splitpoints. Particularly for forest types with smaller numbers of sites, the splitpoints identified by the decision tree model in the exploratory analysis often provided the best measure of *D* when tested in ANOSIM and were therefore used as the basis on which to create the split.

If two or more environmental splits were equally good (or almost so) then expert opinion was used to select the split that made the most ecological sense. If the identified split was deemed to be floristically significant then the type was split into two sub-types. Each of these sub-types was then, in turn, evaluated for further splitting. This process was repeated iteratively until the sub-type currently being assessed was not considered worthy of further splitting for one of the following reasons:

- the sub-type contained fewer than 5 sites;
- the best available environmental split did not yield a significant *D* value;
- groups generated by the best available environmental split did not appear to be ecologically meaningful, as judged by available experts, or were differentiated mainly on the basis of herbaceous species for which field recognition is problematic and seasonally dependent.

The statistical significance of *D* was assessed in relation to a parametric threshold of 0.01 and a probability cutoff of 0.05. This means that a type was considered eligible for splitting if the probability of the true value of *D* being less than or equal to 0.01 was less than 0.05 for the split under consideration (in other words we are at least 95% sure that *D* really is greater than 0.01).

The use of a 0.01 threshold meant that the test of dissimilarity was more rigorous than if a zero threshold was used. The use of this somewhat higher threshold tended to preclude the identification of spurious floristic splits and resulted in groups which were based on clear floristic differences which were also often associated with structural differences. Expert

knowlege was also used as much as possible to inform the derivation of the splits and verify the floristic and ecological integrity of the results.

The splitting phase was conducted on 27 original or amalgamated types to produce a total of 140 derivative types. The analyses which were conducted on each type are presented as trees in Appendix 4, delineating the environmental variable and splitpoint on which each split was made and the *D* statistic, standard deviation and significance of each split. These trees also represent the lineage of any given forest ecosystem back to the forest type from which it was derived.

2.6.4 Post-splitting amalgamation

Sub-types generated by splitting in Phase 2 did, in some cases, warrant re-amalgamation. Consider an example in which two mapped forest types actually contain three distinct floristic communities or forest ecosystems. One community is wholly contained within the first mapped type while another is wholly contained within the second mapped type. The third community, however, is spread across both types. Sometimes it is mapped as one type and sometimes as the other. Phase 2 may split each of these types into two sub-types, one of which represents part of the community spanning both types. The two parts of this community therefore need to be amalgamated.

Since it is not possible to test all potential combinations of all derivative types, this type of problem was addressed by using expert appraisal to identify pairs of sub-types potentially warranting amalgamation and then using the software to measure the floristic difference between these sub-types. These sub-types were then amalgamated if this difference was found to be significantly less than a parametric threshold of 0.01. Both canopy and full floristics data was utilised for this phase. Only types for which the difference was found to be significantly less than a parametric threshold of 0.01 for both the full floristics species matrix and the canopy species matrix were identified for re-amalgamation.

This re-amalgamation phase tested derivative types both within and between original forest types. Several hundred re-amalgamations were tested in this phase and 78 of the 140 derived types were identified for re-amalgamation through this process.

2.6.5 Derived classification

The three-phase strategy outlined above generated a forest ecosystem classification for north-east NSW containing a mix of:

- forest ecosystems that equate directly to existing SFNSW forest types (i.e. types that have been neither split nor amalgamated);
- forest ecosystems that represent a simple amalgam of two or more floristically similar SFNSW forest types;
- forest ecosystems that represent part of an existing SFNSW forest type which is floristically distinct from the remainder of the type; and
- forest ecosystems that represent an amalgam of parts of two or more existing SFNSW forest types.

2.7 DERIVATION OF CLASSIFICATION IN THE WESTERN BIOREGION

Even though the western bioregion was confined to the area west of the New England Highway, some sites were included in the analysis and modelling which occurred east of the New England Highway on the New England Tablelands. This was considered to be appropriate because the environments on either side of the Highway are very similar and the use of such data significantly increased the sample size available. Therefore, sites from the New England Highway east to the eastern edge of the New England Tablelands were included in the dataset for analysis and modelling of the western area.

Numerical classification was applied to all sites from the western portion and the Tablelands sites from the eastern portion of the region using the 'PATN' pattern analysis package (Belbin 1993). The classification was conducted using full floristic cover-abundance data. A matrix of sites by species with cover baundances was input to PATN using the modules 'PRAM' (data

parameters definition) and 'DATN' (data input-output). The PATN output groups were reviewed for floristic composition with reference to other existing published classifications from the western region and an appropriate level of classification expertly assigned by variation to the final level of the dendrogram on the basis of the comparisons.

2.8 DERIVATION OF A SINGLE CLASSIFICATION FOR THE TWO BIOREGIONS

A single classification was derived from the disparate bioregion classifications at this stage by expert assessment of analagous types based on investigation of full floristic abundance information. Six western ecosystems were considered analagous with eastern ecosystems and merged into the analagous eastern map units.

2.9 PEER REVIEW

The methodology utilised to derive forest ecosystems in the north-eastern bioregion was subject to peer review by Dr Mike Austin and Dr Mark Burgman who undertook:

1. To review the scientific rigour of the approach to derivation and mapping of forest ecosystems used in north-east NSW (as outlined in Attachment 1) given the framework specified by the Environment and Heritage Technical Committee and taking into account comparisons with approaches used in other CRA regions throughout Australia.
2. To evaluate the extent to which the approach meets the requirements for forest ecosystems as defined and explained in the JANIS criteria.

In his review Dr Mark Burgman stated that "the method makes good use of both expert judgement and available environmental information in a transparent and repeatable framework. It is likely to produce an outcome that could not be achieved by any other available method....The only general reservation is that the method should be applied with careful oversight by one or several floristic experts." Dr Burgman also identified several potential improvements to the methodology.

Dr Mike Austin concluded that "the method does appear to provide a very feasible and practical solution to combining forest types and floristics to achieve a workable forest ecosystem classification" with the qualification that it is "not possible to foresee all the implications of the approach simply from the outline of the methodology" as this "can only be attempted when the results from several such studies have been published and reviewed."

Further review of the methodology was undertaken at the Finalisation Workshop held on the 4th and 5th June 1998. This workshop was convened by the Environment and Heritage Technical Committee and attended by a number of independent experts in the field of vegetation analysis and classification and several experienced botanists and ecologists from the north-east region. The experts at the workshop endorsed the methodology described above for deriving forest ecosystems (EHTC 1998) as:

- Best practice
- Rigorously incorporating expert review
- Providing a comparable product to classification systems adopted in orther States in a more rigorous manner

3. METHODS FOR MAPPING FOREST ECOSYSTEMS

3.1 MAPPING AREAS WITH EXISTING FINE SCALE MAPPING

Mapping of derived forest ecosystems was most readily achieved in areas covered by existing SFNSW forest type (or equivalent) mapping. Splits in existing types were mapped for each type by using the GIS to apply the environmental decision rules defining these splits. This operation was automated in the software developed for the project (see 2.4.2**0**). Since the derivation of ecosystems often involved iterative subdivisions within each original forest type, the final ecosystems were often derived by iterative applications of binary divisions of environmental variables. Amalgamations of types or sub-types were also mapped through application of a GIS merging operation. All final derived types were merged back into the original layer with the forest types that had not been subject to any splitting or amalgamation. This provided a complete coverage of derived forest ecosystems across all areas with existing fine scale mapping.

3.2 DERIVING PRE-1750 DISTRIBUTION MODELS

3.2.1 Modelling of mapped forest ecosystems in relation to abiotic environmental variables

The distribution of each derived forest ecosystem was modelled in relation to abiotic environmental variables using data extracted from areas covered by existing SFNSW forest type mapping. For each forest ecosystem a random sample of 1ha grid cells was drawn from all cells mapped as containing that ecosystem. A second sample of cells was drawn from all cells mapped as not containing the ecosystem. Samples were selected in a manner which minimizes problems of spatial autocorrelation and model overfitting. A logistic regression model relating the probability of presence of each forest ecosystem to abiotic environmental and geographical variables (see2.1.3 for description of variables) was then fitted using generalised additive modelling (Yee and Mitchell 1991), a technique already applied extensively by NPWS in forest assessment work in NSW. The modelling was conducted via a modelling module (produced by Watson, 1996) which fitted regression models under S-PLUS statistical software (StatSci, 1995).

The predictive accuracy of ecosystem-environment models can be inferred from work conducted previously on species-environment models and information derived during the modelling process. Confidence limits were estimated for each of the probability surfaces interpolated from species-environment models. These indicate the prediction error expected throughout the study area. Another useful measure estimated for all fitted models is the percentage of deviance explained by the model. These measures should be interpreted with some caution as they measure prediction error by simple resubstitution which tend to underestimate the true prediction error of the model. Three additional measures are also

produced during the modelling process which describe the performance of the model in terms of model discrimination, calibration and refinement.

3.2.2 Modelling of western ecosystems in relation to abiotic environmental variables

The distribution of each derived forest ecosystem in the western subregion was modelled in relation to abiotic environmental variables using data extracted from the sites within each ecosystem instead of the mapped extent of the ecosystems as was used in the eastern subregion. There were only four broad environmental predictors available for use in the western subregion compared with the 16 predictors available for the eastern subregion. The resolution of the western variables was also coarse in comparison with the eastern variables (see 2.1.3). Apart from these differences, the modelling was conducted using the same approach as that described above.

3.2.3 Extrapolation of models

These fitted models were then used to extrapolate the distribution of forest ecosystems across unmapped areas of forest and cleared land. Extrapolation within the modelling module was conducted using ARCVIEW Spatial Analyst (ESRI, 1996). The modelling resulted in a probability surface or extrapolated distribution for each forest ecosystem at 100m resolution. The modelling for the western ecosystems was extended to the eastern edge of the New England Tablelands instead of cutting off at the New England Highway (see2.7).

There were a number of forest ecosystems for which models could not be fitted. For a number of restricted types it was not possible to predict pre-1750 distributions robustly because of the very small size of the sample provided by the current distribution. For a number of other ecosystems, it was not possible to find sufficiently strong environmental relationships on which to develop a model. The ecosystems which were not modelled for these two reasons are:

- Type 10: Black Sallee
- Type 12: Blue Mountain Ash
- Type 13: Blue-leaved Stringybark
- Type 39: Dry Heathy New England Stringybarks
- Type 46: Eastern Red Gums
- Type 133: Snow Gum – Black Sallee
- Type 158: Wet Spotted Gum – Tallowwood

In addition to these, fitted models were not able to be derived for non-eucalypt dominated ecosystems. The CRA process was conducted under very tight timeframes and the emphasis was on forests and eucalypt-dominated vegetation. Therefore, the classification used for non-eucalypt ecosystems was very broad and applies virtually at a formation level. Since these ecosystems are so broad they generally contain major floristic variation within them and this variation is paralleled by significant environmental heterogeneity. It is generally not possible to derive robust models for types with such wide environmental characteristics. The ecosystems which were not modelled for this reason are:

- Type 16: Bull Oak
- Type 18: Casuarina Woodland
- Type 22: Coast Cypress Pine
- Type 64: Heath
- Type 66: Herbfield and Fjaeldmark
- Type 77: Mangrove
- Type 96: Natural Grassland
- Type 112: Paperbark

- Type 121: Rock
- Type 125: Saltbush
- Type 141: Swamp
- Type 151: Wattle
- Type 168: Rainforest
- Type 169: Scrub

3.3 MAPPING IN UNMAPPED AREAS AND CLEARED LAND

3.3.1 Derivation of a pre-1750 forest ecosystem layer

A single layer depicting the pre-1750 distribution of each forest ecosystem in the eastern region was derived from the overlay of all the forest ecosystem probability surfaces by randomly proportionally assigning each gridcell to a forest ecosystem according to the relative probabilities of each ecosystem at that gridcell. It is important to keep in mind that for areas without fine scale vegetation mapping the modelled distributions were used to *predict the proportion* of a modelled ecosystem only. No attempt was made to pinpoint the exact geographical location of these proportional allocations. Therefore, the nature of the random, proportional assignment process which was utilised to derive the most accurate areal figures, means that the exact spatial representation of the data is not designed to be accurate. Whilst areal calculations derived from such an approach are valid and reliable, any printed map is only one of many equally valid representations.

Integration of eastern and western map layers

The same approach was used to derive a single layer depicting the pre-1750 distribution of each forest ecosystem in the western area. The classifications for the two areas or bioregions had already been converted to an single classification (see2.8). However, since the western analysis had encompassed the entire Tablelands area instead of the area west of the New England Highway only, there was a zone of overlap between the two mapping schemes from the New England Highway east to the eastern edge of the New England Highway. Therefore, a merge operation was conducted in ARCVIEW GIS to combine the two layers and in the overlap zone the western ecosystems overrode the mapped distribution of eastern ecosystems only for those ecosystems for which the western ecosystem models were deemed (via expert opinion) more robust then the eastern ecosystem models.

Integration of historical data

An extensive analysis of data from historical portion plans was used to inform the pre-1750 distribution of eucalypt forest vegetation and thus to constrain the modelling of eucalypt-dominated forest ecosystems. For a description of the data collection methodology see SFNSW (in prep).

Each data point from a sample of historical portion plans was assigned to open eucalypt forest or non eucalypt vegetation based predominantly on interpretation of the corner tree type recorded by the surveyors and secondarily on the description provided by the surveyors. From this information, the proportion of open eucalypt forest to non eucalypt vegetation was calculated for each vegetation unit derived during the Interim Assessment Process (NPWS 1996). Vegetation units for which no historical portion plan data was collected, were assigned the proportions of their nearest neighbour in the dendrogram for which data was available. This then provided a full coverage of the likely proportion of pre-1750 eucalypt forest on a vegetation unit by vegetation unit basis. Gridcells were then randomly proportionally allocated to eucalypt forest or not according to the vegetation unit proportion. The non-eucalypt gridcells were then cut out from the pre-1750 ecosystem layer within cleared land and did not contribute to the derivation of pre-1750 area values for eucalypt ecosystems.

Integration of fine scale map information for non-eucalypt ecosystems

Existing fine scale forest ecosystem mapping where it was available was then merged over the top of the complete pre-1750 modelled coverage. Mapping for non-eucalypt dominated

ecosystems for areas outside existing fine scale mapping was then incorporated into the coverage from the CRA Aerial Photograph Interpretation Project (CRAFTI). This was available for the Upper North East Region only. Rainforest mapping across all tenures from the CRAFTI project was merged into the derived layer and other non-eucalypt ecosystems were merged into the layer only where they occurred on vegetation outside existing fine scale mapping. Therefore, the CRAFTI rainforest mapping was used to over-ride existing fine scale mapping attribution where it overlapped with such mapping, whilst other non-eucalypt dominated vegetation mapping did not and was itself over-ridden by the existing fine scale map information.

In the Lower North East region, where the CRAFTI data was unavailable, rainforest mapping from the Broad Old Growth Mapping Project (RACAC 1996) was merged into the derived layer. This mapping was available for public land only. The only additional non-eucalypt dominated vegetation mapping which was available was the Eastern Bushlands Database which was captured from Landsat TM at a scale of 1:100,000. This layer contained two map units which included significant areas of non-forest ecosystems: Coastal Sclerophyll Complex and Plateau/Rocky Complex. These map units included non-forest vegetation within mosaics of forested vegetation. A profile of each of the two map units was derived by analysis of the proportions of forest to non-forest within each of the two map units in areas covered by existing fine-scale mapping. The profiles so derived were then applied to areas outside existing fine-scale mapping by random proportional allocation to non-forest or eucalypt forest within each map unit according to the derived proportions. The non-eucalypt areas so identified were then cut out from the ecosystem layer and did not contribute to the derivation of pre-1750 area values for eucalypt ecosystems.

3.3.2 Derivation of an extant forest ecosystem layer

For the Upper North East Region, the final extant forest ecosystem layer was derived by masking the pre-1750 ecosystem layer with the extant forest layer from the CRAFTI project. This layer was derived at a scale of 1:25,000 and mapped patches of extant forest down to 10ha in size. For the Lower North East region, the final extant forest ecosystem layer was derived by masking the pre-1750 ecosystem layer with the extant forest layer from the Eastern Bushlands Database (NPWS 1994b). This layer was derived at a scale of 1:100,000.

4. METHODS FOR MAPPING FOREST ECOSYSTEMS

4.1 MAPPING AREAS WITH EXISTING FINE SCALE MAPPING

Mapping of derived forest ecosystems was most readily achieved in areas covered by existing SFNSW forest type (or equivalent) mapping. Splits in existing types were mapped for each type by using the GIS to apply the environmental decision rules defining these splits. This operation was automated in the software developed for the project (see 0). Since the derivation of ecosystems often involved iterative subdivisions within each original forest type, the final ecosystems were often derived by iterative applications of binary divisions of environmental variables. Amalgamations of types or sub-types were also mapped through application of a GIS merging operation. All final derived types were merged back into the original layer with the forest types that had not been subject to any splitting or amalgamation. This provided a complete coverage of derived forest ecosystems across all areas with existing fine scale mapping.

4.2 DERIVING PRE-1750 DISTRIBUTION MODELS

4.2.1 Modelling of mapped forest ecosystems in relation to abiotic environmental variables

The distribution of each derived forest ecosystem was modelled in relation to abiotic environmental variables using data extracted from areas covered by existing SFNSW forest type mapping. For each forest ecosystem a random sample of 1ha grid cells was drawn from all cells mapped as containing that ecosystem. A second sample of cells was drawn from all cells mapped as not containing the ecosystem. Samples were selected in a manner which minimizes problems of spatial autocorrelation and model overfitting. A logistic regression model relating the probability of presence of each forest ecosystem to abiotic environmental and geographical variables (see 0 for description of variables) was then fitted using generalised additive modelling (Yee and Mitchell 1991), a technique already applied extensively by NPWS in forest assessment work in NSW. The modelling was conducted via a modelling module (produced by Watson, 1996) which fitted regression models under S-PLUS statistical software (StatSci, 1995).

The predictive accuracy of ecosystem-environment models can be inferred from work conducted previously on species-environment models and information derived during the modelling process. Confidence limits were estimated for each of the probability surfaces interpolated from species-environment models. These indicate the prediction error expected throughout the study area. Another useful measure estimated for all fitted models is the percentage of deviance explained by the model. These measures should be interpreted with some caution as they measure prediction error by simple resubstitution which tend to underestimate the true prediction error of the model. Three additional measures are also produced during the modelling process which describe the performance of the model in terms of model discrimination, calibration and refinement.

4.2.2 Modelling of western ecosystems in relation to abiotic environmental variables

The distribution of each derived forest ecosystem in the western subregion was modelled in relation to abiotic environmental variables using data extracted from the sites within each ecosystem instead of the mapped extent of the ecosystems as was used in the eastern subregion. There were only four broad environmental predictors available for use in the western subregion compared with the 16 predictors available for the eastern subregion. The resolution of the western variables was also coarse in comparison with the eastern variables (see 0). Apart from these differences, the modelling was conducted using the same approach as that described above.

4.2.3 Extrapolation of models

These fitted models were then used to extrapolate the distribution of forest ecosystems across unmapped areas of forest and cleared land. Extrapolation within the modelling module was conducted using ARCVIEW Spatial Analyst (ESRI, 1996). The modelling resulted in a probability surface or extrapolated distribution for each forest ecosystem at 100m resolution. The modelling for the western ecosystems was extended to the eastern edge of the New England Tablelands instead of cutting off at the New England Highway (see 0).

There were a number of forest ecosystems for which models could not be fitted. For a number of restricted types it was not possible to predict pre-1750 distributions robustly because of the very small size of the sample provided by the current distribution. For a number of other ecosystems, it was not possible to find sufficiently strong environmental relationships on which to develop a model. The ecosystems which were not modelled for these two reasons are:

- Type 10: Black Sallee
- Type 12: Blue Mountain Ash
- Type 13: Blue-leaved Stringybark
- Type 39: Dry Heathy New England Stringybarks
- Type 46: Eastern Red Gums
- Type 133: Snow Gum – Black Sallee
- Type 158: Wet Spotted Gum – Tallowwood

In addition to these, fitted models were not able to be derived for non-eucalypt dominated ecosystems. The CRA process was conducted under very tight timeframes and the emphasis was on forests and eucalypt-dominated vegetation. Therefore, the classification used for non-eucalypt ecosystems was very broad and applies virtually at a formation level. Since these ecosystems are so broad they generally contain major floristic variation within them and this variation is paralleled by significant environmental heterogeneity. It is generally not possible to derive robust models for types with such wide environmental characteristics. The ecosystems which were not modelled for this reason are:

- Type 16: Bull Oak
- Type 18: Casuarina Woodland
- Type 22: Coast Cypress Pine
- Type 64: Heath
- Type 66: Herbfield and Fjaeldmark
- Type 77: Mangrove
- Type 96: Natural Grassland
- Type 112: Paperbark
- Type 121: Rock
- Type 125: Saltbush
- Type 141: Swamp

- Type 151: Wattle
- Type 168: Rainforest
- Type 169: Scrub

4.3 MAPPING IN UNMAPPED AREAS AND CLEARED LAND

4.3.1 Derivation of a pre-1750 forest ecosystem layer

A single layer depicting the pre-1750 distribution of each forest ecosystem in the eastern region was derived from the overlay of all the forest ecosystem probability surfaces by randomly proportinally assigning each gridcell to a forest ecosystem according to the relative probabilities of each ecosystem at that gridcell. It is important to keep in mind that for areas without fine scale vegetation mapping the modelled distributions were used to *predict the proportion* of a modelled ecosystem only. No attempt was made to pinpoint the exact geographical location of these proportional allocations. Therefore, the nature of the random, proportional assignment process which was utilised to derive the most accurate areal figures, means that the exact spatial representation of the data is not designed to be accurate. Whilst areal calculations derived from such an approach are valid and reliable, any printed map is only one of many equally valid representations.

Integration of eastern and western map layers

The same approach was used to derive a single layer depicting the pre-1750 distribution of each forest ecosystem in the western area. The classifications for the two areas or bioregions had already been converted to an single classification (see 0). However, since the western analysis had encompassed the entire Tablelands area instead of the area west of the New England Highway only, there was a zone of overlap between the two mapping schemes from the New England Highway east to the eastern edge of the New England Highway. Therefore, a merge operation was conducted in ARCVIEW GIS to combine the two layers and in the overlap zone the western ecosystems overrode the mapped distribution of eastern ecosystems only for those ecosystems for which the western ecosystem models were deemed (via expert opinion) more robust then the eastern ecosystem models.

Integration of historical data

An extensive analysis of data from historical portion plans was used to inform the pre-1750 distribution of eucalypt forest vegetation and thus to constrain the modelling of eucalypt-dominated forest ecosystems. For a description of the data collection methodology see SFNSW (in prep).

Each data point from a sample of historical portion plans was assigned to open eucalypt forest or non eucalypt vegetation based predominantly on interpretation of the corner tree type recorded by the surveyors and secondarily on the description provided by the surveyors. From this information, the proportion of open eucalypt forest to non eucalypt vegetation was calculated for each vegetation unit derived during the Interim Assessment Process (NPWS 1996). Vegetation units for which no historical portion plan data was collected, were assigned the proportions of their nearest neighbour in the dendrogram for which data was available. This then provided a full coverage of the likely proportion of pre-1750 eucalypt forest on a vegetation unit by vegetation unit basis. Gridcells were then randomly proportionally allocated to eucalypt forest or not according to the vegetation unit proportion. The non-eucalypt gridcells were then cut out from the pre-1750 ecosystem layer within cleared land and did not contribute to the derivation of pre-1750 area values for eucalypt ecosystems.

Integration of fine scale map information for non-eucalypt ecosystems

Existing fine scale forest ecosystem mapping where it was available was then merged over the top of the complete pre-1750 modelled coverage. Mapping for non-eucalypt dominated ecosystems for areas outside existing fine scale mapping was then incorporated into the coverage from the CRA Aerial Photograph Interpretation Project (CRAFTI). This was available for the Upper North East Region only. Rainforest mapping across all tenures from the CRAFTI project was merged into the derived layer and other non-eucalypt ecosystems were merged into the layer only where they occurred on vegetation outside existing fine scale mapping.

Therefore, the CRAFTI rainforest mapping was used to over-ride existing fine scale mapping attribution where it overlapped with such mapping, whilst other non-eucalypt dominated vegetation mapping did not and was itself over-ridden by the existing fine scale map information.

In the Lower North East region, where the CRAFTI data was unavailable, rainforest mapping from the Broad Old Growth Mapping Project (RACAC 1996) was merged into the derived layer. This mapping was available for public land only. The only additional non-eucalypt dominated vegetation mapping which was available was the Eastern Bushlands Database which was captured from Landsat TM at a scale of 1:100,000. This layer contained two map units which included significant areas of non-forest ecosystems: Coastal Sclerophyll Complex and Plateau/Rocky Complex. These map units included non-forest vegetation within mosaics of forested vegetation. A profile of each of the two map units was derived by analysis of the proportions of forest to non-forest within each of the two map units in areas covered by existing fine-scale mapping. The profiles so derived were then applied to areas outside existing fine-scale mapping by random proportional allocation to non-forest or eucalypt forest within each map unit according to the derived proportions. The non-eucalypt areas so identified were then cut out from the ecosystem layer and did not contribute to the derivation of pre-1750 area values for eucalypt ecosystems.

4.3.2 Derivation of an extant forest ecosystem layer

For the Upper North East Region, the final extant forest ecosystem layer was derived by masking the pre-1750 ecosystem layer with the extant forest layer from the CRAFTI project. This layer was derived at a scale of 1:25,000 and mapped patches of extant forest down to 10ha in size. For the Lower North East region, the final extant forest ecosystem layer was derived by masking the pre-1750 ecosystem layer with the extant forest layer from the Eastern Bushlands Database (NPWS 1994b). This layer was derived at a scale of 1:100,000.

5. RESULTS

5.1 FOREST ECOSYSTEM CLASSIFICATION AND MAP

5.1.1 Pre-1750 eucalypt and non-eucalypt distributions

The derived pre-1750 map layer predicted that approximately 3,412,750ha or 87% of the Upper North East Region and approximately 3,923,494ha or 90% of the Lower North East Region was covered by eucalypt dominated vegetation at the time of European invasion of the Australian continent.

Therefore, approximately 495,278ha of the Upper North East Region and 450,758ha of the Lower North East Region is predicted to have been been covered by non-eucalypt dominated vegetation at that time.

5.1.2 Derived forest ecosystems

One hundred and fifty-seven forest ecosystems were classified and mapped for the eastern area, including 141 dominated by eucalypts, and 16 dominated by non-eucalypt vegetation. Ninety-eight of the eucalypt dominated ecosystems were derived from splitting and amalgamation of 27 original forest types and descriptions of each of these ecosystems is provided in section 0. The remaining 43 ecosystems comprised SFNSW forest types on which no splitting or amalgamation was conducted and 14 of these were non-eucalypt dominated ecosystems which did not have individual pre-1750 distributions derived for the reasons described in section 0 above. Descriptions of these ecosystems are available in FCNSW (1989). A further 22 forest ecosystems were classified and mapped for the western area, including 21 dominated by eucalypts, and one shrubland ecosystem. Appendix 1 provides a floristic profile of all the derived forest ecosystems from both the eastern and western analyses. Each profile describes the major dominant species in each stratum and the percentage frequncy of their occurrence within sites that fall within the ecosystem.

A list of all of the ecosystems which were derived and mapped in the analysis is provided in Appendix 2 for the Upper North East and Lower North East CRA regions separately. Information is presented on the pre-1750 distribution and the extant distribution of each forest ecosystem. Additional information on the proportion of each ecosystem which has been cleared and its threat status sensu JANIS is also provided. Detailed metadata for the Upper North East and Lower North East ecosystem layers is provided in Appendix 3.

One-hundred and sixty three ecosystems were mapped within the Upper North East Region. Of the 149 eucalypt-dominated ecosystems in that region, 31 meet the JANIS criteria for rarity and an additional 19 meet the JANIS criteria for vulnerability.

One-hundred and fifty one ecosystems were mapped within the Lower North East Region north of the Hunter Valley. Of the 137 eucalypt-dominated ecosystems in that region, 41 meet the JANIS criteria for rarity and an additional 30 ecosystems meet the JANIS criteria for vulnerability.

Evaluation of derived forest ecosystem mapping as a biodiversity surrogate

A separate CRA project was conducted to evaluate how well the derived forest ecosystem map performed as a general surrogate for biodiversity in north-east NSW and the results are

presented in NPWS (1999 in prep). This project used analytical techniques developed by the NPWS GIS Research and Development Unit (Ferrier and Watson 1997, Ferrier 1997) to assess the surrogacy value of the mapping in relation to a range of vertebrate, invertebrate and floristic survey datasets.

5.2 PEER REVIEW

An EHTC convened finalisation workshop was held on the 4th and 5th June 1998, to review the forest ecosystem classification. Several experts experienced in vegetation analysis and classification as well as experienced local botanists and ecologists were present.

The experts at the workshop reviewed the derived forest ecosystem classification and concluded that it was "best procedure, ahead of other processes, and satisfying the JANIS criteria for a forest ecosystems that is recognisable in the field, able to be mapped with this mapping extended to private land, able to have their pre-1750 distribution mapped or modelled, has field reliability, and is the best possible surrogate for biodiversity" (EHTC 1998).

5.3 ECOSYSTEM DESCRIPTIONS

Brief ecosystem descriptions are provided below for ecosystems which were derived in the eastern area. These descriptions were derived by subjective interpretation of percentage frequency and mean abundance data for each species within each ecosystem. Common names have been included where they exist.

The descriptions are designed to provide a counterpart to the type descriptions provided in FCNSW (1989) for the derived forest ecosystems. Descriptions of forest types which were not subject to any subdivision or amalgamation should be sought in FCNSW (1989). It is important to note that they are descriptive characterisations and will not necessarily be diagnostic. They do not obviate the need for analysis of diagnostic species and the development of detailed diagnostic keys for field recognition purposes.

Ecosystem 2: Alpine Gum

Low open forest or woodland generally dominated by Snow Gum (*Eucalyptus pauciflora)* with sub-dominant occurrences of other Gums such as Mountain Gum (*E.dalrympleana)* or Ribbon Gum (*E.nobilis)*. There is a sparse understorey and a relatively dense ground layer dominated by Snow Grass *(Poa sieberiana)* and Spiny Headed Mat-rush (*Lomandra longifolia)*.

This ecosystem is primarily mapped and predicted at higher altitudes on the eastern edge of the New England Tablelands with major occurrences on the Dorrigo Plateau and Barrington Tops.

Ecosystem 3: Baileys Stringybark

Low open forest with an overstorey in which Baileys Stringybark (*Eucalyptus baileyana)* is co-dominant with Needlebark-Stringybark (*E.planchoniana)* and in which Rough-barked Apple (*Angophora woodsiana)* frequently occurs as a sub-dominant species. The ecosystem contains a dense heath understorey that is dominated by Grass Trees (*Xanthorrhoea latifolia)* and other heath species such as Banksias (*Banksia oblongifolia* and *B.spinulosa)*, Wattles (*Acacia complanata)* and the Mountain Devil (*Lambertia formosa)*.

This ecosystem is widely distributed in the Upper North East on the Clarence-Glenreagh sandstones with the most extensive stands occurring in Fortis Creek National Park.

Ecosystem 6: Barrington Dry Shrubby New England Blackbutt-Blue Gum

Medium to tall dry forest with an overstorey dominated by New England Blackbutt (*Eucalyptus campanulata)* with Sydney Blue Gum (*E.saligna)* frequently sub-dominant. There is a relatively open mid-storey or tall shrub layer dominated by Forest Oak (*Allocasuarina torulosa)* and Narrow-leaved Geebung (*Persoonia linearis)*. The grassy understorey is dominated by Blady Grass (*Imperata cyclindrica)*, Bracken (*Pteridium esculentum)*, Tussock Grass (Poa labillardieri) and a number of small herbs.

This ecosystem is restricted to the south-western and eastern foothills of the Barrington Tops with the most extensive stand reserved in Mount Royal National Park.

Ecosystem 7: Barrington Moist Blue Gum-White Mahogany

Tall moist forest with an overstorey dominated by Sydney Blue Gum (*Eucalyptus saligna)* and Narrow-leaved White Mahogany (*E.acmenoides)*. The moderately dense shrub layer is dominated by moist or semi-moist species such as Coffee Bush (*Breynia oblongifolia),* Orange Thorn *(Citriobatus pauciflorus), Guoia semi-glauca,* and Scrub Turpentine (*Rhodamnia rubescens).* The understorey contains grasses but is characterised by the presence of the Water Vines *(Cissus hypoglauca* and *C.antarctica)* and ferns such as the Sickle Ferns (*Pellea falcata* and *P.paradoxa).*

This ecosystem is mapped and predicted as scattered occurrences from the south-western foothills of the Barrington Tops east to the Myall River and south into the Hunter Valley. It has small stands reserved in Mount Royal and Ghin-doo-ee National Parks and in The Glen Nature Reserve.

Ecosystem 8: Barrington Wet New England Blackbutt-Blue Gum

Tall wet forest with an overstorey dominated by New England Blackbutt (*Eucalyptus campanulata)* and Sydney Blue Gum (*E.saligna)*. The shrub layer, although relatively open, contains moist species such as Scentless Rosewood (*Synoum glandulosa),* and Socketwood (*Daphnandra* sp A). The ground layer includes a diversity of fern species including Giant Maidenhair (*Adiantum formosum)*, Common Ground Fern (*Calochaena dubia),* Tender Brake *(Pteris tremula),* Rasp Fern *(Doodia aspera),* and grasses are also present at relatively low densities.

This ecosystem is mapped and predicted extensively on the south-western and eastern foothills of the Barrington Tops and is reserved in Barrington and Mount Royal National Parks.

Ecosystem 19: Central Mid Elevation Sydney Blue Gum

Tall wet forest with an overstorey dominated by Sydney Blue Gum (*Eucalyptus saligna)* with Tallowwood (*E.microcorys)* frequently present as a sub-dominant species. The understorey is generally dense and contains warm temperate rainforest species in some diversity and often includes one or more of the characteristic species of Corkwood (*Caldcluvia paniculosa),* Coachwood (*Ceratopetalum apetalum)*, or Crabapple (*Schizomeria ovata).*

This ecosystem occurs on the ranges of the Great Escarpment from the Nymboida River in the north to the Barrington Tops in the south. It is reserved in Nymboi-Binderay and Cottan-bimbang National Parks.

Ecosystem 20: Clarence Lowland Needlebark Stringybark

Very dry forest which is dominated by Needlebark Stringybark (*Eucalyptus planchoniana)* with Turpentine (*Syncarpia glomulifera) or* Red Bloodwood *(Corymbia gummifera*) sometimes occurring as a sub-dominant or occasional species. The ecosystem has a very dense heathy understorey that is dominanted by Banksias (*Banksia oblongifolia* and *B.spinulosa)*, Tea-trees (*Leptospermum trinervium* and *L.polygalifolium*), the Geebung (*Persoonia stradbrokensis)* and the Mountain Devil (*Lambertia formosa).*

This ecosystem is restricted to the sandstones and associated geologies of the Coast Range. It is reserved in Yuraygir National Park and Sherwood Nature Reserve.

Ecosystem 21: Lowlands Grey Box

Tall, dry, open forest in which Grey Box (Eucalyptus moluccana) and Grey Ironbark (E.siderophloia) are generally co-dominant with Swamp Box (Lophostemon suaveolens) also occurring as an occasional species. This ecosystem is generally devoid of an understorey and has a ground layer dominated by a great variety of small herbs and grasses with two of the most dominant being Barbed Wire grass (Cymbopogon refractus) and Kangaroo Grass (Themeda australis).

This ecosystem is predicted extensively in valleys of the Clarenc-Moreton Basin from the lower Clarence Valley around Glenreagh-Coaldale north to the Koreelah Valley. The ecosystems is very restricted on public land with the most notable occurrence in Braemar State Forest

Ecosystem 23: Coast Range Bloodwood-Mahogany

Dry forest dominated by Red Mahogany (*Eucalyptus resinifera* ssp *hemilampra)* and Pink Bloodwood (*Corymbia intermedia).* The ecosystem has a midstorey of Forest Oak (*Allocasuarina torulosa)* and a dry shrubby lower-storey dominated by various Bacon and Egg peas (*Pultenaea* spp.), Geebung (*Persoonia stradbrokensis),* and Riceflower *(Pimelea linifolia).* The ground layer is dominated by Mat-rushes (*Lomandra* spp.), Bracken (*Pteridium esculentum)*, and various grasses.

This ecosystem is restricted to the sandstones and associated geologies of the Coast Range north of the Corindi River. It is reserved in Yuraygir National Park.

Ecosystem 24: Clarence Lowlands Spotted Gum

Tall dry forest which is dominated by Spotted Gum (*Corymbia henryi or C.variegata*), and Grey Ironbark (*Eucalyptus siderophloia*) and often includes Small-fruited Grey Gum (*E.propinqua*) as a sub-dominant. The ecosystem has a midstorey of Forest Oak (Allocasuarina torulosa) and is mostly lacking a shrub layer, with a grassy ground layer dominated by Blady Grass (Imperata cylindrica), Kangaroo Grass (Themeda australis) and Barbed-wire Grass (Cymbopogon refractus).

This ecosystems is extensively mapped and predicted on the foothills and lowlands of the Clarence Moreton Basin and extending north along the Richmond Range. It is reserved in Ramornie and Richmond Range National Parks.

Ecosystem 25: Coast Range Spotted Gum-Blackbutt

Dry forest characterised by Spotted Gum (*Corymbia henryi or C.variegata*) occurring as a co-dominant with either Large or Small-fruited Coastal Blackbutt (*Eucalyptus pyrocarpa or E.pilularis*). The ecosystem has a midstorey of Forest Oak (*Allocasuarina torulosa*) and is mostly lacking a shrub layer, with a grassy ground layer dominated by Blady Grass (*Imperata cylindrica*) and Kangaroo Grass (*Themeda australis*).

This ecosystem has a very restricted and patchy distribution along the Coast Range with a disjunct western occurrence in Grange State Forest. A single stand is reserved in Yuraygir National Park.

Ecosystem 26: Coastal Flooded Gum

Very tall, wet forest which is dominated by Flooded Gum (*Eucalyptus grandis)*, Brushbox (*Lophostemon confertus)* and Tallowwood (*Eucalyptus microcorys)*. The ecosystem has a subtropical rainforest understorey which includes species such as Bangalow palms (*Archontophoenix cunninghamii)* and Celery Wood (*Polyscias elegans)* which occur in high abundance, along with a a great diversity of other rainforest species. The ground layer is dominated by the Giant Maidenhair (*Adiantum formosum)* and the Rasp Fern (*Doodia aspera).*

This ecosystem is distributed extensively on the Richmond and Tweed Ranges with scattered occurrences on other near coastal ranges south to Bulahdelah. Major occurrences are protected in Mebbin and Toonumbar National Parks.

Ecosystem 27: Coastal Sands Blackbutt

Forest dominated by Coastal Blackbutt (*Eucalyptus pilularis)* which often includes Needlebark-Stringybark (*E.planchoniana)* and Smooth-barked Apple (*Angophora costata)* as sub-dominants. The ecosystem contains a relatively dense shrub layer which includes various Wattles (*Acacia* spp.), Banksias (*Banksia aemula* is the most common), a great diversity of Epacrids (family Epacridaceae), and Grass Trees (*Xanthorrhoea* spp.). The ground layer is dominated by Bracken (*Pteridium esculentum)* and the Rush (*Restio tetraphyllus).*

This ecosystem is mapped and predicted on coastal sands from the Esk River south to the Hunter River. Significant stands are reserved in Yuraygir and Myall Lakes National Parks.

Ecosystem 28: Cool Moist Messmate

Tall, very wet forest dominated by Messmate (*Eucalyptus obliqua)* with occasional occurrences of Silvertop Stringybark (*E.laevopinea)* and Diehard Stringybark (*E.cameronii).* The understorey is a well-developed warm-temperate rainforest which includes the Rough Tree

Fern (*Cyathea australis),* Corkwood (*Caldcluvia paniculosa)* and Sassafras (*Doryphora sassafras)* in high abundance along with a great variety of other rainforest species.

This ecosystem is restricted to high elevetations on the eastern edge of the New England Tablelands south-east of Walcha. A stand is reserved in Mummel Gulf National Park.

Ecosystem 29: Corkwood-Crabapple and Mixed Stringybarks.

Tall, very wet forest with a canopy comprised of a number of Stringybarks such as Silvertop Stringybark (*Eucalyptus laevopinea),* Tallowwood (*E.microcorys)* and New England Blackbutt (*E.campanulata)* and a well-developed warm temperate rainforest understorey dominated by Corkwood (*Caldcluvia paniculosa)* and Crabapple (*Schizomeria ovata).*

This ecosystem occurs on the eastern rim of the New England Tablelands from Tenterfield south to the Barnard River. It is reserved in the western portion of Washpool National Park and in Mummel Gulf National Park.

Ecosystem 30: Diehard Stringybark New England Blackbutt

Moderately tall forest dominated by New England Blackbutt (*Eucalyptus campanulata)* usually with Diehard Stringybark (*E.cameronii)* as a sub-dominant. The ecosystem contains a relatively open shrubby understorey which is dominated by *Leucopogon lanceolatus,* Narrow-leaved Geebung *(Persoonia linearis),* and Prickly Shaggy Pea (*Podolobium ilicifolium).* The ground layer is dominated by Bracken (*Pteridium esculentum),* Snow Grass (*Poa sieberiana),* Spiny-headed Mat-rush (*Lomandra longifolia)* and *Dianella caerulea.*

This ecosystem occurs on the eastern edge and fall of the New England Tablelands from the Doyles River north to the Styx River and is concentrated around Mount Seaview and Mount Werrikimbe. The ecosystem is reserved in Werrikimbe, Carrai and Cottan-bimbang National Parks.

Ecosystem 32: Dry Foothills Blackbutt-Turpentine

Tall open forest dominated by Coastal Blackbutt (*Eucalyptus pilularis)* and Turpentine (*Syncarpia glomulifera).* The ecosystem contains a mid-storey of Forest Oak (*Allocasuarina torulosa)* and a sparse, patchy shrub layer which usually includes Elderberry Panax (*Polyscias sambucifolia)* and Tree Heath (*Trochocarpa laurina).* The ground layer is dominated by various herbs and Blady Grass (*Imperata Cyclindrica),* Spiny-headed Mat-rush (*Lomandra longifolia)* and the Blue Flax Lily (*Dianella caerulea).*

This ecosystem is patchily distributed in coastal foothills and escarpment ranges from Dingo Tops north the Corindi River. It is reserved in Ulidarra, Willi Willi and Kumbatine National Parks.

Ecosystem 33: Dry Foothills Spotted Gum

Low forest dominated by Spotted Gum (*Corymbia variegata*) with Grey Ironbark (*Eucalyptus siderophloia*) and Broad-leaved White Mahogany (*E.carnea*) frequently occuring as sub-dominants. The ecosystem has a mid-storey of Forest Oak (*Allocasuarina torulosa*) and is generally devoid of a shrub layer. The ground layer is dominated by Blady Grass (*Imperata cyclindrica*), Kangaroo Grass (*Themeda australis*) and Blue Flax Lily (*Dianella caerulea*) with a diversity of other small herbs and slender twiners.

This ecosystem is predominantly distributed on the ranges and foothills of the Great Escarpment from the Guy Fawkes and Nymboida River gorges east to the Orara Valley with northern extensions to the Cataract River. Large areas are reserved in Chaelundi and Nymboi-binderay National Parks.

Ecosystem 34: Dry Grassy Blackbutt-Tallowwood

Tall open forest dominated by Coastal Blackbutt (*Eucalyptus pilularis*) with Tallowwood (*E.microcorys*) occurring as a sub-dominant. There is a mid-storey of Forest Oak (*Allocasuarina torulosa*) and there are often some straggly shrubs such as Coffee Bush (*Breynia oblongifolia*), the Hopbush (*Dodonea triquetra*), and White Dogwood (*Ozothamnus diosmifolius*). The ground layer is dominated by Blady Grass (*Imperata cyclindrica*), Bracken

(*Pteridium esculentum*), Kangaroo Grass (*Themeda australis*) and Spiny-headed Mat-rush (*Lomandra longifolia*).

This ecosystem is concentrated on coastal lowlands and foothills of the Nambucca and Macleay Valleys, although it is also scattered more patchily from the Myall Lakes north to the Wooli River. It is reserved in Wallingat National Park and Khappingat and Ngambaa Nature Reserves.

Ecosystem 35: Dry Grassy Stringybark

The ecosystem includes one or more Tablelands Stringybarks with a sparse Forest Oak midstorey and no shrub layer. The ground layer is predominantly grassy with Snow Grass (*Poa sieberiana)* and Blady Grass (*Imperata cylindrica)* in high abundance along with the Spiny-headed Mat-rush (*Lomandra longifolia).*

This ecosystem is distributed throughout the dry rugged gorges of the Great Escarpment from the Cataract River through the Guy Fawkes River gorge and south to the Barnard River. It is reserved in Washpool, Barool, Guy Fawkes River, and Oxley Wild River National Parks.

Ecosystem 36: Dry Grassy Tallowwood-Grey Gum

Medium tall ecosystem which generally includes a mixed canopy of Tallowwood (Eucalyptus microcorys), Grey Gum (E.propinqua), Grey Ironbark (E.siderophloia), Broad-leaved White Mahogany (E.carnea) and Turpentine (Syncarpia glomulifera) in more or less equal abundance. The ecosystem has a mid-storey of Forest Oak (Allocasuarina torulosa) and the shrub layer is very sparse or absent. The grassy ground layer is dominated by Kangaroo Grass (Themeda australis) and Blady Grass (Imperata cylindrica).

This ecosystem is distributed throughout the coastal lowlands and foothills of the mid north coast from the Manning Valley north to the Corindi River. Extensive stands are protected in Kumbatine and Bago Bluff National Parks and Ngambaa Nature Reserve.

Ecosystem 37: Dry Heathy Blackbutt - Bloodwood

Medium tall ecosystem in which Coastal Blackbutt (*Eucalyptus pilularis)* is dominant and Red Bloodwood (*Corymbia gummifera)* and Red Mahogany (*Eucalyptus resinifera* ssp *hemilampra)* occur as sub-dominants. The ecosystem has a moderately dense shrub understorey composed of predominantly heathy elements such as Banksias (*Banksia* spp.), Egg and Bacon Peas (*Pultenaea* spp.) and the Geebung (*Persoonia stradbrokensis).*

This ecosystem is concentrated on the Clarence-Glenreagh sandstones from Mt Belmore east to the ocean. It is protected in Yuraygir National Park and Mount Neville Nature Reserve.

Ecosystem 38: Dry Heathy New England Blackbutt

Low ecosystem in which New England Blackbutt (*Eucalyptus campanulata*) is associated with Diehard Stringybark (*E.cameronii*) or a Peppermint (*E.acaciaformis or E.radiata*). The moderately dense shrub understorey is dominated by granitic heath plants such as Black Sheoak *(Allocasuarina littoralis), Monotoca scoparia, the Conestick (Petrophile canescens),* and Jam Tarts *(Melichrus procumbens)*, with grasses such as Snow Grass (Poa sieberiana) and Kangaroo Grass (Themeda australis) also present at high abundance.

This ecosystem is distributed on granitic geologies around Boonoo Boonoo, on the Timbarra Plateau and the Gibraltar range. It is reserved in Gibraltar Range National Park.

Ecosystem 39: Dry Heathy New England Stringybarks

Very low, open forest or woodland which has a mixed canopy comprised of New England Blackbutt (*Eucalyptus campanulata),* Diehard Stringybark (*E.cameronii),* Blue Mountain Ash (*E.olida)* and the Privet-leaved Mallee (*E.ligustrina)* occuring above a very diverse heath understorey.

This ecosystem is confined to coarse granites in Gibraltar Range National Park.

Ecosystem 40: Dry Heathy Sandstone Blackbutt

The ecosystem is dominated by Coastal Blackbutt *(Eucalyptus pilularis)* usually occuring in association with Turpentine (*Syncarpia glomulifera)*. There is a mid-storey of Forest Oak

(*Allocasuarina torulosa)* and a dry shrubby understorey which includes species such as Tree Heath (*Trochocarpa laurina)*, Wattles (*Acacia irrorata* and *A.melanoxylon)* and the Geebung (*Persoonia stradbrokensis)*. The ground layer is comprised of various herbs and grasses.

This ecosystem is distributed on sandstone geologies of the Clarence-Moreton Basin from the southern Richmond Range east to the Coast Range. Large stands are reserved in Mount Neville Nature Reserve.

Ecosystem 41: Dry Open New England Blackbutt

The overstorey is dominated by New England Blackbutt (*Eucalyptus campanulata*) with other Stringybarks occuring occasionally. The understorey may contain scattered shrubs of Black Sheoak (*Allocasuarina littoralis), Leucopogon lanceolatus* and Crinkle Bush *(Lomatia siliaifolia)* and the ground layer is dominated by grasses such as Snow Grass (*Poa sieberiana*), Kangaroo Grass (*Themeda australis*), and Blady Grass (*Imperata cylindrica).*

This ecosystem is extensively distributed on the New England Tablelands predominantly east of the New England Highway from the Queensland border south to the Barnard River. Extensive stands are reserved in Bald Rock and Boonoo Boonoo National Parks with smaller stands reserved elsewhere.

Ecosystem 42: Dry Red Gum-Bloodwood-Apple

Low forest with a mixed canopy comprised of Forest Red Gum (*Eucalyptus tereticornis),* Pink Bloodwood (*Corymbia intermedia)* and the Rough-barked Apple (*Angophora floribunda).* Forest Oak (*Allocasuarina torulosa)* occurs as a mid-storey and there may be a few scattered shrubs in the understorey. The ground layer is dominated by Blady Grass (*Imperata cylindrica),* Bracken (*Pteridium esculentum)* and Spiny-headed Mat-rush (*Lomandra longifolia).*

This ecosystem has scattered occurrences at higher elevations on the ranges of the Great Escarpment with major occurrences in the Doyles River, Bulga Tops and Styx River areas. It is reserved in Cunnawarra and Biriwal Bulga National Parks.

Ecosystem 43: Dry Silvertop Stringybark-Apple

Low forest with a canopy comprised of Broad-leaved Apple (*Angophora subvelutina*) or Forest Red Gum (*Eucalyptus tereticornis*) and Silvertop Stringybark (*E.laevopinea*). Forest Oak occurs as a mid-storey at relatively high abundance and there may be a few scattered shrubs but the understorey is generally not well developed. The ground layer is dominated by Kangaroo Grass (*Themeda australis*).

This ecosystem is concentrated in the rugged western fall of the Guy Fawkes River gorge and is also predicted to occur in the Oxley Wild River and Barnard River gorges. It is reserved in Guy Fawkes River National Park.

Ecosystem 44: Dry Open RedGum-Broad Leaved Apple

Low forest with a canopy dominated by Forest Red-Gum (Eucalyptus tereticornis) with Broad-leaved Apple (Angophora subvelutina) usually present as a sub-dominant and a number of other (predominantly tablelands) eucalypts such as Grey Box (E.moluccana) and New England Stringybark (E.caliginosa) are also occasionally present. There is no shrub layer present except for a few scattered shrubs of Jacksonia scoparia and occasional other species and the ground layer is dominated by grasses such as Kangaroo Grass (Themeda australis) and Sorghum (Sorghum leiocladum) with various small herbs also abundant.

This ecosystem occurs in rugged gorges of the Great Escarpment from the Mann River, through Guy Fawkes River gorge and south to the Apsley River gorge. It is reserved in Guy Fawkes River and Oxley Wild Rivers National Parks and Mann River Nature Reserve.

Ecosystem 47: Redgum - Apple

Medium forest which is similar to type 44 but occurs at lower altitudes with coastal rather than tablelands associates. The canopy is dominated by Forest Red-Gum (*Eucalyptus tereticornis*) with associated species which usually occur in low abundance including Broad-leaved Apple (*Angophora subvelutina*), Grey Ironbark (*E.siderophloia*) and Pink Bloodwood (*Corymbia intermedia*). There is no shrub layer apart from a few scattered shrubs of Coffee Bush (*Breynia*

oblongifolia) and occasional other species and the ground layer is dominated by Blady Grass (*Imperata cylindrica*) and Kangaroo Grass (*Themeda australis*).

This ecosystem is distributed on escarpment ranges from Chandlers Creek north to the MacPherson Ranges. It is reserved in Chaelundi National Park.

Ecosystem 48: Escarpment Scribbly Gum-Apple

Low forest dominated by Broad-leaved Apple (*Angophora subvelutina*) with Thin-leaved Stringybark (*Eucalyptus eugeniodes*) and Scribbly Gum (*E.signata*) usually present as sub-dominants. There is a mid-storey of Forest Oak (*Allocasuarina torulosa*) and often a sparse shrub-layer comprised of *Leucopogon lanceolatus*, Crinkle Bush (*Lomatia silaifolia*) and Dogwood (*Jacksonia scoparia)*. The ground layer is dominated by Kangaroo Grass (*Themeda australis*) and Blady Grass (*Imperata cylindrica*) with a number of different Mat-rush species (*Lomandra* spp.) also present in high abundance.

This ecosystem has restricted occurrences in the Sara River and Chandlers Creek gorges. It is reserved in the Guy Fawkes River National Park.

Ecosystem 49: Escarpment Tallowwood-Bloodwood

Medium to tall moist forest dominated by Tallowwood (*Eucalyptus microcorys)* which may be associated with a number of other tree species of which the most common associates are Pink Bloodwood (*Corymbia intermedia)*, Turpentine (*Syncarpia glomulifera)* and Broad-leaved White Mahogany (*E.carnea)*. There is a mid-storey of Forest Oak (*Allocasuarina torulosa)*and a relatively open shrub layer which includes Narrow-leaved Orange Bark (*Maytenus silvestris)*, Coffee Bush *(Breynia oblongifolia)* and Narrow-leaved Geebung (*Persoonia linearis)*. The ground layer is dominated by Blady Grass (*Imperata cylindrica)* and Bracken (*Pteridium esculentum),* Blue Flax Lily *(Dianella caerulea),* Tick-trefoils *(Desmodium* spp.) and a number of ground ferns such as the Rasp Fern (*Doodia aspera).*

This ecosystem is distributed along the Great Escarpment from the Manning Valley north to the Bellinger River. It is reserved in Biriwal Bulga, Willi Willi and New England National Parks.

Ecosystem 50: Wet Bangalow-Brush Box

Tall forest dominated by Brushbox (*Lophostemon confertus)* which is characterised by a dense, palm rainforest understorey in which Bangalow Palms (*Archontophoenix cunninghamii)* occur in high abundance in association with a great diversity of other predominantly rainforest species.

This ecosystem is patchily distributed on the ranges of the Great Escarpment from Mt Boss to the Border Ranges. Scattered stands are reserved in Werrikimbe, New England and Washpool National Parks.

Ecosystem 52: Foothill Grey Gum-Ironbark-Spotted Gum

Low to medium forest which contains a mixed canopy which is usually dominated by Grey Gum (*Eucalyptus propinqua),* Grey Ironbark (*E.propinqua),* Spotted Gum (*Corymbia variegata)* or a mixture of these in association with a variety of other species of which one of the most common is Turpentine (*Syncarpia glomulifera)*. There is a mid-storey of Forest Oak (*Allocasuarina torulosa)* and there may be an understorey comprised of scattered shrubs of Coffee Bush (*Breynia oblongifolia),* Green Wattle (*Acacia irrorata)* and Tree Heath (*Trochocarpa laurina)*. The ground layer is dominated by Blady Grass (*Imperata cylindrica),* and Blue Flax Lily (*Dianella caerulea)* and Wiry Panic (*Entolasia stricta)* also occur at high abundances.

This ecosystem occurs on sandstone and siliceous soils in the Clarence lowlands with a western extension through the southern Richmond Range inland to Ewingar State Forest and the Mann River. It is reserved in Nymboida National Park.

Ecosystem 53: Gorge Grey Box

Low to medium forest which is usually dominated by Grey Box (*Eucalyptus moluccana*) in association with Pink Bloodwood (*Corymbia intermedia*) and/or Narrow-leaved Ironbark (*E.crebra*). There is a Forest Oak mid-storey and there may be scattered shrubs of species such as Dogwood (*Jacksonia scoparia*) and Hickory Wattle (*Acacia implexa*) in the understorey.

The ground layer is dominated by Barbed-wire Grass (*Cymbopogon refractus*), Kangaroo Grass (*Themeda australis*) and the Tick-trefoil (*Desmodium variens)*.

This ecosystem is concentrated in the Guy Fawkes River gorge with extensions predicted and/or mapped predominantly in gorges, extending north to the Koreelah Range and south to Copeland Tops. It is reserved in Guy Fawkes National Park.

Ecosystem 54: Grey Box-Red Gum-Grey Ironbark

Medium to tall forest which is usually dominated by Grey Box (*Eucalyptus moluccana)* in association with Forest Red-Gum (*E.tereticornis*) and Grey Ironbark (*E.siderophloia*) and less frequently Grey Gum (*E.propinqua*). The types has a mid-storey of Forest Oak (*Allocasuarina torulosa*) and is generally lacking an understorey with a ground layer dominated by grasses such as Kangaroo Grass (*Themeda australis*) and Blady Grass (*Imperata cylindrica*) and herbs such as *Dichondra repens* and various Tick trefoils (*Desmodium* spp).

This ecosystem is concentrated in the upper reaches of the Clarence Valley and associated valley systems with southerly extensions to Copeland Tops. It is reserved in Captains Creek Nature Reserve.

Ecosystem 55: Foothills Grey Gum-Spotted Gum

Low to medium forest which is usually dominated by Spotted Gum (*Corymbia variegata*) with Grey Gum (*Eucalyptus propinqua*), Grey Ironbark (*E.siderophloia*) and Broad-leaved White Mahogany (*E.carnea*) often all present at high abundances. There is a Forest Oak (*Allocasuarina torulosa*) mid-storey and there may be a few very scattered shrubs in the understorey. The ground layer is dominated by Blady Grass (*Imperata cylindrica*), Kangaroo Grass (*Themeda australis*) and the Spiny-headed Mat-rush (*Lomandra longifolia*).

This ecosystem is concentrated on high and low quartz sediments in the southern portion of the Clarence-Moreton Basin. It is reserved in Yuraygir National Park.

Ecosystem 56: Granite Mallee

Very low forest dominated by the mallee *Eucalyptus codonocarpa* with a dense heath understorey dominated by granitic species.

This ecosystem is mostly restricted to Gibraltar Range National Park.

Ecosystem 57: Highland Granite Stringybarks

Low forest usually dominated by Needle-bark Stringybark (*Eucalyptus planchoniana)* or New England Blackbutt (*E.campanulata)* with a dense heath understorey dominated by species such as *Kunzea bracteolata, Leptospermum nova-anglica* and *Callistemon comboynensis. Check swampiness??*

This ecosystem is predominantly restricted to Gibraltar Range, Washpool and Nymboida National Parks.

Ecosystem 58: Gorge Grey Gum

Low forest dominated by Large-fruited Grey Gum (*Eucalyptus biturbinata)* and in which Broad-leaved Apple (*Angophora subvelutina)* is usually subdominant and New England Stringybark (*E.caliginosa)* is also frequent. There is often a mid or understorey of the Black Sheoak (*Allocasuarina littoralis)* and the ground layer is dominated by Snow Grass (*Poa sieberiana)*, the Spiny-headed Mat-rush (*Lomandra longifolia)* and Blady Grass (*Imperata cylindrica)*.

This ecosystem is distributed mainly in the Mann River and Guy Fawkes River gorges. It is reserved in Guy Fawkes National Park and Mann River Nature Reserve.

Ecosystem 59: Gorge Ironbark-Grey Gum

Low to medium forest dominated by Grey Ironbark (*Eucalyptus siderophloia)* or Grey Gum (*E.propinqua)* with occasional occurrences of a number of other species. There is a mid-storey of Forest Oak (*Allocasuarina torulosa)* with the understorey mostly absent and an often sparse ground layer in which Blady Grass (*Imperata cylindrica)*, Barbed-wire Grass (*Cymbopogon refractus)* and the herb *Pratea purpurescens* are most abundant.

This ecosystem is distributed in the rugged gorges associated with the Gibraltar Range and extends south through the rugged reachs of the Cooraldooral Creeks and Mann River to the Nymboida River. It is reserved in Gibraltar Range and Nymboida National Parks.

Ecosystem 60: Grassy New England Blackbutt-Tallowwood-Blue Gum forest

Tall open forest dominated by New England Blackbutt (*Eucalyptus campanulata)* with Tallowwood *(E.microcorys)* often subdominant and Sydney Blue Gum *(E.saligna)* and Diehard Stringybark (*E.cameronii)* also frequently occurring. There is often a Forest Oak (*Allocasuarina torulosa)* mid-storey and scattered shrubs of *Leucopogon lanceolatus*, Tree Heath *(Trochocarpa laurina)* and Hairy Psychotria (*Psychotria loniceroides)* in the understorey. The ground layer is dominated by Bracken (*Pteridium esculentum)*, Snow Grass (*Poa sieberiana*), Blady Grass (*Imperata cylindrica)* and Blue Flax Lily (*Dianella caerulea*).

This ecosystem occurs on the rim of the Great Escarpment at the eastern edge of the New England Tablelands, from Mt Seaview north to the Boonoo River with the major occurrence in Styx River State Forest. It is reserved in Guy Fawkes River and Cunnawarra National Parks.

Ecosystem 65: Heathy Scribbly Gum forest

Medium forest dominated by Scribbly Gum (*Eucalyptus signata*) with either Red or Pink Bloodwood (*Corymbia gummifera* and *C.intermedia)* usually present as subdominants. There is a relatively dense heath understorey dominated by Black Sheoak (*Allocasuarina littoralis)*, the Banksias (*Banksia oblongifolia* and *B.spinulosa)*, the Egg and Bacon Peas (*Pultenaea myrtoides* and *P.retusa*), and the Riceflower (*Pimelea linifolia)* with an understorey of various grasses and *Ptilothrix deusta*.

This ecosystem is distributed on metasediments from the Maria River north to the Richmond River. It is reserved in Bungawalbin, Bundjalung, Yuraygir and Maria River National Parks.

Ecosystem 67: High Elevation Ferny Blackbutt

Tall forest dominated by Coastal Blackbutt (*Eucalyptus pilularis)* with Tallowwood (*E.microcorys)* present as a subdominant. There is an often dense Forest Oak (*Allocasuarina torulosa)* mid-storey with an open, scattered understorey containing moist shrubs such as Tree Heath (*Trochocarpa laurina)*, Blueberry Ash (*Elaeocarpus reticulatus)*, the Laurel (*Cryptocarya rigida)* and Hairy Psychotria (*Psychotria loniceroides)*. The ground layer is dominated by ferns, particularly Common Ground Fern (*Calochlaena dubia),* Gristle Fern (*Blechnum cartilagineum)*, and Rasp Fern (*Doodia aspera)* with Bracken (*Pteridium esculentum)* and Blady Grass (*Imperata cylindrica)* also present in some abundance.

This ecosystem is distributed at medium elevations along the ranges of the Great Escarpment from Chandlers Creek south to Dingo Tops. It is reserved in Nymboi-binderay, New England, Willi Willi and Tapin Tops National Parks.

Ecosystem 68: High Elevation Messmate - Brown Barrel

Medium to tall forest in which Brown Barrel (*Eucalyptus fastigata)* or Messmate (*E.obliqua)* dominates the canopy. There may be scattered shrubs or small trees of *Banksia integrifolia,* and other species such as Blackwood (*Acacia melanoxylon)* and *Leucopogon lanceolatus.* There is a very dense ground layer dominated by Snow Grass (*Poa sieberiana)*, Bracken (*Pteridium esculentum)* and Spiny-headed Mat-rush (*Lomandra longifolia).*

This ecosystem is distributed at high elevations on the New England Tablelands on and around the Barrington Plateau. It occurs in Barrington Crown Reserve.

Ecosystem 69: High Elevation Moist Open Tallowwood-BlueGum

Tall moist to wet forest in which Sydney Blue Gum (*Eucalyptus saligna)* and Tallowwood (*E.microcorys)* co-dominate and Brushbox (*Lophostemon confertus)* is a frequent sub-dominant. There is often Forest Oak present as a mid-storey and a moderate cover of moist understorey shrubs such as Laurels (*Cryptocarya* spp.), Corkwood (*Caldcluvia paniculosa),* Scentless Rosewood (*Synoum glandulosum)* and Hairy Psychotria (*Psychotria loniceroides).* The ground layer is dominated by the Common Ground Fern (*Calochlaena dubia)* and Gristle Fern (*Blechnum cartilagineum)* and Blady Grass (*Imperata cylindrica)* is also present in some

abundance. Twiners such as Climbing Guinea Flower (*Hibbertia scandens)* and the Water Vines (*Cissus hypoglauca* and *C.antarctica)* are also common.

Patchily distributed at high elevations on the ranges of the Great Escarpment from Bulga Tops north to Chandlers Creek. It is reserved in Cottan-bimbang National Park.

Ecosystem 70: High Elevation Open Spotted Gum

Medium forest dominated by Spotted Gum (*Corymbia variegata)* with a mid-storey of Forest Oak (*Allocasuarina torulosa)* which generally lacks an understorey. There is a diverse ground layer in which various grasses and herbs dominate.

This ecosystem is distributed at medium elevation in the foothills and ranges of the Great Escarpment in the southern portion of the Clarence-Morton Basin from the Guy Fawkes River east to the Kangaroo River. It is reserved in Guy Fawkes River and Chaelundi National Parks.

Ecosystem 72: Low Relief Coastal Blackbutt

Medium forest usually dominated by Coastal Blackbutt (*Eucalyptus pilularis)* with Pink Bloodwood (*Corymbia intermedia)* and Red Mahogany (*E.resinifera)* present as subdominants. There is a moderately dense paperbark understorey which usually includes *Melaleuca linariifolia, M.nodosa* and *M.sieberi* and Willow Bottlebrush (*Callistemon salignus*).

This ecosystem is distributed in low lying areas on the central coast from Kendall north to Coffs Harbour. It is reserved in Rawdon Creek Nature Reserve and Maria National Park.

Ecosystem 73: Lowland Red Gum.

Low to medium forest dominated by either Forest Red Gum (*Eucalyptus tereticornis*) or Swamp Box (*Lophostemon suaveolens*). There is a relatively open understorey with a ground layer dominated by Blady Grass (*Imperata cylindrica*) and Kangaroo Grass (*Themeda australis*).

This ecosystem is distributed on high and low quartz sediments in the Clarence lowlands. It is reserved in Bungawalbin National Park.

Ecosystem 74: Lowlands Scribbly Gum

The canopy is usually comprised of pure Scribbly Gum (*Eucalyptus signata)* stands and there is often a scattered understorey of *Leptospermum polygalifolium, Melaleuca sieberi* and *Banksia oblongifolia.* The ground layer is diverse and includes a number of swamp elements such as the rushes *Restio tetraphyllus* and the Twig-rushes *(Baumea articulata* and *B.rubiginosa).*

This ecosystem is distributed predominantly on coastal sands and sandstone from Kempsey to the Tweed River. It is reserved in Limeburner Nature Reserve and Bundjalung and Mount Jerusalem National Parks.

Ecosystem 75: Lowlands Spotted Gum-Box

Tall forest in which Spotted Gum (*Corymbia henryi*) is dominant, Grey Box (*Eucalyptus moluccana*) is sub-dominant and an Ironbark (*E.siderophloia* or *E.fibrosa*) is usually present in low abundances. There is an open understorey with scattered shrubs of Red Ash (*Alphitonia excelsa*) and the Wattle (*Acacia concurrens*) and a ground layer dominated by grasses such as *Aristida vagans,* Kangaroo Grass (*Themeda australis*), Blady Grass (*Imperata cylindrica*) and Barbed-wire Grass (*Cymbopogon refractus*).

This ecosystem is predominantly confined to low quartz sediments in the Clarence Lowlands. It is reserved in Fortis Creek National Park.

Ecosystem 78: Mann River Wet New England Blackbutt

Medium forest dominated by New England Blackbutt (*Eucalyptus campanulata)* with a dense understorey comprised of warm-temperate rainforest species.

This ecosystem is distributed in the upper reaches of Cooraldooral and Cangai Creeks and Mann River and tributaries. It is reserved in Nymboida and Gibraltar Range National Parks.

Ecosystem 80: Manna Gum

Tall forest in which the canopy is often comprised entirely of Manna Gum (*Eucalyptus viminalis)* and in which Messmate (*E.obliqua)* and New England Blackbutt (*E.campanulata)* infrequently occur at moderate abundance. Scattered shrubs such as Riceflower (*Pimelea curviflora), Banksia integrifolia* and Blackthorn (*Bursaria spinosa)* occur in the understorey and the sometimes sparse ground layer is dominated by Snow Grass (*Poa sieberiana)* and a variety of herb species.

This ecosystem is distributed very patchily at high elevations on the New England Tablelands from the Barrington Tops north to Mount Spirabo. A small stand is reserved in the western portion of Washpool National Park and several small stands in Stony Creek National Park.

Ecosystem 82: Messmate - Mountain Gum Forest

Tall forest dominated by Messmate (*Eucalyptus obliqua)* with Mountain Gum (*E.dalrympleana)* also frequently abundant. The understorey is usually sparse but in some situations is comprised of moderately dense stands of Soft Tree Fern (*Dicksonia antarctica*), *Banksia integrifolia,* Blackthorn *(Bursaria spinosa)* and Pepperbush (*Tasmannia stipitata*). The ground layer is dominated by Snow Grass (*Poa sieberiana)* and a variety of ferns of which the most common are the Mother Shield Fern (*Polystichum proliferum)*, Fishbone Water Fern (*Blechnum nudum)* and Bracken (*Pteridium esculentum)*.

This ecosystem is distributed on the eastern rim of the New England Tablelands west of Nundle. It is reserved in Ben Halls Gap National Park and Hell Hole Nature Reserve.

Ecosystem 83: Mid Elevation Wet Blackbutt

Tall forest dominated by Coastal Blackbutt (*Eucalyptus pilularis*) with a variety of species which frequently occur as subdominants including Tallowwood (*E.microcorys)*, New England Blackbutt (*E.campanulata)*, Brushbox (*Lophostemon confertus)* and Turpentine (*Syncarpia glomulifera)*. There is a relatively dense mid-storey of Forest Oak with a sparse to moderately dense understorey comprised of Tree Ferns (*Cyathea australis),* Corkwood (*Caldcluvia paniculosa*) and Scentless Rosewood (*Synoum glandulosum)* and other warm-temperate rainforest elements. The ground layer is dominated by ferns with grasses occurring very infrequently.

This ecosystem is distributed on near coastal ranges of the mid-north coast with major occurrences on the Comara, Snowy and Bushmans Ranges and the Dorrigo Escarpment. It is reserved in New England and Bindarri National Parks.

Ecosystem 84: Mid North Coast Wet Brushbox-Tallowwood-Blue Gum

Tall wet forest co-dominated by Tallowwood (*Eucalyptus microcorys)*, Brushbox (*Lophostemon confertus)* and Sydney Blue Gum (*E.saligna)* occurring in approximately equal proportions over a very well-developed warm temperate rainforest understorey.

This ecosystem is distributed extensively at mid elevation on the ranges of the Great Escarpment from Clouds Creek south to Dingo Tops. It is reserved in Nymboi-Binderay, Werrikimbe, Cottan-bimbang, Tapin Tops and Biriwal Bulga National Parks.

Ecosystem 87: Mixed Tableland Stringybark - Gum Open Forest

The ecosystems is characterised by a mixed canopy comprised of New England Blackbutt (*Eucalyptus campanulata),* Silvertop Stringybark (*E.laevopinea)* and Round-leaved Gum (*E.brunnea)* often associated with a variety of other, less frequent species. The understorey is generally open with some scattered shrubs and a ground layer dominated by Spiny-headed Mat-rush (*Lomandra longifolia)* and Snow Grass (*Poa sieberiana)*.

This ecosystem is distributed on the New England Tablelands mostly east of the New England Highway from the Barnard River to Mount Mitchell. Small areas are reserved in Ben Halls Gap and Mummel Gulf National Parks and Mt Hyland Nature Reserve.

Ecosystem 88: Moist Escarpment New England Blackbutt

Moderate to tall forest in which the canopy is dominated by New England Blackbutt (*Eucalyptus campanulata),* and in which Tallowwood (*E.microcorys)* and, less frequently,

Sydney Blue Gum (*E.saligna),* occur as subdominants. There is a moderately dense and diverse understorey of moist shrubs such as Tree Heath (*Trochocarpa laurina),* Hairy Psychotria (*Psycotria loniceroides)* and Scentless Rosewood (*Synoum glandulosum)* and a ground layer dominated by Bracken (*Pteridium esculentum)* and the Common Ground Fern (*Calochlaena dubia).*

This ecosystem is distributed at high rainfalls as scattered occurrences along the eastern fall of the Great Escarpment from the Cataract River south to the Manning River. It is reserved in Washpool, Carrai, Oxley Wild Rivers, Willi Willi, Werrikimbe and Cottan-bimbang National Parks.

Ecosystem 89: Moist Foothills Spotted Gum

The canopy is dominated by Spotted Gum (*Corymbia variegata)* in association with a variety of species with the most frequent including Tallowwood (*Eucalyptus microcorys),* Brushbox (*Lophostemon confertus)* and Narrow-leaved White Mahogany (*E.acmenoides).* There is a mid-storey of Forest Oak and a sparse understorey of semi-moist species such as Tree Heath (*Trochocarpa laurina),* Coffee Bush *(Breynia oblongifolia),* and Hairy Psychotria (*Psychotria loniceroides).* The ground layer is dominated by Blue Flax Lily (*Dianella caerulea)* and the Rasp Fern (*Doodia aspera)* along with the common grasses such as Tussock Grasses (*Poa* spp.) and Blady Grass (*Imperata cylindrica).*

This ecosystem has major occurrences in Grange State Forest and the Bindery-Mann Wilderness area, with scattered occurrences in gullys from the Chandlers Creek to the Coast. It is reserved in Nymboida, Chaelundi and Nymboi-binderay National Parks.

Ecosystem 90: Moist Messmate - Gum

Tall forest in which Messmate (*Eucalyptus obliqua)* and New England Blackbutt (*E.campanulata)* co-dominate, frequently in association with Silvertop Stringybark (*E.laevopinea)* and Round-leaved Gum (*E.brunnea).* There is a scattered understorey of moist elements of which the more frequent species are the Tree Fern (*Cyathea australis),* Crinkle Bush (*Lomatia siliaifolia), Leucopogon lanceolatus* and Elderberry Panax (*Polyscias sambucifolia).* The ground layer is dominated by Snow Grass (*Poa sieberiana),* Bracken (*Pteridium esculentum*) and the Common Ground Fern *(Calochlaena dubia).*

This ecosystem occurs on deep sedimentary soils on the eastern edge of the New England Tablelands between the Timbarra plateau and the Dorrigo plateau. It is reserved in Washpool and Butterleaf National Parks.

Ecosystem 91: Moist Open Escarpment White Mahogany

The ecosystem contains a mixed canopy of Narrow-leaved White Mahogany *(Eucalyptus acmenoides),* Tallowwood *(E.microcorys),* Sydney Blue Gum *(E.saligna)* and New England Blackbutt *(E.campanulata).* There is a midstorey of Forest Oak with occasional scattered shrubs in the understorey and a ground layer dominated by Snow Grass *(Poa sieberiana),* Blady Grass (*Imperata cylindrica)* and Blue Flax Lily (*Dianella caerulea).*

This ecosystem is distributed along the great escarpment from Barrington Tops north to the Chandlers Creek. Large areas are reserved in Cunnawarra and New England National Parks.

Ecosystem 92: Moist Shrubby Stringybark-Gum

Moderate to tall forest in which New England Blackbutt (*Eucalyptus campanulata)* and Round-leaved Gum (*E.brunnea)* co-dominate, frequently in association with Tallowwood (*E.microcorys)* and/or Messmate (*E.obliqua).* There is an understorey of scattered shrubs with the most frequent including the Tree Fern (*Cyathea australis), Leucopogon lanceolatus* and Green Wattle (*Acacia irrorata).* The ground layer is dominated by a variety of grasses, ferns, herbs and twiners.

This ecosystem is predominantly distributed on the eastern edge of the New England Tablelands from the the Dorrigo Plateau north to the Timbarra Plateau. It is reserved in Guy Fawkes River National Park.

Ecosystem 93: Montane Stringybark-Gum forest

Low to moderate forest in which Mountain Gum (*Eucalyptus dalrympleana)* and New England Stringybark (*E.caliginosa)* co-dominate with moderately frequent occurrences of one of the Peppermints (*E.nova-anglica* and *E.radiata)*. There is a dense, diverse dry shrub understorey with the more common species including *Banksia integrifolia*, Black Sheoak (*Allocasuarina littoralis)* and *Acacia filicifolia*.

This ecosystem occurs on the New England Tablelands and is predominantly distributed from Guyra north to the Queensland border. It is reserved in Bald Rock and Warra National Parks.

Ecosystem 94: Mountain Gum - Brown Barrel

Low to moderate forest with a mixed canopy of Mountain Gum (*Eucalyptus dalrympleana*), Brown Barrel (*E.fastigata)* and Messmate (*E.obliqua)*. There is a relatively dense, semi-moist understorey dominated by Blackwood (*Acacia melanoxylon), Banksia integrifolia*, Elderberry Panax (*Polyscias sambucifolia),* and *Leucopogon lanceolatus*. The ground layer is dominated by Snow Grass (*Poa sieberiana)* and Spiny-headed Mat-rush (*Lomandra longifolia).*

This ecosystem is confined to steep slopes in the Barrington wilderness

Ecosystem 95: Northern Moist Blackbutt

Tall forest dominated by Coastal Blackbutt (*Eucalyptus pilularis)* with Tallowwood (E.microcorys) and Brushbox (*Lophostemon confertus)* present as subdominants and Narrow-leaved White Mahogany frequently present at lower abundances. There is a dense understorey dominated by a diversity of predominantly subtropical rainforest species.

This ecosystem is confined to the eastern Mt Warning shield where it is reserved in Mooball, Nightcap and Mt Jerusalem National Parks.

Ecosystem 97: Needlbark Stringybark-Large Fruited Blackbutt

The canopy is dominated by Large-fruited Blackbutt (*Eucalyptus pyrocarpa)* with Needlebark Stringybark (*E.planchoniana)* and Red Bloodwood (*Corymbia gummifera)* usually subdominant and various other canopy species occasionally present above a dense heath understorey.

This ecosystem is confined to Coast Range sandstones from the Orara River north to Bungawalbin Creek. It is reserved in Sherwood Nature Reserve.

Ecosystem 99: New England Stringybark-Blakelys Red Gum.

Low forest in which New England Stringybark (*Eucalyptus caliginosa*) and Blakely's Red Gum (*E.blakelyi*) co-dominate with Broad-leaved Apple (*Angophora subvelutina*) present at lower abundances. There is no shrub layer and a ground layer dominated by grasses such as Barbed-wire Grass (*Cymbopogon refractus*), *Aristida ramosa*, and Kangaroo Grass (*Themeda australis*) and several Mat-rush species (*Lomandra* spp.).

This ecosystem is associated with gorges of the Great Escarpment from the Queensland Border south to Barrington Tops. It is reserved in Guy Fawkes River and Oxley Wild River National Parks.

Ecosystem 100: Northern Grassy Sydney Blue Gum

Tall forest dominated by Sydney Blue Gum (*Eucalyptus saligna*) in association with Brushbox (*Lophostemon confertus)* and Tallowwood (*E.microcorys*). The understorey may contain scattered wattles (*Acacia irrorata* and *A.maidenii*), Tree Heath (*Trochocarpa laurina*) and other semi-moist shrubs but is generally open with a ground layer dominated by Kangaroo Grass (*Themeda australis*), Sorghum (*Sorghum leiocladum*), Tussock Grass (*Poa labillardieri*), Blady Grass (*Imperata cylindrica*) and Rasp Fern (*Doodia aspera*).

This ecosystem is distributed on the ranges of the Great Escarpment from Clouds Ck north to the Boonoo River at mid to high elevation with an easterly extension to the ranges of the Focal Peak Shield and the northern Richmond Range. The area is reserved in Toonumbar, Border Ranges, Richmond Range, Tooloom, Koreelah and Gibraltar Range National Parks.

Ecosystem 101: Northern Open Grassy Blackbutt

Forest with a mixed canopy usually dominated by Coastal Blackbutt (*Eucalyptus pilularis*) and in which one or several of the following species may be subdominant or occasional: Red Bloodwood (*Corymbia gummifera*), Red Mahogany (*E.resinifera*), Tallowwood (*E.microcorys*) or Turpentine (*Syncarpia glomulifera*). There is often a Forest Oak (*Allocasuarina torulosa*) midstorey and scattered dry shrubs in the understorey of which the Geebung (*Persoonia stradbrokensis)* and *Leucopogon lanceolatus* are the most frequent. There is a predominantly grassy ground layer dominated by Kangaroo Grass (*Themeda australis*), Blady Grass (*Imperata cylindrica*) and Bracken (*Pteridium esculentum*).

This ecosystem is concentrated on high and low quartz sediments in the near coastal lowlands of the Clarence Valley east of the Coast Range with scattered occurrences on the southern Richmond Range and inland to a disjunction in Ewingar State Forest. It is reserved in Yuraygir National Park.

Ecosystem 102: Northern Ranges Dry Tallowwood

Forest with a very mixed canopy which usually contains Tallowwood (*Eucalytpus microcorys)* in association with one or several other species which may include, among others, Narrow-leaved White Mahogany (*E.acmenoides)*, Pink Bloodwood (*Corymbia intermedia)*, Grey Gum (*E.propinqua)* or Brushbox (*Lophostemon confertus)*. The type often has a Forest Oak (*Allocasuarina torulosa)* midstorey and is characterised by a very open understorey and grassy ground layer.

This ecosystem is distributed on the exposed slopes of the Koreelah, Macpherson and Main Camp ranges with extensions east to the Border and Tweed Ranges. It is reserved in Captains Creek Nature Reserve, Border Ranges, Richmond Range and Mebbin National Parks.

Ecosystem 103: Northern Wet Brushbox

The canopy is dominated by Brushbox which usually occurs as pure stands and there is a dense, wet understorey dominated by Laurels (*Cryptocarya* spp.) and a diversity of other, predominantly rainforest, species.

This ecosystem occurs predominantly on the Koreelah, Tooloom and Richmond Ranges with scattered occurrences south to Chandlers Creek. It is reserved in Toonumbar and Richmond Range National Parks.

Ecosystem 104: Northern Wet Tallowwood-Blue Gum.

Sydney Blue Gum (*Eucalyptus saligna)* and Tallowwood (*E.microcorys)* dominate the canopy with Brushbox (*Lophostemon confertus)* frequently subdominant. There is a dense understorey of wet shrubs with a significant rainforest element and a ground layer dominated by ferns.

This ecosystem is distributed along the Koreelah, Richmond and Tooloom Ranges to the north and along the eastern fall of the Gibraltar Range to the south. It is reserved in Washpool, Toonumbar and Richmond Range National Parks.

Ecosystem 105: Nymboida Tallowwood-Turpentine

The canopy is dominated by Tallowwood (*Eucalyptus microcorys)* with one or more of Narrow-leaved White Mahogany (*E.acmenoides)*, Turpentine (*Syncarpia glomulifera)* and Sydney Blue Gum (*E.saligna)* occuring as sub-dominants. There is a relatively dense moist to semi-moist understorey in which Tree Heath (*Trochocarpa laurina)*, Hairy Psychotria (*Psychotria loniceroides)*, and Scrub Turpentine (*Rhodamnia rubescens)* are most common with various rainforest elements also frequently present. There is a diverse ground layer in which grasses, ferns, herbs and bracken are present in similar abundances.

This ecoystem is relatively restricted to ranges and foothills from Clouds Creek east to the Little Nymboida.River. It is reserved in Nymboi-Binderay National Park.

Ecosystem 106: Open Coastal Brushbox

Tall forest dominated by Brushbox (Lophostemon confertus) with Turpentine (*Syncarpia glomulifera)* present as a sub-dominant. There is a midstorey of Forest Oak (*Allocasuarina torulosa)* and an open to moderately dense understorey of semi-moist shrubs in which some of

the more common and abundant species are Tree Heath (*Trochocarpa laurina), Cordyline stricta* and Scentless Rosewood (*Synoum glandulosum)*. The ground layer is dominated by ferns such as Gristle Fern (*Blechnum cartilagineum)* and Giant Maidenhair (*Adiantum formosum).*

This ecosystem is distributed on coastal lowlands and foothills from the Manning Valley north to the Corindi River. It is reserved in New England and Kumbatine National Parks and Ngambaa Nature Reserve.

Ecosystem 107: Open Messmate-New England Blackbutt

Forest dominated by New England Blackbutt (*Eucalyptus campanulata)* often in association with Messmate (*E.obliqua)*. There is usually no understorey and the ground layer is dominated by Snow Grass (*Poa sieberiana)* and Bracken (*Pteridium esculentum)*.

This ecosystem is confined to the western and eastern falls of Barrington Tops. It is reserved in Barrington National Park.

Ecosystem 108: Open Ribbon Gum

Tall forest dominated by Forest Ribbon Gum (*Eucalyptus nobilis)* often in association with New England Blackbutt (*E.campanulata)* and Messmate (*E.obliqua)*. The understorey may contain scattered shrubs of *Leucopogon lanceolatus,* Prickly Shaggy Pea *(Podolobium ilicifolium),* and Blackwood (*Acacia melanoxylon)* and the ground layer is dominated by Spiny-headed Mat-rush (*Lomandra longifolia),* Snow Grass (*Poa sieberiana)* and Bracken (*Pteridium esculentum)*.

This ecosystem is restricted to high altitude, colder regions of the New England Tablelands near Mummel Gulf and the Werrikimbe escarpment. It is reserved in Mummel Gulf and Cottan-bimbang National Parks.

Ecosystem 109: Open Shrubby Brushbox-Tallowwood

Tall forest often comprised of pure Brushbox (*Lophostemon confertus)* stands or with Tallowwood (*Eucalyptus microcorys)* present as a sub-dominant. There may be an understorey of scattered shrubs with common species including Hairy Psychotria (*Psychotria loniceroides),* Scentless Rosewood (*Synoum glandulosum)*, and Tree Heath (*Trochocarpa laurina).* The understorey is dominated by Maidenhair Ferns (*Adiantum* spp.*)* and the Rasp Fern (*Doodia aspera)*.

This ecosystem is primarily distributed on the eastern fall of the Great Escarpment north of the Nymboida River and on the ranges north of the Clarence River. It is reserved in Washpool and Border Ranges National Park.

Ecosystem 110: Open Silvertop Stringybark - Blue Gum

Tall forest with a canopy dominated by Silvertop Stringybark (*Eucalyptus laevopinea)* with Sydney Blue Gum often present as a sub-dominant. There is generally no understorey present and the ground layer is dominated by Snow and Tussock grasses (*Poa sieberiana* and *P.labillardieri)* and Spiny-headed Mat-rush (*Lomandra longifolia)*.

This ecosystem is distributed along the rugged eastern fall of the New England Tablelands from Barrington Tops north to the Queensland Border. It is reserved in Barakee, Mummel Gulf, Barrington and Washpool National Parks.

Ecosystem 111: Open Silvertop Stringybark-Tallowwood

Mixed forest with a canopy dominated by Silvertop Stringybark (*Eucalyptus laevopinea*) associated with Tallowwood (*E.microcorys)* or a number of other species. There are often scattered shrubs in the understorey and the ground layer is dominated by a variety of grasses, ferns and herbs.

This ecosystem is concentrated on the New England Tablelands north from the Dorrigo Plateau to the Gibraltar Range. It is reserved in Guy Fawkes National Park

Ecosystem 118: Richmond Range Spotted Gum

Tall forest in which Spotted Gum (*Corymbia variegata*) is dominant, and Grey Gum (*Eucalyptus propinqua),* Grey Ironbark (*E.siderophloia)* and Grey Box (*E.moluccana)* are usually present in subdominant proportions. There may be an understorey of scattered moist and semi-moist shrubs with the most common including Prickly Alyxcia (*Alyxcia ruscifolia),* Coffee Bush (*Breynia oblongifolia),* and Wild Quince (*Alectryon subcinereus)* and the ground layer is often sparse with a variety of herbs and the sedge *Gahnia aspera* frequent and grasses generally not dominant.

This ecosystem is confined to the northern Richmond Range and adjacent valleys and is reserved in Richmond Range National Park.

Ecosystem 119: Richmond Range Spotted Gum-Box

Forest in which Spotted Gum (*Corymbia variegata)* is dominant, and Grey Box (*Eucalyptus moluccana)* and, less frequently, Grey Gum (*E.propinqua)* are present. This type is unlikely to contain the Ironbark as in type 118 and is somewhat drier with a ground layer in which grasses are frequent and abundant and very scattered dry shrubs in the understorey.

This ecosystem is distributed along the Richmond Range from Mount Marsh north to Mallanganee with extensions north-west into the upper reaches of the Clarence Valley. It is reserved in Banyabba Nature Reserve and Mt Pikapene National Park.

Ecosystem 126: Sandstone Spotted Gum-Blackbutt

Medium forest in which Coastal Blackbutt (*Eucalyptus pilularis)* and Large-fruited Spotted Gum (*Corymbia henryi)* co-dominate. There is often a midstorey of Forest Oak (*Allocasuarina torulosa)* and a sparse to moderately dense understorey of dry shrubs with more common species including Geebung (*Persoonia stradbrokensis),* the Wattle *(Acacia concurrens)* and Dogwood (*Jacksonia scoparia).* The ground layer is dominated by grasses.

This ecosystem has scattered occurrences on sandstones in the Clarence Moreton basin Small areas are reserved in Fortis Creek and Ramornie National Parks.

Ecosystem 127: Sherwood Needlebark Stringybark

Low forest in which Needlebark Stringybark (*Eucalyptus planchoniana)* is usually dominant with Red Bloodwood (*Corymbia gummifera*) frequently occurring as a co-dominant. The type is characterised by a dense heath understorey.

This ecosystem is concentrated on the Glenreagh sandstones in the lower Clarence Valley and is reserved in Sherwood Nature Reserve.

Ecosystem 134: South Coast Shrubby Grey Gum

Forest with a very mixed canopy which is usually co-dominated by Grey Gum (*Eucalyptus propinqua),* Tallowwood (*E.microcorys)* and one of the White Mahoganies (*E.carnea* or *E.acmenoides)* often in association with a number of other species. There is a midstorey of Forest Oak and a sparse to moderately dense understorey of dry shrubs and a dense, grassy ground layer.

This ecosystem is distributed extensively on coastal lowlands and foothills from Port Stephens north to the Manning Valley. Large areas are reserved in Myall Lakes National Park and Talawahl Nature Reserve.

Ecosystem 135: South Coast Tallowwood-Blue Gum

Mixed forest with a canopy usually co-dominated by Tallowwood (*Eucalyptus microcorys),* Brushbox (*Lophostemon confertus)* and Sydney Blue Gum (*E.saligna)* and in which Narrow-leaved White Mahogany (*E.acmenoides)* and Turpentine (*Syncarpia glomulifera)* also frequently occur in high proportions. There is a dense moist understorey dominated by Laurels (*Cryptocarya* spp.) and Scentless Rosewood (*Synoum glandulosum)*. The ground layer is dominated by ferns such as Gristle Fern (*Blechnum cartilagineum),* the Common Ground Fern (*Calochlaena dubia)* and Rasp Fern (*Doodia aspera)* and herbs, twiners and vines are also present in high abundances.

This ecosystem is distributed predominantly in the Buladelah region with northern extensions as scattered occurences along the foothills and ranges to the Corindi River. It is reserved in Nymboi-binderay National Park, New England National Park, Ghin-doo-ee National Park and Myall Lakes National Park.

Ecosystem 137: Southern Wet Sydney Blue Gum

Tall forest with the canopy comprised of pure or near pure stands of Sydney Blue Gum (*Eucalyptus saligna)* with a dense understorey comprised of moist shrubs such as *Guoia semiglauca* and Orange Thorn (*Citriobatus pauciflorus)* and rainforest elements such as Laurels (*Cryptocarya* spp.), Lilly Pilly (*Acmena smithii)* and *Diospyros australis*.

This ecosystem is distributed from the southern and eastern foothills of the Barrington Tops east to the ocean. It is reserved in Barrington Tops and Wallingat National Parks and in The Glen Nature Reserve.

Ecosystem 139: Stringybark-Apple

Low forest usually dominated by Broad-leaved Apple (*Angophora subvelutina)* with Thin-leaved Stringybark (*Eucalyptus eugenoides)* often present as a subdominant and a number of other species potentially present at low abundance. The understorey is generally absent and the sometimes sparse groundlayer is dominated by *Microlaena stipoides* and Blady Grass (*Imperata cylindrica)* and a number of common herbs.

This ecosystem is distributed on rugged escarpment gorges from the Macpherson Ranges south to the Hunter River. It is reserved in Guy Fawkes River and Oxley Wild Rivers National Parks.

Ecosystem 140: Stringybark-Mallee

Very low forest in which New England Blackbutt (*Eucalyptus campanulata)*, the mallee (*E.codonocarpa)* and Diehard Stringybark (*E.cameronii)* often co-dominate over a dense heath understorey.

This ecosystem is confined to very high rainfall areas in the Gibraltar Range and Mt Boss regions. It is reserved in Gibraltar Range National Park and Werrikimbe National Park.

Ecosystem 148: Very wet New England Blackbutt - Tallowwood

Medium forest in which the canopy often consists of pure stands of New England Blackbutt (*Eucalyptus campanulata)* but which is sometimes associated with Tallowwood (*E.microcorys)* at low abundances. These trees occur over a well-developed warm temperate rainforest understorey.

This ecosystem is distributed at very high rainfalls as disjunct occurrences on the Nightcap Range, Gibraltar Range and at Mount Banda Banda and Mt Killerkerankie. It is reserved in Nightcap, Gibraltar Range, Willi Willi and New England National Parks.

Ecosystem 149: Mallee-Peppermint mosaic

A mosaic of very low forest dominated by the mallee *Eucalyptus codonocarpa* in outcrop areas, adjacent to stands of Wattle-leaved Peppermint (*E.acaciaformis)* with a dense understorey of heathy shrubs.

This ecosystems is concentrated in Warra National Park with very scattered occurences north and south.

Ecosystem 150: Washpool Brushbox-Tallowwood

Forest in which the canopy is co-dominated by Brushbox (*Lophostemon confertus)*, Tallowwood (*Eucalyptus microcorys)* and New England Blackbutt (*E.campanulata)* which occur above a well-developed warm-temperate rainforest understorey.

This ecosystem occurs at higher elevations near the headwaters of Washpool Creek in Washpool National Park.

Ecosystem 152: Wet Bloodwood-Tallowwood

Tall forest dominated by Pink Bloodwood (*Corymbia intermedia)* frequently in association with Tallowwood (*Eucalyptus microcorys)* as a subdominant and also often including Brushbox (*Lophostemon confertus)*, Narrow-leaved White Mahogany (*E.acmenoides)*, Grey Ironbark (*E.siderophloia)* and Grey Gum (*E.propinqua)*. The canopy occurs over a dense wet understorey dominated by species such as Celery Wood (*Polyscias elegans)*, Native Ginger (*Alpinia caerulea)* and *Euroschinus falcatus*. The ground layer is diverse but is most frequently dominated by Rasp Fern (*Doodia aspera)*, Blady Grass (*Imperata cylindrica)* and Spiny-headed Mat-rush (*Lomandra longifolia)* along with a diverse number of vines and twiners.

This ecosystem is confined predominantly to metasediments of the MacPherson and Richmond Ranges with extendions east on similar geologies to the Focal Peak and Mt Warning Shields. Small areas are reserved in Yabbra, Richmond Range and Mebbin National Parks.

Ecosystem 153: Wet Coastal Tallowwood-Brushbox

Tall forest which is usually co-dominated by Coastal Blackbutt (*Eucalyptus pilularis*), Tallowwood (*E.microcorys)* and Brushbox (*Lophostemon confertus*). There is a sparse to moderately dense understorey dominated by predominantly moist shrubs with some of the more common and abundant species including Tree Heath (*Trochocarpa laurina)*, Scentless Rosewood (*Synoum glandulosum*) and Rose Myrtle (*Archirhodomyrtus beckleri)*. The ground layer is diverse and includes ferns (*Blechnum cartilagineum* and *Calochlaena dubia*), grasses (Blady Grass and Kangaroo Grass), Mat-rushes (*Lomandra* spp.) and Blue Flax Lily (*Dianella caerulea*) all in high abundances.

This ecosystem is distributed in near coastal valleys and foothills from the Nambucca Valley north to the Corindi River. A small area is reserved in Jaaningga National Park

Ecosystem 154: Wet Flooded Gum-Tallowwood

Very tall forest dominated by Flooded Gum (*Eucalyptus grandis)* with Tallowwood (*E.microcorys)*, Brushbox (*Lophostemon confertus)* and Turpentine (*Syncarpia glomulifera)* frequently present in subdominant proportions which occurs above a dense rainforest understorey characterised by a high abundance of Bangalow Palms (*Archontophoenix cunninghamii)*.

This ecosystem is predominantly distributed on near coastal valleys and foothills of the Nambucca, Bellinger, Orara and Tweed Valleys. Small areas are reserved in Bindarri National Park and Bollanolla Nature Reserve.

Ecosystem 155: Wet Foothills Blackbutt-Turpentine

Tall forest dominated by Coastal Blackbutt (*Eucalyptus pilularis)* with Tallowwood (*E.microcorys)*, Brushbox (*Lophostemon confertus)* and Turpentine (*Syncarpia glomulifera)* present as subdominants. There is a midstorey of Forest Oak and a dense understorey dominated by moist shrubs such as Blueberry Ash (*Elaeocarpus reticulatus)*, Rose Myrtle (*Archirhodomyrtus beckleri)* and Scentless Rosewood (*Synoum glandulosum)*. The ground layer is dominated by ferns with the most frequent and abundant species including Common Ground Fern (*Calochlaena dubia)*, Gristle Fern (*Blechnum cartilagineum)* and Bracken (*Pteridium esculentum)*, and Spiny-headed Mat-rush (*Lomandra longifolia)* and Blue Flax Lily (*Dianella caerulea)* also occur at high abundance along with a diversity of vine species such as the Water Vines (*Cissus* spp.).

This ecosystem is distributed on foothills and ranges from the Manning Valley north to the Corindi River. It is reserved in New England, Big Nellie, Yoorigan and Dooragan National Parks.

Ecosystem 156: Wet New England Blackbutt-Silvertop Stringybark

Forest dominated by New England Blackbutt (*Eucalyptus campanulata)* frequently in association with either Silvertop Stringybark (*E.laevopinea)* or Sydney Blue Gum (*E.saligna*). The dense understorey is composed of moist shrubs such as Scentless Rosewood (*Synoum glandulosum)* and Tree Heath (*Trochocarpa laurina)* and rainforest shrubs such as Laurels (*C.rigida* and *C.glaucescens)* and the Blueberry Ash (*Elaeocarpus reticulatus)*. The ground layer is dominated by ferns with the more common and abundant species including Rasp Fern

(*Doodia aspera)*, Common Ground Fern (*Calochlaena dubia)* and Gristle Fern (*Blechnum cartilagineum)* and a number of vine species such as the Water Vines (*Cissus hypoglauca* and *C.antarctica)* are also common and abundant.

This ecosystem is distributed on the western, eastern and southern foothills of the Barrington Tops and is reserved in Barrington Tops National Park.

Ecosystem 157: Wet Shrubby Brushbox-Tallowwood

Tall forest dominated by Brushbox (*Lophostemon confertus)* with Tallowwood (*Eucalyptus microcorys)* frequently present at relatively low abundances and, less frequently, Sydney Blue Gum (*E.saligna)* also present at low abundance. The canopy occurs over a dense warm-temperate rainforest understorey with the characteristic species such as Corkwood (*Caldcluvia paniculosa)* and Crabapple (*Schizomeria ovata)* occurring frequently at high abundances.

This ecosystem is distributed on the ranges of the great escarpment from Dingo Tops north to Chandlers Creek. It is reserved in New England, Biriwal Bulga, Tapin Tops and Cottan-bimbang National Parks.

Ecosystem 158: Wet Spotted Gum-Tallowwood

Tall forest frequently co-dominated by Spotted Gum (*Corymbia variegata)*, Tallowwood *(Eucalyptus microcorys*) and Narrow-leaved White Mahogany (*E.acmenoides)* and in which Brushbox (*Lophostemon confertus)* is occasionally present as a subdominant. There is a dense moist to wet understorey dominated by Tree Heath (*Trochocarpa laurina)*, Hairy Psychotria (*Psychotria loniceroides)* and Cabbage Palm (*Livistona australis)* with a diverse ground layer dominated by ferns, grasses, vines and a variety of herbs.

This ecosystem is confined to Washpool National Park and Washpool State Forest.

6. DIRECTIONS FOR FURTHER WORK

6.1 INTRODUCTION

Due to the accelerated timeframes of the CRA process and the unavailability of some key input layers, it was not possible to implement all of the methodological refinements and analyses that were initially proposed. However, the implementation of several of these analyses would considerably improve the applicability of the classification and map for future Reserve Planning and the development of Regional Vegetation Management Plans. Due to the ground work done in the CRA process, many of them are straightforward and implementation time would be minimal.

6.2 DEVELOPMENT OF DIAGNOSTIC KEYS

Full diagnostic keys for the derived classification would provide field recognition aids for field staff who are required to identify the derived ecosystems in the field. A trial of diagnostic key development was conducted during the CRA on a subset of four forest types that had been subdivided. Full diagnostic key development and detailed analysis of diagnostic species would considerably improve and simplify the interpretation and use of the mapping for end users.

6.3 ASSESSMENT OF MAP ACCURACY

A series of field validation sites were conducted in the CRA process within the forest types for which trial diagnostic keys had been developed. The diagnostic key relevant to the forest type was applied at each site and the site was assigned a field categorisation of ecosystem type on this basis. The survey teams did not have information on the mapped forest ecosystem at the sites which they were assessing.

Analysis of the results of the validation surveys would provide indications on the field reliability of the derived ecosystem layer and the utility of the trial diagnostic keys.

The accuracy of the derived forest ecosystem map can also be assessed by cross-validation (Efron 1982). Tests can be conducted by re-subjecting selected forest types to splitting with selected subsets of survey sites being experimentally withheld from the analysis. These sites can then be used to assess map accuracy by comparing the forest ecosystem predictively mapped at each withheld site with the forest ecosystem actually occurring at that site. The latter will be estimated by using the site's floristic survey data to automatically allocate the site to a forest ecosystem, based on floristic dissimilarities between the withheld site and sites employed in the original classification. The level of agreement between mapped and actual forest ecosystems will be evaluated using the Kappa statistic (Congalton 1991).

Cross-validation techniques have already been incorporated into the ANOSIM software in preparation for such analyses.

6.4 INCORPORATION OF CRAFTI FLORISTIC DATA

Aerial Photograph Interpretation of floristic groups across all tenures has been conducted by the CRA Aerial Photograph Interpration Project (CRAFTI). This data was not available for use when the forest ecosystem layer was derived. The use of this data will significantly improve the spatial accuracy of the ecosystem mapping on private land and will considerably increase its utility to Regional Vegetation Management Plans. It is possible to incorporate the CRAFTI floristic data into the forest ecosystem map layer relatively simply at the final map derivation stage. This would not require the re-derivation of pre-1750 ecosystem models but would utilise existing models as developed in the CRA project.

The approach would entail using the existing ecosystem models and simply re-running the final stage of the ecosystem derivation process which combines all the models to create a single layer.

The CRAFTI floristic mapping is of a significantly broader resolution than the existing Forest Ecosystem Classification in a more or less heirarchical system. So several ecosystems occur within any given CRAFTI map unit.

Every ecosystem model, prior to the final combination stage, models a predicted occurrence (from 0-100% probability) across the entire region. So many ecosystems model over the same areas, and to derive a final layer, one ecosystem has to be chosen to over-ride the others. In the approach proposed for incorporation of the CRAFTI data the mapped CRAFTI floristics would be used to constrain the ecosystems which would go through to the final map layer.

After the CRAFTI floristic data had been applied to the models to derive a final map layer, the historical data would have to be incorporated into the layer followed by existing fine scale mapped data, to derive a final pre-1750ha layer. That layer would then be trimmed to extant forest to provide a final extant layer.

6.5 REFINEMENT OF CLASSIFICATION FOR NON-EUCALYPT DOMINATED ECOSYSTEMS

Non-eucalypt ecosystems were not subject to the same analysis as eucalypt ecosystems in this process. The emphasis was on eucalypt-dominated ecosystem derivation. The non-eucalypt dominated ecosystems are classified at a much broader formation level. It is difficult to make informed land use decisions without information at a finer level than the formation level. There are several options for deriving classifications for the non-eucalypt dominated ecosystems which are of a comparable resolution to the eucalypt-dominated ecosystems.

One approach would require a two-fold process of derivation of a classification and delineation on public land, and extrapolation of the classification to private land. Existing finer resolution classification and mapping are already available for rainforest and coastal heath and wetlands on public land. These exist as digital map layers and only require GIS manipulation for inclusion in the existing layer. However, these layers are predominantly confined to public land and would require some sort of modelling for extrapolation to private land. A detailed review of the extent and resolution of alternative map sources for all non-eucalypt ecosystems would be required as a preliminary step to inform consideration of this option.

A second approach would involve a one step process which would utilise the ANOSIM analysis technique which was used in the CRA process to derive and map a classification for each non-eucalypt formation across all tenures simultaneously. This would entail treating each formation separately and iteratively splitting the formation in relation to floristic data and environmental variables and simultaneously mapping the products of such splits. This option is more rigorous than that described below because it only identifies subtypes that display environmental and floristic distinctions. This would be feasible for formations for which there was sufficient floristic site data available.

Another approach would involve a somewhat simpler one step process. This would entail an analysis of the environmental variation within each of the broad non-eucalypt ecosystems and the derivation of finer units based on this variation. This could be done across all tenures simultaneously as all the requisite data is currently available across all tenures.

6.6 RE-MODELLING

This would involve re-modelling of pre-1750 forest ecosystem distributions using newly available soil-attribute mapping and incorporating CRAFTI floristic data.

After remodelling, final map derivation would have to be undertaken, followed by incorporation of historical information and incorporation of fine-scale map information (where available) to provide an updated pre1750 layer, and then trimming to the extant area to provide an updated extant layer.

7.

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9. APPENDIX ONE

FLORISTIC PROFILES OF DERIVED FOREST ECOSYSTEMS

Value	Name	Floristics - Upper (brackets denote percentage frequency)	Floristics - Mid (brackets denote percentage frequency)	Floristics - Lower (brackets denote percentage frequency)
2	Alpine Gum	Eucalyptus pauciflora (60), Eucalyptus nobilis (40), Eucalyptus dalrympleana (40), Eucalyptus cameronii (40)	Leucopogon lanceolatus (60), Rubus parviflorus (60)	Viola betonicofolia (80), Poa sieberiana (80), Lomandra longifolia (60), Gonocarpus micranthus (60), Pratea pedunculata (60), Glycine clandestina (60)
3	Baileys Stringybark	E. baileyana (82), E.planchoniana (70), Angophora woodsiana (63), Corymbia gummifera (48)	Xanthorrhoea latifolia (85), Banksia oblongifolia (67), Acacia complanata (68), Leptospermum trinervium (63), Lambertia formosa (56), Pultenaea villosa (56), Persoonia stradbrokensis (52)	Entolasia stricta (93), Persoonia tenuifolia (70), Gahnia sieberana (68), Phyllanthus hirtellus (56), Hardenbergia violacea (52)

6	Barrington Dry Shrubby New England Blackbutt-Blue Gum	Eucalyptus campanulata (100), Eucalyptus saligna (78)	Rubus parviflorus (78), Allocasuarina torulosa (78), Persoonia linearis (78)	Imperata cylindrica (100), Glycine clandestina (100), Hibbertia scandens (100), Pteridium esculentum (100), Hardenbergia violaceous (89), Lomandra longifolia (89), Desmodium varians (89), Viola betonicofolia (78), Vernonia cinerea (67), Pratea purpurascens (67), dichondra repens (67), Poa labillardieri (67), Lagenifera stipata (67), Microlaena stipoides (67), Dianella caerulea (67), Sigesbeckia orientalis (67)
7	Barrington Moist Blue Gum-White Mahogany	Eucalyptus saligna (50), Eucalyptus acmenoides (40), Eucalyptus tereticornis (30)	Breynia oblongifolia (90), Allocasuarina torulosa (60), Cymbidium suave (60), Citriobatus pauciflorus (60), Rapanea variabilis (60), Psycotria loniceroides (60), Guoia semiglauca (60), Persoonia linearis (60)	Cissus hypoglauca (90), Dianella caerulea (90), Hibbetis scandens (80), Dichondra repens (70), Cissus antarctica (70), Lomandra longifolia (70), Pellea falcata (70), Desmodium varians (70), Poa labillardieria (70), Imperata cylindrica (70),
8	Barrington Wet New England Blackbutt-Blue Gum	Eucalyptus saligna (77), Eucalyptus campanulata (77)	Synoum glandulosum (65), Rubus parviflorus (59), Psychotria loniceroides (59), Cissus hypoglauca (53)	Lomandra longifolia (77), Hibbertia scandens (77), Pteridium esculentum (77), Dianella caerulea (77), Doodia aspera (77), Dichondra repens (65), Desmodium varians (65), Eustrephus latifolius (65), Viola hederacea (65), Smilax australis (53)
19	Central Mid Elevation Sydney Blue Gum	Eucalyptus saligna (91)	Persicaria media (52), Citriobatus pauciflorus (52), Trochocarpa laurina (52).	Dianella caerulea (65), Smilax australis (65), Lomandra longifolia (65), Hibbertia scandens (65), Cissus hypoglauca (65), Geitonoplesium cymosum (61).
20	Clarence Lowland Needlebark Stringybark	Syncarpia glomulifera (58), E. planchoniana (37),	Leptospermum polygalifolium (90), Banksia oblongifolia (84), Banksia spinulosa (68), Persoonia stradbrokensis (68), Lambertia formosa (63), Lomatia silaifolia (58), Leucopogon lanceolata (58), Ceratopetalum gummifera (47)	Pimelia linifolia (90), Entolasia stricta (74), Gompholobium pinnatum (74), Patersonia sericea (68), Pteridium esculentum (58), Lepidosperma laterale (58)

21	Lowlands Grey Box	E. moluccana (100), E. siderophloia (100), Lophostemon suaveolens (75)	Alphitonia excelsa (100), Lantana camara (63)	Imperata cylindrica (100), Aristida vagans (78), Jasminum suavissimum (78), Cymbopogon reftractus (75), Cheilanthes sieberi (75), Themeda australis (75), Dichondra repens (63), Oplismenus aemula (63), Panicum simile (63), Eustrephus latifolius (63)
23	Coast Range Bloodwood-Mahogany	Corymbia intermedia (50), Angophora woodsiana (40)	Pimelea linifolia (80), Persoonia stradbrokensis (80), Allocasuarina torulosa (80), Gompholobium pinnatum (70), Leucopogon lanceolatus (50)	Entolasia stricta (90), Cymbopogon refractus (80), Dianella caerulea (80), Imperata cylindrica (80), Lepidosperma laterale (70), Pratia purpurascens (70), Panicum simile (70), Digitaria parviflora (60), Patersonia glabrata (60), Aristida vagans (60), Echi

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
24	Clarence Lowlands Spotted Gum	Eucalyptus siderophloia (60), Corymbia henryi (43), Eucalyptus propinqua (43), Corymbia variegata (40), Corymbia intermedia (40)	Allocasuarina torulosa (61)	Imperata cylindrica (79), Cymbopogon refractus (75), Pratia purpurascens (71), Desmodium rhytidophyllum (68), Eustrephus latifolius (68), Hardenbergia violacea (68), Glycine clandestina (64), Vernonia cinerea (61), Aristida vagans (57), Lomandra longifolia (57), Themeda australis (54), Cheilanthes sieberi (54), Dianella caerulea (54)
25	Coast Range Spotted Gum-Blackbutt	Corymbia variegata (77), Eucalyptus microcorys (56), Syncarpia glomulifera (56), Eucalyptus pilularis (56), Angophora costata (44), Eucalyptus pyrocarpa (44)	Allocasuarina torulosa (78), Leucopogon lanceolatus (56)	Imperata cylindrica (100), Dianella caerulea (100), Hardenbergia violacea (78), Glycine clandestina (67), Themeda australis (56), Entolasia stricta (57),

26	Coastal Flooded Gum	Eucalyptus grandis (75), Lophostemon confertus (75)	Neolitsea dealbata (75), Polyscias elegans (75), Synoum glandulosum (67), Archontophoenix cunninghamiana (67), Citriobatus pauciflorus (67), Guioa semiglauca (67), Linospadix monostachya (58), Mallotus philippensis (58), Alpinia caerulea (58), Diospyros p	Smilax australis (75), Cissus antarctica (75), Doodia aspera (75), Dioscorea transversa (67), Ripogonum elseyanum (58), Oplismenus imbecillis (58), Sarcopteryx stipata (58)
27	Coastal Sands Blackbutt	E. pilularis (64), E. planchoniana (57), Angophora costata (57)	Persoonia virgata (79), Leucopogon lanceolatus (64), Banksia aemula (50), Xanthorrhoea latifolia (43)	Hibbertia vestita (71), Pteridium esculentum (64), Restio tetraphyllus (64)
28	Cool Moist Messmate	Eucalyptus obliqua (83)	Cyathea australis (100), Tasmannia insipida (83), Acacia melanoxylon (67), Bursaria spinosa (67), Caldcluvia paniculosa (67), Elaeocarpus reticulatus (67), Shizomeria ovata (50), Doryphora sassafras (50), Ceratopetalum apetalum (50)	Dyrmophila moorei (100), Smilax australis (100), Lomandra longifolia (83), Hibbertia scandens (83), Cissus hypoglauca (67), Pteridium esculentum (67), Eustrephus latifolius (67), Blechnum cartilagineum (67), Poa sieberiana (67)
29	Corkwood-Crabapple and Mixed Stringybarks.	Eucalyptus microcorys (50), Eucalyptus saligna (50), Eucalyptus laevopinea (42), Eucalyptus campanulata (42)	Cryptocarya rigida (83), Caldcluvia paniculosa (75), Synoum glandulosum (75), Trochocarpa laurina (75), Schizomeria ovata (75), Cyathea australis (75), Tasmannia insipida (67), Psychotria loniceroides (67), Endiandra sieberi (58), Pittosporum revolutum (50)	Blechnum cartilagineum (75), Cephalaralia cephalobotrys (75), Cissus hypoglauca (75), Smilax australis (67), Hibbertia scandens (67), Viola hederacea (67), Calochlaena dubia (67), Cissus antarctica (67), Dianella caerulea (67), Lomandra spicata (67), Morinda jasminoides (58), Geitonoplesium cymosum (58), Gymnostachys anceps (58), Hibbertia dentata (58), Dictymia brownii (58)
30	Diehard Stringybark New England Blackbutt	Eucalyptus campanulata (89), Eucalyptus cameronii (61)	Leucopogon lanceolatus (80), Persoonia linearis (61), Oxylobium ilicifolium (59), Persoonia media (47)	Lomandra longifolia (96), Pteridum esculentum (89), Poa sieberiana (78), Dianella caerulea (67), Hibbertia scandens (65), Billardieria scandens (57), Hibbertia dentata (52)

32	Dry Foothills Blackbutt-Turpentine	Syncarpia glomulifera (92), Eucalyptus pilularis (80), Eucalyptus microcorys (52)	Allocasuarina torulosa (92), Polyscias sambucifolia (72), Trochocarpa laurina (60)	Dianella caerulea (92), Hibbertia scandens (76), Lomandra longifolia (64), Smilax australis (64), Cissus hypoglauca (60), Pteridium esculentum (56), Imperata cylindrica (52), Pandorea pandorana (52)
33	Dry Foothills Spotted Gum	Corymbia variegata (86), Eucalyptus siderophloia (69), Eucalyptus carnea (61), Eucalyptus microcorys (59)	Allocasuarina torulosa (92), Breynia oblongifolia (61)	Dianella caerulea (92), hardenbergia violacea (75), Imperata cylindrica (74), Glycine clandestina (72), Desmodium rhytidophyllum (72), Vernonia cinerea (71), Oplimensus aemulus (71), Eustrephus latifolius (69), Pratia purpurascens (69), Sigesbeckia orientalis (59), Lomandra filiformis (56), Dichondra repens (56)

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
34	Dry Grassy Blackbutt-Tallowwood	E. piluaris (90), E. microcorys (90)	Allocasuarina torulosa (90), Breynia oblongifolia (90), Ozothamnus diosmifolium (53)	Imperata cylindrica (90), Lomandra longifolia (74), Pteridium esculentum (74), Vernonia cinerea (68), Glycine clandestina (68), Lepidosperma laterale (68), Themeda australis (63), Hardenbergia violacea (63)
35	Dry Grassy Stringybark	Eucalytpus campanulata (45), Eucalyptus caliginosa (26), Eucalyptus microcorys (24), Eucalyptus cameronii (24), Eucalyptus biturbinata (24)		Dianella caerulea (74), Lomandra longifolia (74), Poa sieberiana (69), Imperata cylindrica (60)

36	Dry Grassy Tallowwood-Grey Gum	Eucalyptus microcorys (70), Eucalyptus proprinqua (67), Eucalyptus siderophloia (63), Syncarpia glomulifera (61), Eucalyptus carnea (61), Corymbia intermedia (58)	Allocasuarina torulosa (87), Breynia oblongifolia (70), Lantana camara (54), Smilax australis (54)	Dianella caerulea (93), Lomandra longifolia (82), Imperata cylindrica (78), Glycine clandestina (67), Hibbertia scandens (67), Vernonia cinerea (63), Desmodium rhytidophyllum (57), Pseuderantherum variabile (57), Themeda australis (56), Desmodium varians (53), Solanum densevestitum (54)
37	Dry Heathy Blackbutt - Bloodwood	Syncarpia glomulifera (53), Corymbia intermedia (38)	Pimelea linifolia (69), Persoonia stradbrokensis (69), Leucopogon lanceolatus (55), Hibbertia vestita (52), Gompholobium pinnatum (50)	Entolasia stricta (93), Imperata cylindrica (76), Dianella caerulea (72), Pteridium esculentum (64), Lepidosperma laterale (64), Lomandra longifolia (62), Themeda australis (60), Panicum simile (60), Glycine clandestina (57)
38	Dry Heathy New England Blackbutt	Eucalyptus campanulata (75), Eucalyptus radiata (50), Eucalyptus cameronii (50), Eucalyptus dalrympleana (50)	Monotoca scoparia (75), Petrophile canescens (50), Pimelea linifolia (50), Melichrus procumbens (50), Hovea linearis (50)	Gooodenia bellidifolia (75), Pratea purpurascens (75), Lomandra filiformis (75), Themeda australis (50), Poa sieberiana (50)
39	Dry Heathy New England Stringybarks	Eucalyptus cameronii (57), Eucalyptus campanulata (43), Eucalyptus ligustrina (43), Eucalyptus williamsianus (29), Eucalyptus cameronii (29)	Hakea dactyloides (86), Leptospermum trinervium (71), Pimelea linifolia (71), Monotoca scoparia (71), Persoonia rufa (71), Bossiaea neo-anglica (71), Mirbelia speciosa (57), Petrophile canescens (57), Acacia barringtonensis (57)	Entolasia stricta (86), Dianella caerulea (71), Lepidosperma laterale (71), Lomandra longifolia (71), Goodenia hederacea (71), Dampiera stricta (57), Poa sieberiana (57)
40	Dry Heathy Sandstone Blackbutt	E.pilularis (50), Syncarpia glomulifera (50)	Persoonia stradbrokensis (88), Trochocarpa laurina (83), Monotoca scoparia (63), Allocasuarina torulosa (50), Leucopogon lanceolatus (50), Leptospermum polygalifolium (50)	Dianella caerulea (88), Lepidosperma laterale (88), Aristida vagans (75), Entolasia stricta (63), Pomax umbellata (50)

41	Dry Open New England Blackbutt	Eucalyptus campanulata (73)	Leucopogon lanceolatus (70), Lomatia siliaifolia (46), Allocasuarina rigida (45)	Lomandra longifolia (76), Pteridium esculentum (73), Poa sieberiana (70), Hardenbergia violaceous (62), Dianella caerulea (60), Pratea purpurascens (60), Glycine clandestina (58), Themeda australis (58), Viola betonicofolia (56), Imperata cylindrica (54),

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
42	Dry Red Gum-Bloodwood-Apple	Corymbia intermedia (55), Angophora floribunda (55), Eucalyptus tereticornis (55)	Allocasuarina torulosa (82), Breynia oblongifolia (73), Rubus parviflorus (64), Hardenbergia violaceous (55)	Imperata cylindrica (82), Lomandra longifolia (73), Glycine clandestina 973), Hibbertia scandens (64), Sigesbeckia orientalis (55), Petedium esculentum (55), Pratea purpurascens (55), Doodia aspera (55).
43	Dry Silvertop Stringybark-Apple	Angophora subvelutina (58), Eucalyptus laevopinea (42), Eucalyptus tereticornis (42)	Jacksonia scoparia (58), Acacia implexa (50), Allocasuarina torulosa (50)	Themeda australis (92), Desmodium varians (83), Desmodium brachypodum (75), Hardenbergia violaceous (67), Lepidosperma laterale (58), Chrysocephalum apetalum (58)
44	Dry Open RedGum-Broad Leaved Apple	Eucalyptus tereticornis (78), Angophora subvelutina (69), Eucalyptus moluccana (39)	Jacksonia scoparia (69), Rostellularia adscendens (62)	Bidens pilosa (85), Themeda australis (85), Dichondra repens (77), Desmodium brachypodum (77), Cymbopogon refractus (69), Sorghum leiocladum (62), Cheilanthes sieberi ssp sieberi (54), Commelina cyanea (54), Hardenbergia violacea (54), Chrysocephalum apic

47	Redgum - Apple	Eucalyptus tereticornis (83), Angophora subvelutina (50), Corymbia intermedia (43), Eucalyptus siderophloia (33)	Breynia oblonglofilia (53)	Imperata cylindrica (90), Themeda australis (83), Pratea purpurascens (73), Dichondra repens (63), Vernonia cinerea (63), Lomandra longifolia (60), Desmodium rhytidophyllum (60), Hardenbergia violaceous (60), Dianella caerulea (60), Oplismenus aemuls (57)
48	Escarpment Scribbly Gum-Apple	Angophora subvelutina (90), Eucalyptus eugenioides (60), Eucalyptus signata (60)	Allocasuarina torulosa (80), Leucopogon lanceolatus (60), Lomatia silaifolia (60)	Hardenbergia violacea (70), Themeda australis (70), Desmodium rhytidophyllum (70), Desmodium variens (70), Dianella caerulea (70), Glycine clandestina (70), Gonocarpus tetragynus (70), Lomandra longifolia (60), Lomandra filiformis (60)
49	Escarpment Tallowwood-Bloodwood	Eucalyptus microcorys (82), Corymbia intermedia (65), Syncarpia glomulifera (59)	Allocasuarina torulosa (94), Rubus parviflorus (71), Maytenus silvestris (65), Breynia oblongifolia (65), Persoonia linearis (53), Solanum densevestitum (53)	Dianella caerulea (88), Imperata cylindrica (82), Lomandra longifolia (82), Poa sieberiana (82), Hibbertia scandens (77), Desmodium varians (71), Geitonoplesium cymosum (71), Cissus hypoglauca (65), Pratea purpurascens (65), Pteridium esculentum (65), Glycine clandestina (65), Doodia aspera (59), Oplismenus imbecillus (59), Smilax australis (53), Desmodium rhytidophyllum (53), Vernonia cinerea (53)
50	Wet Bangalow-Brush Box	Lophostemon confertus (87)	Archontophoenix cunninghamii (80), Guioa semiglauca (73), Synoum glandulosum (67), Alpinia caerulea (67), Neolitsea dealbata (60), Cordyline petiolaris (60), Citriobatus pauciflorus (53), Diploglottis australis (57), Citriobatus pauciflorus (50), Sarcopteryx stipitata (50), Dendrocnide excelsa (50), Eupomatia laurina (50)	Cissus antarctica (60), Morinda jasminoides (53), Smilax australis (53)

52	Foothill Grey Gum-Ironbark-Spotted Gum	Eucalyptus proprinqua (52), Eucalyptus siderophloia (52), Syncarpia glomulifera (43), Corymbia intermedia (43), Corymbia variegata (38)	Allocasuarina torulosa (86), Breynia oblongifolia (76), Alphitonia excelsa (52), Trochocarpa laurina (52)	Dianella caerulea (1000, Imperata cylindrica (95), Pratea purpurascens (67), Eustrephus latifolius (62), Glycine clandestina (62), Entolasia stricta (62), Lomandra longifolia (62)

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
53	Gorge Grey Box	E. moluccana (63), Corymbia intermedia (50)	Allocasuarina torulosa (75), Jacksonia scoparia (50), Acacia implexa (50)	Cymbopogon refractus (100), Desmodium variens (88), Sigesbeckia orientalis (63), Vernonia cinerea (63), Dichondra repens (63), Themeda australis (63), Hardenbergia violacea (63), Cheilanthes sieberi (50), Desmodium brachyandrum (50) Dianella caerulea (50
54	Grey Box-Red Gum-Grey Ironbark	E. moluccana (89), E.tereticornis (67), E. siderophloia (61), E. propinqua (56)	Lantana camara (67)	Desmodium variens (78), Themeda australis (78), Dichondra repens (72), Oplismenus aemula (72), Pratia purpurescens (72), Geitonoplesium cymosum (67), Cymbopogon refractus (67), Vernonia cinerea (67), Imperata cylindrica (67), Eustrephus latifolius (61)
55	Foothills Grey Gum-Spotted Gum	Eucalyptus propinqua (77), Corymbia variegata (71), Eucalyptus siderophloia (65), Eucalyptus carnea (65), Syncarpia glomulifera (47)	Allocasuarina torulosa (88), Breynia oblongifolia (88), Cissus hypoglauca (59), Cissus antarctica (53)	Dianella caerulea (88), Imperata cylindrica (88), Lantana camara (82), Pratia purpurascens (77), Lomandra longifolia (71), Smilax australis (59), Desmodium variens (59), Geitonoplesium cymosum (59), Entolasia stricta (59), Glycine clandestina (59), Cymbopogon refractus (52)

56	Granite Mallee	Eucalyptus codonocarpa (67)	Persoonia rufa (83), Boronia anethifolia (83), Leptospermum nova-anglica (83), Allocasuarina rigida (67), Phebalium squamulosum (67), Acacia suaveolens (67), Kunzea bracteolata (67), Mirbelia conferta (67), Xanthorrhoea glauca (67)	Entolasia stricta (83), Lepidosperma gunnil (83), Lepidosperma laterale (83), Gahnia sieberiana (83), Stipa scabrosa (67), Lomandra longifolia (67)
57	Highland Granite Stringybarks	Eucalyptus planchoniana (38), Euclayptus codonocarpa (25), Eucalyptus campanulata (25)	Bossiaea neo-anglica (63), Leptospermum trinervium (63), Acacia obtusifolia (63), Callistemon comboynensis (50), Phebalium squamulosum (50), Allocasuarina rigida (50), Persoonia rufa (50), Kunzea bracteolata (50), Boronia anethifolia (50)	Pteredium esculentum (88), Lepidosperma laterale (88), Entolasia stricta (88), Lomandra longifolia (63), Cassytha filiformis (50), Lepidosperma gunnii (50)
58	Gorge Grey Gum	Eucalyptus biturbinata (73), Angophora subvelutina (64), Eucalyptus caliginosa (46)	Hibbertia obtusifolia (73), Allocasuarina littoralis (64	Poa sieberiana (100), Lomandra longifolia (82), Lepidosperma laterale (82), Opercularia hispida (73), Panicum effusum (64), Imperata cylindrica (64),Chrysocephalum apiculatum (64), Themeda australis (55), Dianella revoluta (52), Pomax umbellata (55)
59	Gorge Ironbark-Grey Gum	Eucalyptus siderophloia (53), Eucalyptus proprinqua (47), Eucalyptus microcorys (40), Corymbia intermedia (40), Eucalyptus acmenoides (33)	Allocasuarina torulosa (67), Rubus parviflorus (53)	Imperata cylindrica (73), Eustrephus latifolius (60), Pratea purpurascens (60), Dianella caerulea (53), Desmodium varians (53), Desmodium rhytidophyllum (53).
60	Grassy New England Blackbutt-Tallowwood-Blue Gum forest	Eucalyptus campanulata (90), Eucalyptus microcorys (60), Eucalyptus saligna (55)	Leucopogon lanceolatus (60), Rubus parviflorus (53)	Hibbertia scandens (85), Pteridium esculentum (80), Lomandra longifolia (80), Dianella caerulea (80), Poa sieberiana (68), Imperata cylindrica (60), Hardenbergia violaceous (60), Eustrephus latifolius (60), Viola betonicofolia (58), Desmodium varians (58)

Value	Name	Floristics - Upper (brackets denote percentage frequency)	Floristics - Mid (brackets denote percentage frequency)	Floristics - Lower (brackets denote percentage frequency)
65	Heathy Scribbly Gum forest	Eucalyptus signata (81), Corymbia gummifera (63)	Pimelia linifolia (81), Persoonia stradbrokensis (75), Gompholobium pinnatum (63), Banksia oblongifolia (63), Allocasuarina littoralis (56), Banksia spinulosa (56), Pultenaea myrtoides (56)	Imperata cylindrica (75), Entolasia stricta (75), Lepidosperma lateral (75), Pteridum esculentum (69), Dianella caerulea (63), Glycine clandestina (63), Themeda australis (57)
67	High Elevation Ferny Blackbutt	E. pilularis (90), E. microcorys (88)	Allocasuarina torulosa (86), Trochocarpa laurina (72), Breynia oblongfolia (70), Acacia melanoxylon (52)	Dianella caerulea (88), Hibbertia scandens (81), Pteridium esculentum (74), Lomandra longifolia (70), Calochlaena dubia (70),, Imperata cylindrica (60), Blechnum carilagineum (58)
68	High Elevation Messmate - Brown Barrel	Eucalyptus obliqua (53), Eucalyptus fastigata (46), Eucalyptus nobilis (34)	Leucopogon lanceolatus (69), Acacia melanoxylon (60), Rubus parviflorus (53)	Pteridium esculentum (100), Poa sieberiana (97), Lomandra longifolia (94), Smilax australis (84), Viola hederacea (84), Geranium potentilloides (82), Poranthera microphylla (72), Dichondra repens (69), Glycine clandestina (69), Coprosma quadrifida (63), Hydrocotyle laxiflora (63), Lagenifera stipitata (56), Viola betonicofolia (53), Pratea pedunculata (53), Asperula confertus (53)
69	High Elevation Moist Open Tallowwood-BlueGum	Eucalyptus microcorys (86), Eucalyptus saligna (86), Lophostemon confertus (68).	Synoum glandulosum (73), Psychotria loniceroides (73), Allocasuarina torrulosa (59), Breynia oblongifolia (54), Cryptocarya rigida (54).	Dianella caerulea (82), Hibbertia scandens (64), Lomandra longifolia (64) Blechnum cartilagineum (59), Caloclaena dubia(59), Smilax australis (54), cissus antarcticus (54), Doodia aspera (54), Cissus hypoglauca (54).

70	High Elevation Open Spotted Gum	Eucalyptus microcorys (56), Corymbia variegata (56)	Allocasuarina torulosa (75), Leucopogon lanceolatus (63), Rubus parvifolius (56)	Dianella caerulea (94), Desmodium variens (88), Cymbopogon refractus (88), Viola betonicifolia (88), Pratia purpurascens (75), Vernonia cinerea (75), Desmodium rhytidophyllum (75), Hardenbertia voilacea (59), Imperata cylindrica (69), Billardiera scandens (63), Themeda australis (63), Lomandra longifolia (63), Dichelachne micrantha (56), Hypericum gramineum (56), Desmodium brachypodum (56), Dichondra repens (56)
72	Low Relief Coastal Blackbutt	Corymbia intermedia (80), Eucalyptus resinifera (60), Eucalyptus pilularis (60)	Glochidion ferdinandi (80), Rubus hillii (80), Melaleuca linariifolia (60), Callistemon salignus (60), Breynia oblongifolia (60)	Lomandra longifolia (100), Eustrephus latifolius (80), Pseuderantherum variabile (80), Pratea purpurascens (80), Entolasia marginata (80), Imperata cylindrica (80), Viola hederacea (60), Pteridium esculentum (60), Oplismenus imbecillis (60)
73	Lowland Red Gum.	Lophostemon suaveolens (70), Eucalyptus tereticornis (47), Corymbia intermedia (39), Eucalyptus siderophloia (33)	Alphitonia excelsa (58)	Imperata cylindrica (70), Pratia purpurascens (61), Lomandra longifolia (58), Vernonia cinerea (58), Cymbopogon refractus (58), Themeda australis (52), Entolasia stricta (52)
74	Lowlands Scribbly Gum	Eucalyptus signata (75)	Leptospermum polygalyfolium (50)	Entolasia stricta(58), Dianella caerulea (58), Lomandra longifolia (58), Pteridium esculentum (58)

75	Lowlands Spotted Gum-Box	Corymbia henryi (91), Eucalyptus moluccana (67), Eucalyptus siderophloia (62)	Alphitonia excelsa (86), Acacia concurrens (76)	Aristida vagans (100), Pratia purpurascens (91), Imperata cylindrica (91), Cymbopogon refractus (76), Lomandra multiflora (67), Desmodium rhytidophyllum (67), Eragrostis brownii (62), Goodenia hederacea (62), Cheilanthes sieberi (62), Themeda australis (57), Glycine clandestina (52), Eustrephus latifolius (52), Hardenbergia violacea (52)

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
78	Mann River Wet New England Blackbutt	Eucalyptus campanulata (60)	Synoum glandulosum (80), Rhodamnia rubescens (80), Cryptocarya rigida (80), Shizomeria ovata (60), Psychotria loniceriodes (60), Cordyline stricta (60), Acacia irrorata (60)	Geitonoplesium cymosum (80), Palmeria scandens (80), Smilax australis (60), Tetrastigma nitens (60), Cissus hypoglauca (60), Blechnum cartilagineum (60), Morinda jasminoides (60), Cissus antarctica (60), Lastreopsis decomposita (60), Dianella caerulea (60
80	Manna Gum	Eucalyptus viminalis (50), Eucalyptus obliqua (33), Eucalyptus campanulata (33)	Rubus parviflorus (67), Pimelea curviflora (67)	Glycine clandestina (67), Dichondra repens (67), Galium propinqium (67), Geranium potentilloides (67), Themeda australis (67), Acaena novae-zelandiae (67)
82	Messmate - Mountain Gum Forest	Eucalyptus obliqua (89), Eucalyptus dalrympleana (67), Eucalyptus pauciflora (22)	Dicksonia antarctica (44), Tasmannia purpurascens (33)	Polystichum proliferum (67), Poa sieberiana (89), Pteridium esculentum (78), Smilax australis (56)

83	Mid Elevation Wet Blackbutt	E. pilularis (82), E. microcorys (64), Lophostemon confertus (64), Syncarpia glomulifera (59)	Allocasuarina torulosa (82), Acacia melanoxylon (73), Cyathea australis (68), Synoum glandulosum (64),	Dianella caerulea (82), Lomandra longifolia (68), Blechnum cartilagineum (68), Pteridium esculentum (68), Calochlaena dubia (64), Elaeocarpus reticulatus (64)
84	Mid North Coast Wet Brushbox-Tallowwood-Blue Gum	Lophostemon confertus (79), Eucalyptus microcorys (75), Eucalyptus saligna (65)	Crytocarya rigida (83), Trochocarpa laurina (79), Caldacluvia paniculosa (75), Psychotria loniceroides (75), Elaeocarpus reticulatus (73), Cyathea australis (69), Synoum glandulosum (69), Schizomeria ovata (67), Eupomatia laurina (69) , Citriobatus pauciflorus (58), Pittosporum revolutum (50), Endiandra sieberi (50) Acmena smithii (50).	Blechnum cartilagineum (98), Smilax australis (75), Cissus hypoglauca (63), Cephalaralia cephalobotrys (58) Pandorea pandorana (54), Dianella caerulea (53), Geitonoplesium cymosum (54), Palmeria scandens (52), Lomandra longifolia (52), Cissus antarctica (52), Hibbertia scandens (52).
87	Mixed Tableland Stringybark - Gum Open Forest	Eucalyptus campanulata (50), Eucalyptus obliqua (50), Eucalyptus brunnea (38), Eucalyptus laevopinea (38), Eucalyptus dalrympleana (25), Eucalyptus nobilis (25)	Leucopogon lanceolatus (63), Rubus parviflorus (50)	Lomandra longifolia (100), Pteridium esculentum (100), Viola betonicofolia (88), Poa sieberiana (88), Dichondra repens (75), Glycine clandestina (63), Hardenbergia violaceous (62), Smilax australis (50)
88	Moist Escarpment New England Blackbutt	Eucalyptus campanulata (73), Eucalyptus microcorys (62), Eucalyptus saligna (46)	Trochocarpa (81), Psychotria loniceroides (65), Leucopogon lanceolatus (62), Synoum glandulosum (58), Elaeocarpus reticulatus (58), Cryptocarya rigida (54), Schizomeria ovata (50), Acacia melanoxylon (50)	Lomandra longifolia (89), Pteridium esculentum (73), Dianella caerulea (73), Hibbertia scandens (65), Hibbertia dentata (54), Calochlaena dubia (54), Blechnum cartilagineum (50)
89	Moist Foothills Spotted Gum	Corymbia variegata (76), Lophostemon confertus (65), Eucalyptus microcorys (63), Eucalyptus acmenoides (55), Eucalyptus siderophloia (55), Eucalyptus propinqua (50)	Allocasuarina torulosa (82), Trochocarpa laurina (68), Cissus antarctica (68), Breynia oblongifolia (64), Rubus parvifolius (64), Psychotria loniceroides (59)	Dianella caerulea (96), Imperata cylindrica (82), Doodia aspera (73), Glycine clandestina (68), Lomandra longifolia (68), Cissus hypoglauca (64), Pratia purpurascens (64), Eustrephus latifolius (64), Gymnostachys anceps (59), Hardenbergia violacea (59)

90	Moist Messmate - Gum	Eucalyptus campanulata (79), Eucalyptus obliqua (64), Eucalyptus brunnea (50), Eucalyptus laevopinea (43)	Leucopogon lanceolatus (86), Polyscias sambucifolius (64), Rubus parviflorus (64), Cyathea australis (57), Lomatia siliaifolia (43)	Pteridium esculentum (86), Viola hederacea (79), Lomandra longifolia (79), Viola betonicofolia (71), Pratea purpurascens (71), Glycine clandestina (71), Eustrephus latifolius (71), Dianella caerulea (64), Poa sieberiana (57), Calochlaena dubia (57)
91	Moist Open Escarpment White Mahogany	Eucalyptus microcorys (67), Eucalyptus saligna (63), Eucalyptus acmenoides (50)	Allocasuarina torulosa (77), Rubus parviflorus (57), Persoonia linearis (57), Breynia oblongifolia (53)	Lomandra longifolia (87), Dianella caerulea (80), Desmodium varians (80), Poa sieberiana (70), Imperata cylindrica (70), Hibbertia scandens (67), Glycine clandestina (60), Pteridium esculentum (60), Hardenbergia violaceous (57), Doodia aspera (57)

Value	**Name**	**Floristics - Upper (brackets denote percentage frequency)**	**Floristics - Mid (brackets denote percentage frequency)**	**Floristics - Lower (brackets denote percentage frequency)**
92	Moist Shrubby Stringybark-Gum	Eucalyptus campanulata (74), Eucalyptus brunnea (68), Eucalyptus obliqua (58), Eucalyptus microcorys (52)	Cyathea australis (74), Leucopogon lanceolatus (63), Acacia irrorata (58)	Hibbertia scandens (90), Pteridium esculentum (79), Dianella caerulea (74), Imperata cylindrica (74), Blechnum cartilagineum (74), Poa sieberiana (63), Glycine clandestina (63), Lomandra longifolia (63), Billardiera scandens (58), Viola hederacea (52)
93	Montane Stringybark-Gum forest	Eucalyptus dalrympleana (72), Eucalyptus caliginosa (64)	Banksia integrifolia (86), Acacia filicifolia (86), Rubus parviflorus (72), Leucopogon lanceolatus (72), Monotoca scoparia (72), Hovea linearis (64), Persoonia cornifolia (57), Bossiaea scortechinii (57)	Pteridium esculentum (86), Glycine clandestina (86), Hypochaeris radicata (86), Lomandra filiformis (86), Poa sieberiana (86), Viola betonicofolia (72), Stylidium graminium (72), Imperata cylindrica (72), Themeda australis (64), Billardieria scandens (64)

94	Mountain Gum - Brown Barrel	Eucalyptus dalrympleana (60), Eucalyptus fastigata (50), Eucalyptus obliqua	Polyscias sambucifolia (70), Banksia integrifolia (60), Coprosma quadrifida (60), Leucopogon lanceolatus (60), Acacia melanoxylon (60)	Viola hederacea (90), Poa sieberiana (80), Lomandra longifolia (70), Dianella caerulea (60), Pteredium esculentum (60), Smilax australis (60), Pratea purpurascens (60), Geranium potentilloides (60), Wahlenbergia stricta (60)
95	Northern Moist Blackbutt	E. pilularis (90), E. microcorys (90)	Allocasuarina torulosa (90), Breynia oblongifolia (90)	Imperata cylindrica (90), Entolasia stricta (84), Lomandra longifolia (74), Pteridium esculentum (74), Vernonia cinerea (68), Glycine clandestina (68), Themeda australis (63)
97	Needlbark Stringybark-Large Fruited Blackbutt	E. planchoniana (83), E. pyrocarpa (83), Corymbia gummifera (67), Syncarpia glomulifera (50)	Petrophile cannescens (83), Leptospermum trinervium (83), Bossiaea rhomboidea (63), Leptospermum polygalifolium (67), Banksia oblongifolia (67), Monotoca scoparia (67), Hakea dactyloides (67), Lambertia formosa (67)	Patersonia glabrata (100), Gahnia sieberana (83), Entolasia stricta (67), Persoonia tenuifolia (67), Lomandra filiformis (67)
99	New England Stringybark-Blakelys Red Gum.	Eucalyptus caliginosa (60), Angophora subvelutina (60),Eucalyptus blakelyi (60)	Jacksonia scoparia (60), Melichrus urceolatus (50), Acacia implexa (50)	Cymbopogon refractus (80), Conyza bonariensis (70), Glycine clandestina (70), Bidens pilosa (70), Lomandra filiformis (70), Themeda australis (60), Aristida ramosa (60), Chrysocephalum apiculatum (50)
100	Northern Grassy Sydney Blue Gum	E. saligna (67), E. microcorys (50)	Acacia maidenii (75), Trochocarpa laurina (67), Lophostemon confertus (67), Angophora subvelutina (58)	Lomandra longiflolia (75), Lepidosperma laterale (75), Imperata cylindrica (67), Desmodium variens (67), Oplimenus aemula (67), Dianella caerulea (67), Sorgum leiocladum (58)

101	Northern Open Grassy Blackbutt	E.pilularis (42), Syncarpia glomulifera (42)	Persoonia stradbrokensis (83), Leucopogon lanceolatus (78), Allocasuarina torulosa (56), Glochidion ferdandii (56)	Entolasia stricta (98), Imperata cylindrica (81), Pteridium esculentum (81), Lepidosperma laterale (81), Lomandra longifolia (78), Glycine clandestina (73), Pratia purpurescens (73), Dianella caerulea (71), Panicum simile (68), Themeda australis (66)

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102	Northern Ranges Dry Tallowwood	Eucalyptus microcorys (64), Lophostemon confertus (56), Corymbia intermedia (48), Eucalyptus siderophloia	Breynia oblongofolia (64), Allocasuarina torulosa (48)	Imperata cylindrica (84), Dianella caerulea (72), Smilax australis (72), Geitonoplesium cymosum (68), Themeda australis (64), Hardenbergia violaceous (56), Cissus antarctica (52), Pratea purpurascens (52), Lantana camara (52), Lomandra longifolia (52)
103	Northern Wet Brushbox	Lophostemon confertus (96)	Cryptocarya microneura (79), Alpinia caerulea (79), Synoum glandulosum (79), Eupomatia laurina (79), Cordyline petiolaris (71), Rhodamnia rubescens (68), Citriobatus pauciflorus (64), Polyscias elegans (64), Neolitsea dealbata (64), Croton verrauxii (64),	Cissus antarctica (93), Dioscorea transversa (86), Adiantum formosum (71), Smilax australis (71), Blechnum cartilagineum (68), Geitonoplesium cymosum (64), Dianella caerulea (64), Pseuderanthemum variabile (61), Parsonsia straminea (57),
104	Northern Wet Tallowwood-Blue Gum.	Eucalyptus microcorys (79), Eucalyptus saligna (69), Lophostemon confertus (55).	Synoum glandulosum (50), Alpinia caerulea (81), Guioa semiglauca (74), Neolitsea dealbata (64), Rhodrube (64), Psychotria loniceroides (64), Cryptocarya microneura (64), Trochocarpa laurina (60), Polyscia elegans (55) Eupomatia laurina (52)	Cissus antarctica (86), Smilax australis (76), Dianella caerulea (69), Geitonoplesium cymosum (64), Cissus hypoglauca (64), Diostran???, Adiantum formosum (57), Rubus rosifolius (52).

105	Nymboida Tallowwood-Turpentine	Eucalyptus microcorys (100), Syncarpia glomulifera (70), Eucalyptus acmenoides (50)	Allocasurina torulosa (80), Trochocarpa laurina (80), Psychotria loniceroides (80), Breynia oblongifolia (70), Solanum densevestitum (70), Rhodamnia rubescens (70), Acacia melanoxylon (70), Persoonia media (60), Polyscias elegans (60)	Dianella caerulea (100), Cissus antarctica (90), Hibbertia scandens (80), cissus hypoglauca (80), Lomandra longifolia (70), Smilax australis 970), Pandorea pandorana (70), Venonia cinerea (60), Rubus hillii (60), Oplismenus hirtellus (60), Kennedia rubicunda (60), poa sieberiena (60), Geitonoplesium cymosum (60)
106	Open Coastal Brushbox	Lophostemon confertus (78), Syncarpia glomulifera (64),	Trochocarpa laurina (64), Allocasuarina torulosa (64), Cordyline stricta (61), Wilkea huegeliana (61), Synoum glandulosum (56), Cryptocarya microneura (56)	Smilax australis (70), Dianella caerulea (70), Lomandra longifolia (70), Dioscorea transversa (70), Blechnum cartilagineum (61), Pseuderantherum variabile (58), Morinda jasminoides (58), Doodia aspera (53), Gymnostachys anceps (53), Lantana camara (53)
107	Open Messmate-New England Blackbutt	Eucalyptus campanulata (86), Eucalyptus obliqua (43)	Leucopogon lanceolatus (71)	Lomandra longifolia (79), Smilax australis (71), Dianella caerulea (64), Pteredium esculentum (57), Lepidosperma laterale (57), Pyrossia rupestris (50)
108	Open Ribbon Gum	Eucalyptus nobilis (64), Eucalyptus obliqua (55), Eucalyptus campanulata (55)	Leucopogon lanceolatus (73), Rubus parviflorus (55), Acacia melanoxylon (55)	Pteridium esculentum (100), Poa sieberiana (100), Lomandra longifolia (100), Glycine clandestina (73), Viola betonicifolia (64), Hibbertia scandens (64), Desmodium varians (64), Viola hederacea (64), Wahlenbergia stricta (53), Gonocarpus teucrioides (55)
109	Open Shrubby Brushbox-Tallowwood	Lophostemon confertus (89), E. microcorys (67)	Psychotria loniceroides (78), Synoum glandulosum (67), Trochocarpa laurina (67), Polyscias elegans (67), Allocasuarina torulosa (56)	Dianella caerulea (100), Desmodium variens (67), Imperata cylindrica (67), Doodia aspera (56)

110	Open Silvertop Stringybark - Blue Gum	Eucalyptus laevopinea (74), Eucalyptus saligna (57)	Rubus parviflorus (64)	Lomandra longifolia (92), Pteridium esculentum (87), Glycine clandestina (82), Desmodium varians (77), Dianella caerulea (74), Poa labillardieria (69), Acaena novae-zelandiae (67), Dichondra repens (67), Hibbertia scandens (64), Pratea purpurascens (64),

Value	Name	Floristics - Upper (brackets denote percentage frequency)	Floristics - Mid (brackets denote percentage frequency)	Floristics - Lower (brackets denote percentage frequency)
111	Open Silvertop Stringybark-Tallowwood	Eucalyptus laevopinea (56), Eucalyptus microcorys (44)	Rubus parviflorus (67), Cyathea australis (56), Breynia oblonglifolia (56), Polyscias sambucifolia (56)	Desmodium varians (78), Eustrephus latifolius (78), Viola hederacea (67), Hibbertia scandens (67), Dianella caerulea (67), Poa sieberiana (67), Pratea purpurascens (67), Sigesbeckia orientalis (56), Smilax australis (56), Hibbertia dentata (56), Glycine clandestina (56), Pteridium esculentum (56), Imperata cylindrica (56), Blechnum cartilagineum (56), Lomandra longifolia (56)
118	Richmond Range Spotted Gum	Corymbia variegata (100), Eucalyptus siderophloia (83), Eucalyptuspropinqua (83), Eucalyptus molucanna (67(	Alxyia ruscifolia (83), Breynia oblongifolia (83), Alectryon subcinereus (67), Maytenus bilocularis (67)	Eustrephus latifolius (83), Cissus antarctica (67), Pratea purpurascens (67), Pandorea pandorana (67)
119	Richmond Range Spotted Gum-Box	Eucalyptus moluccana (63), Eucalyptus propinqua (50), Corymbia variegata (72)	Breynia oblongifolia (88), Lantana camara (88), Alphitonia excelsa (63)	Themeda australis (88), Lepidosperma laterale (63), Oplimenus aemula (63), Pratia purpurascens (63), Eustrephus latifolius (63), Dianella caerulea (62), Imperata cylindrica (62)
126	Sandstone Spotted Gum-Blackbutt	Eucalyptus pilularis (100), Corymbia henryi (50), Eucalyptus siderophloia (40), Corymbia intermedia (40)	Persoonia stradbrokensis (80), Allocasuarina torulosa (70), Acacia concurrens (70), Jacksonia scoparia (70), Pimelea linifolia (60), Alphitonia excelsa (60)	Dianella caerulea (90), Themeda australis (90), Hardenbergia violacea (70), Imperata cylindrica (70), Cymbopogon refractus (70), Desmodium rhytidophyllum (60), Lepidosperma laterale (60), Pratia purpurascens (60), Entolasia stricta (80), Laxmania gracilis (70)

127	Sherwood Needlebark Stringybark	E.planchoniana (80), Corymbia gummifera (60)	Hakea dactyloides (80), Banksia oblongifolia (80), Persoonia stradbrokensis (80), Leptospermum trinervium (80), Petrophile cannescens (60), Lambertia formosus (60), Xanthorrhoea latifolia (60), Boronia rosmarinifolia (60)	Melichrus procumbens (80), Hibbertia vestita (80), Entolasia stricta (80), Persoonia tenuifolia (60), Themeda australis (60)
134	South Coast Shrubby Grey Gum	Eucalyptus propinqua (67), Eucalyptus microcorys (61), Syncarpia glomulifera (44), Eucalyptus acmenoides (44)	Allocasuarina torulosa (83), Breynia oblongifolia (83), Maytenus silvestris (78), Persoonia linearis (61), Polyscias sambucifolia (56), Acacia maidenii (56)	Dianella caerulea (94), Lomandra longifolia (78), Imperata cylindrica (78), Pratia purpurascens (78), Desmodium varians (78), Pseuderantherum variabilie (72), Geitonoplesium cymosum (72), Poa labillardieri (67), Vernonia cinerea (61), Billardieria scandens (61), gymnostachys anceps (61), Entolasia marginata (61), Hibbertia scandens (56), Oplismenus imbecillus (56), Lepidosperma laterale (56)
135	South Coast Tallowwood-Blue Gum	Eucalyptus microcorys (74), Lophostemon confertus (74), Eucalyptus saligna (67), Syncarpia glomulifera (52), Eucalyptus acmenoides (48)	Synoum glandulosum (78), Breynia oblongifolia (74), Allocasuarina torulosa (70), Cryptocarya microneura (63), Cordyline stricta (63), Psychotria loniceroides (63), Rubus hillii (59), Trochocarpa laurina (56), Citriobatus pauciflorus (56), Cryptocarya rigi, Cryptocarya rigida (56), Rhodamnia rubescens (52)	Smilax australis (93), Dioscorea transversa (89), Cissus antarctica (83), Blechnum cartilagineum (78), Lomandra longifolia (78), Dianella caerulea (70), Pseuderantherum variabile (70), Doodia aspera (70), Gymnostachys anceps (67), Oplismenus imbecilus (63, Geitonoplesium cymosum (63), Lastreopsis decomposita (56)

137	Southern Wet Sydney Blue Gum	Eucalyptus saligna (74)	Guioa semiglauca (61), Citriobatus pauciflorus (74), Dioscorea transversa (61), Acmena smithii (61), Diospyros australis (61), Synoum glandulosum (57), Psychotria loniceroides (52), Eupomatia laurina (52), Cryptocarya glaucescens (52), Cryptocarya microneura (52)	Lomandra spicata (52), Cissus antarctica (70), Cissus hypoglauca (61) Smilax australis (61), Parsonsia straminea (51).

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139	Stringybark-Apple	Angophora subvelutina (57), Eucalyptus eugeniodes (50)	Breynia oblongifolia (64), Rubus parviflorus (50)	Pratea purpurascens (71), Dichondra repens (64), Microlaena stipoides (57), Desmodium varians (57), Imperata cylindrica (50), Cymbopogon refractus (50), Bidens pilosa (50), Adianthum aethiopicum (50)
140	Stringybark-Mallee	Eucalyptus codonocarpa (50), Eucalyptus cameronii (33), Eucalyptus campanulata (33)	Persoonia cornifolia (67), Mirbelia rubiifolia (67), Kunzea bracteolata (67), Leucopogon neo-anglica (67), Leucopogon microphylla (67), Leptospermum nova-anglica (67), Acacia brunoniodes (67), Laxmannia compacta (67), Boronia anethifolia (67)	Entolasia stricta (100), Lepidosperma laterale (100), Schoenus melanostachys (67), Lepidosperma gunnii (67), Aristida ramosa (67), Trachymene incisa (67), Calytrix tetragona (67), Cassytha filiformis (67), Callistemon comboynensis (67)
148	Very wet New England Blackbutt - Tallowwood	Eucalyptus campanulata (65), Eucalyptus microcorys (42)	Synoum glandulosum (77), Elaeocarpus reticulatus (71), Cyathea australis (65), Endiandra sieberi (65), Orites excelsa (53), Allocasuarina torulosa (53), Trochocarpa laurina (53), Caldcluvia paniculata (53), Tasmannia insipida (47), Schizomeria ovata (47),	Dianella caerulea (65), Blechnum cartilagineum (65), Lomandra longifolia (65), Gymnostachys anceps (53), Smilax glyciphylla (53), Palmeria scandens (53), Calochlaena dubia (47)

149	Mallee-Peppermint mosaic	Eucalyptus codonocarpa (58), Eucalyptus acaciaformis (50)	Acacia ulicifolia (75), Leptospermum nova-anglica (75), Leucopogon neo-anglica (67), Acacia falcata (67), Dillwynia phylicoides (67), Hovea sp. A, Kunzea obovata (67),	
150	Washpool Brushbox-Tallowwood	Lophostemon confertus (80), Eucalyptus microcorys (70)	Trochocarpa laurina (90), Psychotria loniceroides (80), Synoum glandulosum (80), Cryptocarya rigida (80), Archontophoenix cunninghamii (70), Caldcluvia paniculosa (70), Archirhodimyrtus beckleri (60), Schizomerizia ovata (60), Cyathea australis (60), Elaeocarpus reticulatud (60)	Dianella caerulea (90), Blechnum cartilagineum (90), Geitonoplesium cymosum (80), Hibbertia scandens (80), Gymnostachyes anceps (80), Cissus antartica (80), Smilax australis (70), Cissus hypoglauca (70), Cephalaralia cehpalobotrys (60)
152	Wet Bloodwood-Tallowwood	Corymbia intermedia (77), Eucalyptus microcorys (69), Lophostemon confertus (54), Eucalyptus siderophloia (50), Eucalyptus acmenoides (50), Eucalyptus propinqua (39)	Lantana camara (85), Alpinia caerulea (81), Euroschinus falcatus (77), Polyscias elegans (73), Guioa semiglauca (69), Trochocarpa laurina (65), Rhodamnia rubescens (65), Psychotria daphnoides (65), Breynia oblongifolia (62), Allocasuarina torulosa (62), Cryptocarya microneura (58), Citriobatus pauciflorus (58)	Smilax australis (96), cissus antarctica (89), Dianella caerulea (81), Cissus hypoglauca (73), Geitonoplesium cymosum (69), Eustrephus latifolius (69), Imperata cylindrica (65), Celastrus subspicatus (65), Lomandra longifolia (65), Doodia aspera (58)
153	Wet Coastal Tallowwood-Brushbox	E. microcorys (85), Lophostemon confertus (77) E.pilularis (69), Syncarpia glomulifera (62)	Allocasuarina torulosa (69), Synoum glandulosum (54), Trochocarpa laurina (54), Cordyline stricta (54), Notelaea longifolia (54), Archirhodomyrtus beckleri (54), Elaeocarpus reticulatus (54)	Lomandra longifolia (69), Blechnum cartilagineum (62), Calochlaena dubia (62), Pteridium esculentum (62), Imperata cylindrica (62), Themeda australis (54)

154	Wet Flooded Gum-Tallowwood	Eucalyptus grandis (88), Eucalyptus microcorys (75), Lophostemon confertus (69), Syncarpia glomulifera (63)	Wilkiea huegeliana (82), Lantana camara (82), Cordyline stricta (82), Cryptocarya rigida (82), Archontophoenix cunninghamiana (75), Guioa semiglauca (75), Acmena smithii (75), Synoum glandulosum (69), Cryptocarya microneura (69), Trochocarpa laurina (69),	Dioscorea transversa (94), Morinda jasminoides (82), Blechnum cartilagineum (82), Cissus hypoglauca (75), Dianella caerulea (75), Smilax australis (69), Smilax glyciphylla (65), Hibbertia scandens (63)

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155	Wet Foothills Blackbutt-Turpentine	Eucalyptus pilularis (91), Syncarpia glomulifera (86), Eucalyptus microcorys (81), Lophostemon confertus (74)	Allocasuarina torulosa (95), Elaeocarpus reticulatus (70), Breynia oblongifolia (67), Archirhodimyrtus beckleri (65), Synoum glandulosum (63), Cordyline stricta (61), Trochocarpa laurina (61), Alpinia caerulea (58), Polyscias sambucifolia (54), Psychotria loniceroides (54), Cyathea australis (51), Persoonia media (51)	Hibbertia scandens (81), Dianella caerulea (79), Cissus hypoglauca (74), Smilax australis (72), Calochlaena dubia (72), Blechnum cartilagineum (70), Pteridium esculentum (67), Dioscorea transversa (65), Lomandra longifolia (58)
156	Wet New England Blackbutt-Silvertop Stringybark	Eucalytpus campanulata (67), Eucalyptus laevopinea (56), Eucalyptus saligna (44)	Synoum glandulosum (78), Trochocarpa laurina (67), Cryptocarya rigida (67), Cryptocarya glaucescens (56), Acmena smithii (56), Psychotria loniceroides (56), Elaeocarpus reticulatus (56)	Lomandra longifolia (100), Geitonoplesium cymosum (78), Gymnostachys anceps (67), Cissus hypoglauca (67), Hibbertia dentata (67), Dianella caerulea (56), Senecio amygdalyfolius (56), Pteridium esculentum (56), Blechnum cartilagineum (56), Parsonsia straminea (56), Calochlaena dubia (56)

157	Wet Shrubby Brushbox-Tallowwood	Lophostemon confertus (84), Eucalyptus microcorys (50), Eucalyptus saligna (41)	Eupomatia laurina (72), Synoum glandulosum (72), Cryptocarya rigida (69), Psychotria loniceroides (60), Caldcluvia paniculosa (60), Trochocarpa laurina (56), Shizomeria ovata (56), Asplenium australasicum (53), Cryptocarya microneura (53)	Smilax australis (69), Blechnum cartilagineum (69), Dianella caerulea (69), Morinda jasminoides (63), Cissus antarctica (63), Palmeria scandens (60), Doodia aspera (60), Cissus hypoglauca (56).
158	Wet Spotted Gum-Tallowwood	Eucalyptus microcorys (60), Eucalyptus acmenoides (55), Corymbia variegata (50), Lophostemon confertus (40)	Trochocarpa laurina (95), Psychotria loniceroides (85), Livistona australis (85), Cissus antarctica (75), Alpinia caerulea (75), Rhodamnia rubuscens (70), Celastrus subspicatus (65), Guioa semiglauca (65), Breynia oblongifolia (60), Rapania variabilis(60), Acacia irrorata (60), Synoum glandulosum (55)	Dianella caerulea (100), Hibbertia scandens (95), Solanum densevenstitum (95), Pratia purpurascens (85), Desmodium variens (85), Sigesbeckia orientalis (85), Glycine clandestina (85), Eustrephus latifolius (80), Imperata cylindrica (80), Pseuderanthemum variabile (75), Oplimenus aemula (65), Hydrocotyle peduncularis (65), Desmodium rhytidophyllum (65), Adiantum formosum (60), Cayratia clematidea (80)
174	Orange Gum - Tumbledown Gum - Apple	Eucalyptus prava, Eucalyptus dealbata, Angophora floribunda, Callitris endlicheri	Acacia leiocarpa, Melichrus urceolata, Olearia elliptica, Ozothamnus obcordatus, Prostanthera nivea, Calytrix tetragona, Olearia viscidula, Persoonia cornifolia, Acacia neriifolia, Cryptandra amara	Isotoma anethifolia, Brachyloma daphnoides, Brachycome stuartii, Stypandra glauca, Danthonia monticola, Dichelachne micrantha, Lomandra longifolia, Eragrostis leptostachyus
175	Orange Gum - New England Blackbutt - Tumbledown Gum	Eucalyptus andrewsii, Eucalyptus prava, Eucalyptus dealbata, Callitris endlicheri	Acacia neriifolia, Cassinia quinquefaria, Persoonia cornifolia, Leucopogon melaleucoides, Leucopogon neo-anglicus, Kunzea obovata, Xanthorrhea johnsonii, Leptospermum nova-anglica, Prostanthera nivea, Calytrix tetragona, Cryptandra amara	Cymbopogon refractrus, Dianella caerulea, Entolasia stricta, Dianella revoluta, Pomax umbellata, Gahnia aspera, Brachycome stuartii, Danthonia moticola, Stypandra glauca

176	Orange Gum - Ironbark	Eucalyptus caleyi ssp ovendii, Eucalyptus prava, Callitris endlicheri	Hibbertia acicularis, Acacia pruinosa, Allocasuarina brachystachya, Prostanthera nivea, Cryptandra amara, Calytrix tetragona, Leptospermum nova-anglica, Leucopogon neo-anglicus, Kunzea obovata, Acacia torringtonensis, Mirbelia speciosa, Babingtonia densifolia, Hibbertia riparia, Xanthorrhea johnsonii, Phebalium rotundifolium	Goodenia bellidifolia, Entolasia stricta, Aotus subglauca, Tripogon loliiformis, Pterosytlis daintreana, Laxmannia complanata, Trachymene incisa
177	Outcrop Orange Gum - New England Blackbutt	Eucalyptus andrewsii, Eucalyptus prava, Callitris endlicheri	Hovea lanceolata, Dodonea hirsuta, Calytrix tetragona, Leptospermum novae-angliae, Persoonia cornifolia, Leptospermum trinervium, Leucopogon neo-anglicus, Kunzea bracteolata, Leucopogon melaleucoides, Prostanthera staurophylla, Phebalium rotundifolium, Acacia viscidula, Leucopogon microphyllus, Mirbelia speciosa, Monotoca scoparia, Hibbertia sp B, Leucopogon biflorus, Zieria laevigata, Babbingtonia densifolia	Stylidium laricifolium, Lepidosperma laterale, Brachyloma saxicola, Micromyrtus sessilis, Tracymene incisa, Brachycome stuartii, Tripogon loliiformis, Entolasia stricta, Aristida jerichoensis, Cheilanthes sieberi, Lomandra longifolia, Dianella revoluta, Digitaria breviglumis

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178	Outcrop Black Cypress - Tumbledown Gum	Eucalyptus dealbata, Eucalyptus prava, Callitris endlicheri	Acacia triptera, Babingtonia densifolia, Acacia granitica, Prostanthera nivea, Eriostemon myoporoides, Leucopogon neo-anglicus, Leucopogon melaleucoides, Homoranthus prolixus	Paspalidium constrictum, Brachycome stuartii, Tropogon loliiformis, Cheilanthes sieberi, Fimbristylis dichotoma, Commelina cyanea, Lepidosperma laterale, Trachymene incisa, Eragrostis brownii, Entolasia stricta, Lobelia gracilis, Laxmania complanatas
179	Yellow Box - Broad-leaved Stringybark	Eucalyptus melliodora, Eucalyptus caliginosa, Eucalyptus dalrympleana, Eucalyptus andrewsii	Allocasuarina littoralis, Lomatia siliaifolia, Leucopogon muticus, Hovea linearis, Monotoca scoparia, Xanthorrhea johnsonni, Leucopogon melaleucoides, Persoonia cornifolia, Hibbertia obtusifolia, Acacia fimbriata, Melichrus urceolatus, Leucopogon lanceolatus	Poa sieberiana, Dianella caerulea, Goodenia hederacea, Dichondra repens, Glycine clandestina, Poranthera microphylla, Viola betonicofolia, Lagenifera stipitata, Pteridium esculentum, Lomandra multiflora, Oxalis perennans, Paspalidium constrictum, Lepidosperma laterale, Lomandra filiformis, Caustis flexuosa, Patersonia sericea, Imperata cylindrica, Billardieria scandens, Opercularia hispidula, Goodenia bellidifolia, Gahnia aspera, Dichelachne micrantha
180	Western New England Blackbutt	Eucalyptus andrewsii	Grevillea linearifolia, Dillwynia phylicoides, Pultenea stuartiana, Persoonia tenuifolia, Petrophile canescens, Melichrus procumbens, Monotoca scoparia, Leucopogon melaleucoides, Persoonia cornifolia, Leptospermum trinervium, Xanthorrhea johnsonii	Dampiera stricta, Causis flexuosus, Patersonia sericea, Platysace ericoides, Aotus subglauca, Entolasia stricta, Brachyloma dahpnoides, Dichelachne micrantha

181	Stringybark - Gum	Eucalyptus laevopinea, Eucalyptus brunnea, Eucalyptus andrewsii	Persoonia sericea, Xanthorrhea johnsonii, Leucopogon lanceolatus, Monotoca scoparia, Leptospermum trinervium, Melichrus urceolatus, Melichrus procumbens, Leucopogon melaleucoides, Petrophile canescens, Persoonia cornifolia, Hibbertia obtusifolia, Lomatia siliaifolia, Acacia buxifolia, Acacia fimbriata	Aotus subglauca, Billardiera scandens, Lomandra multiflora, Themeda australis, Glycine clandestina, Poranthera microphylla, Caustis flexuosa, Entolasia stricta, Imperata cylindrica, Opercularia aspera, Aristida jerichoensis, Lepidosperma laterale, patersonia sericea, Styphelia triflora, Lomandra longifolia, Gonocarpus tetragona, Indigofera australis, Trachymene incisa, Phyllanthus hirtellus, Chionochloa pallida, Goodenia hederacea, Opercularia hispida, Lomandra confertifolia, Dianella revoluta, Pteridium esculentum, hardenbergia violaceus, Dichelachne micrantha
182	Apple - Black Cypress	Callitris endlicheri, Eucalyptus prava, Angophora floribunda, Eucalyptus subtilior	Leucopogon attenuatus, Hibbertia obtusifolia, Melichrus urceolatus, Acacia buxifolia, Xanthorrhea johnsonii, Leucopogon muticus, Monotoca scoparia, Leptospermum trinervium, Cassinia quinquefaria, Lomatia siliaifolia, Persoonia cornifolia, Acacia venulosa	Dianella revoluta, Eragrostis brownii, Cheilanthes sieberi, Aristida jerichoensis, Schoenus apogon, Imperata cylindrica, Gonocarpus tetragona, Lepidosperma laterale, Styphelia triflora, Lomandra longifolia, Trachymene incisa, laxmannia complanata, Echinopogon caespitosus, Patersonia sericea, Entolasia stricta, Cymbopogon refractus, Billardiera scandens

183	Red Gum - Apple	Eucalyptus blakelyi, Angophora floribunda, Callitris endlicheri	Leptospermum brevipes, Leucopogon muticus	Poa sieberiana, Trachymene incisa, Lomandra longifolia, Cyperus sanguinolentus, Desmodium varians, Dichonra repens, Entolasia stricta, Juncus continuus, Imperata cylindrica, Microlaena stipoides, Gonocarpus micranthus, Glycine clandestina, Viola betonicofolia, Arundinella nepalensis, Pteridium esculentum, Carex gaudichaudiana, Lepidosperma laterale, Gahnia aspera, Hydrocotyle pedunculata, Adianthum aethiopicum, Junus usitatus, Paspalum dilatatum, Viola hederacea, Echinopogon caespitosus, Isotoma fluviatilus
184	Tumbledown Gum - Ironbark	Eucalyptus dealbata, Eucalyptus caleyi, Angophora floribunda, Eucalyptus laevopinea, Callitris endlicheri, Eucalyptus prava	Cassinia quinquefaria, Melichrus urceolatus, Phyllanthus virgatus, Acacia burbidgeae, Acacia penninervis, Acacia neriifolia, Leucopogon muticus, Xanthorrhea johnsonni, Hovea lanceolata, Hibbertia sp B, Hibbertia obtusifolia, Jacksonia scoparia	Glycine clandestina, Desmodium brachypodum, Laxmannia complanata, Lomandra confertifolia, Pomax umbellata, Oxalis perennans, Patersonia sericea, Panicum simile, Cymbopogon refractus, Lomandra multiflora, Cheilanthes sieberi, Lepidosperma laterale, Entolasia stricta, Eragrostis brownii, Digitaria ramularis, Opercularia hispida, Stylidium laricifolium, Commelina cyanea, Aristida jerichoensis, Dianella revoluta, Gahnia aspera, Dichelachne micrantha

185	Orange Gum - Black Cypress	Eucalyptus prava, Callitris endlicheri	Acacia penninervis, Hovea lanceolatus, Leptospermum trinervium, Acacia torringtonensis, Leucopogon attenuatus, Leucopogon melaleucoides, Melichrus urceolatus, Hibbertia sp B, Xanthorrhea johnsonii, Mirbelia speciosas, Pultenea stuartiana, Persoonia terminalis	Tripogon loliiformis, Aristida jerichoensis, Lobelia gracilis, Entolasia stricta, Brachyloma daphnoides, Digitaria breviglumis, Styphelia triflora, Stylidium laricifolium, Lepidosperma laterale, Lomandra confertifolia, Dianella revoluta, Hardenbergia violaceus, Isotoma anethifolia, Cheilanthes sieberi, Laxmannia complanata, Pomax umbellata

Value	Name	Floristics - Upper (brackets denote percentage frequency)	Floristics - Mid (brackets denote percentage frequency)	Floristics - Lower (brackets denote percentage frequency)
186	Open Tumbledown Gum - Black Cypress - Orange Gum	Eucalyptus dealbata, Eucalyptus prava, Eucalyptus crebra, Callitris endlicheri, Angophora floribunda, Eucalyptus youmanni	Acacia neriifolia, Lissanthe strigosa, Persoonia cornifolia, Hibbertia obtusifolia, Melichrus urceolatus, Leucopogon muticus, Leucopogon melaleucoides, Cassinia quinquefaria, Olearia elliptica	Desmodium varians, Cheilanthes sieberi, Echiniopogon caespitosus, Geranium solanderi, Glycine clandestina, Paspalidium constrictum, Lepidsperma laterale, Hardenbergia violaceus, Aristida jerichoensis, Lomandra multiflora, Pomax umbellata, Cymbopogon refractus, Brachyloma daphnoides, Opercularia aspera
189	Silvertopped Ironbark - Cypress	Callitris glauca, Eucalytpus melanophloia, Eucalyptus dealbata, Eucalyptus albens	Bursaria spinosa, Leucopogon muticus, Cassinia quinquefaria, Hibbertia obtusifolia, Notelea microcarpa, Melichrus urceolatus	Desmodium brachypodium, Cheilanthes distans, Lomandra filiformis, Cyperus gracilus, Poa sieberiana, Glycine tabacina, Dianella revoluta, Aristida ramosissima, Chrysocephalum apiculatum, Calotus lappulaceus, Dichondra repens, Panicum effluens, Dichelachne micrantha, Bothriochloa macra, Desmodium varians, Echinopogon ovatus, Glycine clandestina, Cheilanthes sieberi, Cymbopogon refractus
190	Yellow Box - Grey Box - Red Gum	Eucalytpus blakelyi, Eucalyptus melliodora, Eucalyptus moluccana, Angophora floribunda	Lissanthe strigosa, Acacia implexa, Cassinia quinquefaria, Notelea microcarpa, Rubus parviflorus	Poa sieberiana, Asperula conferta, Dichondra repens, Echinopogon ovatus, Glycine clandestina, Desmodium brachypodium, Glycine tabacina, Sorghum leiocladum, cymbopogon refractus, Aristida ramosissima, Echinopogon caespitosus, Themeda australis, Dichelachne micrantha, Chrysocephalum apiculatum

194	Roundleaved Gum wet heath	Eucalyptus brunnea	Hibbertia riparia, Leptospermum arachnoides, Baeckea sp C, Banksia cunninghamii, Pultenea stuartiana, Persoonia cornifolia, Leptospermum polygalifolium, Epacris microphylla, Boronia polygalifolia, Grevillea linearifolia, Xanthorrhea johnsonii, Boronia algida, Petrophile canescens	Dichondra repends, Trachymene incisa, Tricoryne elatior, Deyeuxia imbricata, Aristida jerichoensis, Entolasia stricta, Juncus continuus, Eremochloa bimaculata, Gonocarpus micranthus, Dampiera stricta, Themeda australis, Ptilothrix deusta, Goodenia bellidifolia, Schoenus apogon, Lepyrodia leptocaulis, Xyris gracilis, Chionochloa pallida
195	Apple - Manna Gum woodland	Eucalyptus viminalis, Angophora floribunda, Eucalyptus melliodora		Poa sieberiana, Sporobolus creba, Cirsium vulgare, Dichelachne sericea, Phalaris aquatic, Bothriochloa macra, Gerandium solanderi, Aristida ramosissima, Trifolium repens, Danthonia racemosa, Dichondra repens, Lomandra filiformis, Asperula confertus, Desmodium varians, Microlaena stipoides, Elymus scaber, Sclerus biflorus, Rumex brownii, Carex gaudichaudiana
196	Broad-leaved Stringybark - Apple Box	Eucalyptus caliginosa, Eucalyptus dalrympleana, Euclayptus bridgesiana	Hibbertia obtusifolia, Melichrus urceolatus,	Danthonia racemorsa, Bothriochloa macra, Goodenia bellidifolia, Lomandra filiformis, Elymus scaber, Microlaena stipoides, Poa sieberiana, Desmodium varians, Brachyloma daphnoides, Dichondra repens, Gonocarpus tetragona

197	Broad-leaved Stringybark	Eucalytpus caliginosa	Lissanthe strigosa	Acaena nova-zellandiae, Hyrdocotyle laxiflora, Trifolium repens,Taraxacum officianalis, Scleria biflorus, Poa sieberiana, Desmodium varians, Dichondra repens, Geranium solanderi, Veronica calycina, Viola betonicofolia, Poranthera microphylla, Glycine clandestina, Pteridium esculentum, hypericum gramineum, Dichelachne micrantha, Themeda australis
198	Silvertop Stringybark	Eucalyptus laevopinea, Eucalyptus melliodora, Eucalyptus dalrympleana, Angophora floribunda	Bursaria spinosa, Lissanthe strigosa, Acacia dealbata	Elymus scaber, Acaena Poa sieberiana, Dichondra repens, Glycine clandestina, Veronica calycina, Desmodium varians, Geranium solanderi,
199	Riparian shrubland	Eucalyptus nova-anglica, Eucalyptus pauciflora	Hakea microcarpa, Leptospermum polygalifolium	Carex gaudichaudiana, Adiantum aethiopicum, Lomandra longifolia, Poa labillardieri, Myriophyllum variifolium, Epilobium billardierianum
200	Broad-leaved Stringybark - Ribbon Gum	Eucalyptus nobilis, Eucalyptus caliginosa, Eucalytpus radiata, Banksia integrifolia	Persoonia cornifolia, Leucopogon lanceolatus, Montoca scoparia, Bursaria spinosa, Acacia filicifolia, Lomatia silaifolia	Pteridium esculentum, Gonocarpus tetragynus, Rubus parvifolius, Wahlenbergia stricta, Glycine clandestina, Goodenia hederacea, Poa sieberiana, Poranthera microphylla, Imperata cylindrica, Dichelachne micrantha, Desmodium varians, Dichondra repens, Geranium solanderi, Lomandra longifolia, Themeda australis

10. APPENDIX TWO

FOREST ECOSYSTEMS WHICH OCCUR IN THE UPPER NORTH EAST AND LOWER NORTH EAST CRA REGIONS

Pre-1750 and Extant Ecosystem Distributions in the Upper North East CRA Region

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
2	Alpine Gum	4167	1329	68
3	Baileys Stringybark	46722	34931	25
5	Banksia	7598	2046	73
10	Black Sallee	NA	6	NA
12	Blue Mountain Ash	NA	121	NA
14	Brown Barrell	401	166	59
15	Brown Barrell-Gum	2602	1004	61
16	Bull Oak	NA	2	NA
17	Candlebark	10200	1961	81
18	Casuarina Woodland	NA	43	NA
19	Central Mid Elevation Sydney Blue Gum	12591	6786	46
20	Clarence Lowland Needlebark Stringybark	12496	10817	13
21	Lowlands Grey Box	61798	23913	61
22	Coast Cypress Pine	NA	82	NA
23	Coast Range Bloodwood-Mahogany	18056	5919	67
24	Clarence Lowlands Spotted Gum	344000	174787	49
25	Coast Range Spotted Gum-Blackbutt	885	743	16
26	Coastal Flooded Gum	14921	9426	37
27	Coastal Sands Blackbutt	4518	3101	31
29	Corkwood-Crabapple and Mixed Stringybarks	7149	6093	15
30	Diehard Stringybark-New England Blackbutt	2773	1062	62
31	Dorrigo White Gum	3853	3385	12
32	Dry Foothills Blackbutt-Turpentine	9370	7364	21
33	Dry Foothills Spotted Gum	97714	90829	7

34	Dry Grassy Blackbutt-Tallowwood	9880	6052	39
35	Dry Grassy Stringybark	87820	69987	20
36	Dry Grassy Tallowwood-Grey Gum	9726	5564	43
37	Dry Heathy Blackbutt-Bloodwood	75583	46630	38
38	Dry Heathy New England Blackbutt	4580	4276	7
39	Dry Heathy New England Stringybarks	NA	1178	NA
40	Dry Heathy Sandstone Blackbutt	20940	19036	9

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
41	Dry Open New England Blackbutt	219286	121339	45
42	Dry Redgum-Bloodwood-Apple	245	243	1
43	Dry Silvertop Stringybark-Apple	15059	13041	13
44	Dry open Redgum-Broad Leaved Apple	11330	10484	7
45	Dunns White Gum	1453	975	33
46	Eastern Red Gums	NA	3002	NA
47	Escarpment Redgum	55910	28206	50
48	Escarpment Scribbly Gum-Apple	5871	5488	7
50	Wet Bangalow-Brushbox	16193	10098	38
52	Foothill Grey Gum-Ironbark-Spotted Gum	59397	46753	21
53	Gorge Grey Box	12259	11147	9
54	Grey Box-Red Gum-Grey Ironbark	38417	20438	47
55	Foothills Grey Gum-Spotted Gum	10634	8685	18
56	Granite Mallee	1951	1887	3
57	Highland Granite Stringybarks	2713	2483	8
58	Gorge Grey Gum	6218	5532	11
59	Gorge Ironbark-Grey Gum	74798	63226	15
60	Grassy New England Blackbutt-Tallowwood-Blue Gum	46952	40245	14
61	Grey Box-Ironbark	146	131	10
62	Grey Box-Northern Grey Gum	1625	509	69
63	Grey Gum-Stringybark	14033	12810	9
64	Heath	NA	9805	NA
65	Heathy Scribbly Gum	10544	7758	26
66	Herbfield and Fjaeldmark	NA	68	NA
67	High Elevation Ferny Blackbutt	12235	10462	14
68	High Elevation Messmate-Brown Barrell	1932	329	83

69	High Elevation Moist Open Tallowwood-Blue Gum	4003	3533	12
70	High Elevation Open Spotted Gum	61596	50005	19
71	Ironbark	24668	7713	69
72	Low Relief Coastal Blackbutt	1574	859	45
73	Lowland Red Gum	141161	57016	60
74	Lowlands Scribbly Gum	6789	3496	49

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
75	Lowlands Spotted Gum-Box	37107	19737	47
76	Coastal Mallee	2513	1412	44
77	Mangrove	NA	734	NA
78	Mann River Wet New England Blackbutt	5139	5132	0
79	Manna Gum-Stringybark	95	90	5
80	Manna Gum	5477	1287	77
81	Messmate	17002	6309	63
83	Mid Elevation Wet Blackbutt	1333	1180	11
84	Mid North Coast Wet Brushbox-Tallowwood-Blue Gum	12744	10378	19
85	Mixed Moist Hardwood	818	346	58
86	Mixed New England Stringybarks	3320	3002	10
87	Mixed Tableland Stringybark-Gum OpenForest	13471	4694	65
88	Moist Escarpment New England Blackbutt	10354	10275	1
89	Moist Foothills Spotted Gum	37545	35657	5
90	Moist Messmate-Gum	30214	25159	17
91	Moist Open Escarpment White Mahogany	1966	1814	8
92	Moist Shrubby Stringybark-Gum	5868	4139	29
93	Montane Stringybark-Gum	61335	28687	53
95	Northern Moist Blackbutt	10899	9101	16
96	Natural Grassland	NA	370	NA
97	Needlebark Stringybark-Large Fruited Blackbutt	10595	9966	6
98	New England Peppermint	4372	3590	18
99	New England Stringybark-Blakelys Red Gum	14496	10786	26
100	Northern Grassy Sydney Blue Gum	11251	9245	18
101	Northern Open Grassy Blackbutt	30488	21590	29

102	Northern Ranges Dry Tallowwood	100616	57107	43
103	Northern Wet Brushbox	25433	16379	36
104	Northern Wet Tallowwood-Blue Gum	29608	25764	13
105	Nymboida Tallowwood-Turpentine	3006	2645	12
106	Open Coastal Brushbox	9552	6533	32
109	Open Shrubby Brushbox-Tallowwood	23578	17472	26

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
110	Open Silvertop Stringybark-Blue Gum	3681	3130	15
111	Open Silvertop Stringybark-Tallowwood	4876	4525	7
112	Paperbark	NA	28577	NA
113	Peppermint	11201	6478	42
114	Peppermint-Mountain/Manna Gum	42801	12829	70
115	Red Bloodwood	239	217	9
116	Red Gum-Stringybark	58022	27128	53
117	Red Mahogany	1363	1273	7
118	Richmond Range Spotted Gum	48695	22511	54
119	Richmond Range Spotted Gum-Box	41843	24814	41
120	River Oak	4772	3221	33
121	Rock	NA	18162	NA
122	Rough-barked Apples	3764	1683	55
123	Roundleaved Gum	40718	17975	56
124	Roundleaved Gum-Turpentine	30	30	0
125	Saltbush	NA	16	NA
126	Sandstone Spotted Gum-Blackbutt	8874	4808	46
127	Sherwood Needlebark Stringybark	11498	9098	21
128	Silverleaved Ironbark	2328	1988	15
129	Smoothbarked Apple	273	270	1
131	Snow Gum	304	288	5
132	Snow Gum -Mountain/Manna Gum	97979	21305	78
133	Snow Gum-Black Sallee	NA	2	NA
135	South Coast Tallowwood-Blue Gum	6754	5338	21
138	Steel Box/Craven Grey Box	634	427	33
139	Stringybark-Apple	57503	34813	39
140	Stringybark-Mallee	2196	2194	0
141	Swamp	NA	24118	NA
142	Swamp Mahogany	699	578	17

143	Swamp Oak	11265	2883	74
145	Sydney Peppermint-Stringybark	267	255	4
146	Tallowwood	9191	8430	8
147	Turpentine	6786	2943	57
148	Very Wet New England Blackbutt-Tallowwood	1500	1498	0
149	Mallee-Peppermint mosaic	2721	1618	41

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
150	Washpool Brushbox-Tallowwood	5683	5683	0
151	Wattle	NA	1314	NA
152	Wet Bloodwood-Tallowwood	53792	33357	38
153	Wet Coastal Tallowwood-Brushbox	12436	6581	47
154	Wet Flooded Gum-Tallowwood	24215	9317	62
155	Wet Foothills Blackbutt-Turpentine	8219	7437	10
157	Wet Shrubby Brushbox-Tallowwood	6265	4891	22
158	Wet Spotted Gum-Tallowwood	NA	2538	NA
162	Whitetopped Box	4	4	0
163	Yellow Box-Blakely's Red Gum	39525	7245	82
168	Rainforest	NA	159211	NA
169	Scrub	NA	5447	NA
174	Orange Gum-Tumbledown Gum-Apple	27288	15435	43
175	Orange Gum-New England Blackbutt-Tumbledown Gum	39537	19304	51
176	Orange Gum-Ironbark	82312	34295	58
177	Outcrop Orange Gum-New England Blackbutt	26429	7945	70
178	Outcrop Black Cypress-Tumbledown Gum	1642	1034	37
179	Yellow Box-Broad-leaved Stringybark	11549	3859	67
180	Western New England Blackbutt	14754	12415	16
181	Stringybark-Gum	34306	30258	12
182	Apple-Black Cypress	2350	1994	15
183	Red Gum-Apple	1569	592	62
184	Tumbledown Gum-Ironbark	13841	11070	20
185	Orange Gum-Black Cypress	5585	3510	37
186	Open Tumbledown Gum-Black Cypress-Orange Gum	25417	10593	58
189	Silverleaved Ironbark-Cypress	40819	23285	43
190	Yellow Box-Grey Box-Red Gum	60630	21273	65

194	Round-leaved Gum wet heath	8627	5997	30
195	Apple-Manna Gum woodland	35674	16214	55
196	Broad-leaved Stringybark-Apple Box	53458	19948	63
197	Broad-leaved Stringybark	4409	1643	63
198	Silvertop Stringybark	4527	1200	73
199	Riparian Shrubland	5509	1252	77

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
200	Broad-leaved Stringybark-Ribbon Gum	2022	650	68

Pre-1750 and Extant Ecosystem Distributions in the Lower North East CRA Region

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
2	Alpine Gum	15021	3971	74
3	Baileys Stringybark	301	285	5
5	Banksia	8786	4196	52
6	Barrington Dry Shrubby New England Blackbutt-Blue Gum	3667	3227	12
7	Barrington Moist Blue Gum-White Mahogany	46597	32659	30
8	Barrington Wet New England Blackbutt-Blue Gum	68504	45911	33
10	Black Sallee	NA	2	NA
11	Blackbutt-Sydney Peppermint-Smoothbarked Apple	3560	1382	61
12	Blue Mountain Ash	NA	1	NA
13	Blue-leaved Stringybark	NA	25	NA
14	Brown Barrell	1557	814	48
15	Brown Barrell-Gum	15290	8711	43
16	Bull Oak	NA	5	NA
17	Candlebark	243	20	92
18	Casuarina Woodland	NA	362	NA
19	Central Mid Elevation Sydney Blue Gum	92222	40971	56
20	Clarence Lowland Needlebark Stringybark	81	81	0
21	Lowlands Grey Box	5917	1219	79
22	Coast Cypress Pine	NA	34	NA
23	Coast Range Bloodwood-Mahogany	636	564	11
25	Coast Range Spotted Gum-Blackbutt	25	25	0
26	Coastal Flooded Gum	15166	8753	42
27	Coastal Sands Blackbutt	27026	17312	36
28	Cool Moist Messmate	14324	6467	55
29	Corkwood-Crabapple and Mixed Stringybarks	2891	2293	21
30	Diehard Stringybark-New England Blackbutt	51716	43510	16
31	Dorrigo White Gum	6449	1123	83

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared

32	Dry Foothills Blackbutt-Turpentine	48456	33592	31
33	Dry Foothills Spotted Gum	32880	17688	46
34	Dry Grassy Blackbutt-Tallowwood	134865	59390	56
35	Dry Grassy Stringybark	133894	97614	27
36	Dry Grassy Tallowwood-Grey Gum	264265	178516	32
37	Dry Heathy Blackbutt-Bloodwood	4939	2889	42
38	Dry Heathy New England Blackbutt	550	528	4
39	Dry Heathy New England Stringybarks	NA	15	NA
41	Dry Open New England Blackbutt	115751	32932	72
42	Dry Redgum-Bloodwood-Apple	107232	69509	35
43	Dry Silvertop Stringybark-Apple	19265	14918	23
44	Dry open Redgum-Broad Leaved Apple	2404	2291	5
46	Eastern Red Gums	NA	38	NA
47	Escarpment Redgum	74953	20498	73
48	Escarpment Scribbly Gum-Apple	27471	7574	72
49	Escarpment Tallowwood-Bloodwood	57865	49918	14
50	Wet Bangalow-Brushbox	5677	3614	36
51	Eurabbie	277	276	0
53	Gorge Grey Box	6995	6034	14
54	Grey Box-Red Gum-Grey Ironbark	91248	19838	78
55	Foothills Grey Gum-Spotted Gum	3065	2438	20
56	Granite Mallee	7173	4025	44
57	Highland Granite Stringybarks	2481	924	63
58	Gorge Grey Gum	51	51	0
60	Grassy New England Blackbutt-Tallowwood-Blue Gum	40573	33586	17
63	Grey Gum-Stringybark	23099	16056	30
64	Heath	NA	14286	NA
65	Heathy Scribbly Gum	31362	23471	25
66	Herbfield and Fjaeldmark	NA	2	NA
67	High Elevation Ferny Blackbutt	34934	30899	12

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared

68	High Elevation Messmate-Brown Barrell	19641	15974	19
69	High Elevation Moist Open Tallowwood-Blue Gum	30029	27141	10
70	High Elevation Open Spotted Gum	21	12	43
71	Ironbark	209443	89985	57
72	Low Relief Coastal Blackbutt	23365	10894	53
73	Lowland Red Gum	574	366	36
74	Lowlands Scribbly Gum	11527	9724	16
76	Coastal Mallee	963	801	17
77	Mangrove	NA	1001	NA
79	Manna Gum-Stringybark	1180	632	46
80	Manna Gum	13123	3852	71
81	Messmate	60985	20291	67
82	Messmate-Mountain Gum Forest	19288	8537	56
83	Mid Elevation Wet Blackbutt	7883	6981	11
84	Mid North Coast Wet Brushbox-Tallowwood-Blue Gum	43303	31917	26
85	Mixed Moist Hardwood	229	229	0
87	Mixed Tableland Stringybark-Gum OpenForest	20293	7897	61
88	Moist Escarpment New England Blackbutt	23267	22579	3
89	Moist Foothills Spotted Gum	12467	7929	36
90	Moist Messmate-Gum	113	78	31
91	Moist Open Escarpment White Mahogany	42669	38495	10
92	Moist Shrubby Stringybark-Gum	805	423	47
93	Montane Stringybark-Gum	11191	2567	77
94	Mountain Gum-Brown Barrell	3210	3196	0
96	Natural Grassland	NA	138	NA
97	Needlebark Stringybark-Large Fruited Blackbutt	556	502	10
98	New England Peppermint	814	656	19
99	New England Stringybark-Blakelys Red Gum	116133	28245	76
105	Nymboida Tallowwood-Turpentine	310	248	20
106	Open Coastal Brushbox	103225	64878	37

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared

107	Open Messmate-New England Blackbutt	14929	12151	19
108	Open Ribbon Gum	34467	24537	29
109	Open Shrubby Brushbox-Tallowwood	5033	2887	43
110	Open Silvertop Stringybark-Blue Gum	68155	53990	21
111	Open Silvertop Stringybark-Tallowwood	2116	1889	11
112	Paperbark	NA	12866	NA
113	Peppermint	51650	13115	75
114	Peppermint-Mountain/Manna Gum	29728	5736	81
115	Red Bloodwood	5	5	0
116	Red Gum-Stringybark	38169	12238	68
117	Red Mahogany	64	64	0
120	River Oak	1566	922	41
121	Rock	NA	6576	NA
122	Rough-barked Apples	13990	2636	81
123	Roundleaved Gum	1544	172	89
124	Roundleaved Gum-Turpentine	59	59	0
125	Saltbush	NA	200	NA
129	Smoothbarked Apple	25437	18751	26
130	Smoothbarked Apple-Sydney Peppermint-Stringybark	16521	9517	42
131	Snow Gum	6526	4433	32
132	Snow Gum -Mountain/Manna Gum	83882	23120	72
133	Snow Gum-Black Sallee	NA	16	NA
134	South Coast Shrubby Grey Gum	357935	151030	58
135	South Coast Tallowwood-Blue Gum	106137	71217	33
137	Southern Wet Sydney Blue Gum	57235	41695	27
138	Steel Box/Craven Grey Box	133	125	6
139	Stringybark-Apple	208921	81300	61
140	Stringybark-Mallee	671	665	1
141	Swamp	NA	9130	NA
142	Swamp Mahogany	4645	2177	53
143	Swamp Oak	21477	4868	77

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
145	Sydney Peppermint-Stringybark	13866	13778	1

146	Tallowwood	875	746	15
147	Turpentine	239	235	2
148	Very Wet New England Blackbutt-Tallowwood	3218	2867	11
149	Mallee-Peppermint mosaic	6208	3621	42
151	Wattle	NA	199	NA
153	Wet Coastal Tallowwood-Brushbox	15901	10245	36
154	Wet Flooded Gum-Tallowwood	9393	6161	34
155	Wet Foothills Blackbutt-Turpentine	54288	50264	7
156	Wet New England Blackbutt-Silvertop Stringybark	18005	15604	13
157	Wet Shrubby Brushbox-Tallowwood	35601	30589	14
162	Whitetopped Box	1743	967	45
163	Yellow Box-Blakely's Red Gum	28088	2696	90
168	Rainforest	NA	256326	NA
169	Scrub	NA	3073	NA
174	Orange Gum-Tumbledown Gum-Apple	33343	10169	70
175	Orange Gum-New England Blackbutt-Tumbledown Gum	64031	23572	63
176	Orange Gum-Ironbark	34097	6636	81
177	Outcrop Orange Gum-New England Blackbutt	15949	3170	80
178	Outcrop Black Cypress-Tumbledown Gum	1492	659	56
179	Yellow Box-Broad-leaved Stringybark	1026	273	73
182	Apple-Black Cypress	46374	14635	68
183	Red Gum-Apple	8088	4065	50
184	Tumbledown Gum-Ironbark	527	160	70
186	Open Tumbledown Gum-Black Cypress-Orange Gum	43246	7959	82
189	Silverleaved Ironbark-Cypress	6649	2007	70
190	Yellow Box-Grey Box-Red Gum	35934	7724	79
195	Apple-Manna Gum woodland	36588	6638	82

Value	Name	Pre1750 (ha)	Extant (ha)	Percentage Cleared
196	Broad-leaved Stringybark-Apple Box	55280	10442	81
197	Broad-leaved Stringybark	8827	1346	85

198	Silvertop Stringybark	5634	1501	73
199	Riparian Shrubland	6978	1172	83
200	Broad-leaved Stringybark-Ribbon Gum	25	7	72

11. APPENDIX THREE:

METADATA FOR THE UPPER NORTH EAST AND LOWER NORTH EAST CRA REGIONS

NSW CRA/RFA Metadata Proforma

CATEGORY	CORE METADATA ELEMENT	DESCRIPTION
DATASET	**Title:**	Upperr North East Forest Ecosystem Layer
	Custodian:	New South Wales National Parks and Wildlife Service (NSW NPWS)
	Jurisdiction:	NSW
	CRA Project Name:	LNE Forest Ecosystem Derivation Project Stage 2 Analysis and UNE pre-1750 Forest Ecosystem Derivation
	CRA Project Number:	NA 35/EH
CONTACT ADDRESS	**Contact organisation:**	New South Wales National Parks and Wildlife Service (NSW NPWS) Northern Zone CRA Unit

	Contact position:	Northern Zone CRA Flora Co-ordinator
	Mail address 1:	PO Box 914, Coffs Harbour, NSW, 2450
	Mail Address 2:	
	Suburb/place/locality:	Coffs Harbour
	State/Locality 2:	NSW
	Country:	Australia
	Postcode:	2450
	Telephone:	0266 515 946
	Facsimile:	0266 516187
	Electronic mail address:	carmel.flint@npws.nsw.gov.au
DESCRIPTION	**Abstract:**	Map of the distribution of each forest ecosystem across the extant forest estate in the Upper North East CRA region. Two separate classifications and mapping techniques were used to derive the ecosystems in two distinct biogeographic regions and these classifications and maps were then expertly integrated and merged to create a full coverage across the region. The ecosystems were mapped for application in the Comprehensive Regional Assessment process.
	Search Words:	ECOLOGY Ecosystem
	Geographic extent, Name(s):	Upper North East Comprehensive Regional Assessment Region
	Geographic Extent, Polygon(s):	
	Type of feature:	Grid cell
	Attribute/Field List:	Value, Count, Ecosystem, Feat_ID

	Attribute/Field Description:	Value = unique ecosystem identification field, Count = area of ecosystem in hectares, Ecosystem = ecosystem name, Feat_ID = unique entity identification field for use in C-plan
	Scale/Resolution:	100m resolution
DATASET CURRENCY	**Beginning date:**	August 1998
	Ending date:	Current
DATASET STATUS	**Progress:**	Complete
	Maintenance and update frequency:	Not Known
DATASET ENVIRONMENT	**Software:**	DIGITAL Arcview Version 3.0a
	Computer Operating System:	**Windows NT**
	Dataset Size:	3.8 MB
ACCESS	**Stored Data Format:**	DIGITAL Arcview Version 3.0a
	Available Format Type:	DIGITAL Arcview Version 3.0a
	Access constraints:	Data has been compiled and manipulated for the NSW CRA process and therefore the use of this data is restricted to projects being undertaken within the NSW CRA under the CRA Data Licence Agreement

DATA QUALITY	**Lineage:**	***Eastern Portion of the CRA Region - west to the New England Highway*** Data Collecton Method: 1. Fine Scale Vegetation Mapping from Aerial Photograph Interpretation 2. Field survey 3. Mapping of ecosystems across areas covered by existing fine scale mapping 4. Modelling of ecosystems across unmapped forest and cleared land Data Set Source: 1. The following fine scale vegetation mapping from aerial photograph interpretation was utilised: • SFNSW Forest Typing • Natural Resources Audit Council Multi-attribute Mapping • Coffs Harbour Council Vegetation Mapping • Henry James Tweed Vegetation Mapping • Department of Land and Water Conservation Nambucca Vegetation Mapping • National Parks and Wildlife Service Coastal Vegetation Mapping 2. Information from the following field surveys was utilised: • Flora survey of Ben Halls Gap State Forest • Flora Survey of Broadwater National Park • Flora survey of Bundjalung National Park • Flora Survey of the Coffs Harbour Local Government Area • CRA Systematic Flora Survey • Flora Survey of Demon Nature Reserve • Vegetation Survey of the National Parks of Dorrigo District

Positional accuracy:	1. All areas with fine scale vegetation mapping were derived at a scale of 1:25,000. Areas with fine scale vegetation mapping have an estimated positional accuracy of map polygon boundaries of within 25m. 2. Survey sites are generally located using a Geographic Positioning System and 1:25,000 topographic maps and involve the use of set bearings and measured distances from known points. Survey sites are generally considered accurate to within 100m. 3. All environmental variables were derived at 1:25,000 or 1:100,000 scale except for the geological layer which was rarely used and was derived at 1:250,000 scale. All environmental variables except for the geology layer have an estimated positional accuracy of within 100m. Details of the positional accuracy of the environmental variables used to derive and model the forest ecosystems is decoumented in separate metadata statements for those layers. 4. For areas without fine scale vegetation mapping (for the eastern and western portions only) the modelled distributions were used to *predict the proportion* of a modelled ecosystem only. The nature of the random, proportional assignment process which was utilised to derive the most accurate areal figures, means that the exact spatial representation of the data is not designed to be accurate. Whilst areal calculations derived from such an approach are valid and reliable, any printed map is only one of many equally valid representations.

Attribute accuracy:	The attribute of this dataset is the forest ecosystem which is derived from analysis of full floristic survey data. Three different approaches were utilised to classify forest ecosystems in the three distinct biogeographic regions within the CRA area and these are described below. ***Eastern Portion of the CRA Region - north of the Hunter River to the northern boundary of the Lower North East region and west to the New England Highway*** The forest ecosystem classification was derived by splitting and amalgamating SFNSW mapped forest types based on an analysis of full floristic variation between field survey plots, in relation to abiotic environmental variables. The approach is described briefly below: 1. Pairs of forest types (which contained greater than 10 survey sites) within the same league were tested for initial amalgamation based on floristic similarity using the statistic described below in step 5 and testing the hypothesis described below in step 9 and utilising a canopy species cover abundance matrix. Twenty four forest types were amalgamated prior to analysis of further floristic variation. 2. All forest types or forest type amalgamations from this process which contained greater than 10 full floristic sites were assessed for floristic variation. 3. For each forest type with greater than 10 sites, a search was conducted of all possible binary environmental splits for that type which maximised floristic compositional dissimilarity between the two resulting groups of sites, relative to the floristic variation exhibited within these groups. Each binary environmental splits was defined in terms of a cutpoint which was used to map the floristic distinction within the forest type. Twenty-eight forest types and forest type amalgamations were subject to identification of floristic splits. 4. A Bray Curtis measure of dissimilarity was utilised to derive a sites by sites dissimilarity matrix based on non-standardised full floristic cover abundance data and it was from this matrix that a statistic of floristic difference was derived. 5. The statistic which was used to measure the floristic difference was $D = \bar{d}_B - \bar{d}_W$ where $\bar{d}_B$ is the average 'between group' dissimilarity and $\bar{d}_w$ is the average 'within group' similarity. 6. The statistical significance of *D* was estimated using a Monte Carlo randomization procedure (Manly 1991) in which *D* is repeatedly calculated after randomly permuting the assignment of sites to groups. The value of *D* obtained using the real grouping of sites was then compared to the distribution of *D* obtained using random permutations.

	Logical consistency:	The logical consistency tests done were: • a test of valid values within each initial forest type and derived forest ecosystem • a visual check of the initial forest type maps and derived forest ecosystem layer
	Completeness:	The spatial dataset coverage is complete for the entire extant forest in the Upper North East region as delineated by the CRAFTI extant forest layer. Areas of forest less than 10ha will not be included in the extant forest layer. Since the forest ecosystem layer is derived from mapped forest types where available small areas less than 2ha in size or 50m in width, are not represented..
NOTES	**Notes:**	
METADATA DATE	**Metadata date:**	9/8/1998
METADATA COMPLETED BY	**Metadata sheet compiled by:**	Carmel Flint, NPWS

FURTHER INFORMATION	**Further information:**	Ferrier, S, Flint, C & Binns, D in prep (1998). Methodology for forest ecosystem classification and mapping in Upper North East and Lower North East CRA Regions. Draft 4 May 1998 NSW NPWS. 1998. in prep. Draft Northern CRA Regions Forest Ecosystems Results Report. RACAC. 1996. Broad Old Growth Mapping Project: Final Report. Unpublished report prepared by NPWS for the Resource and Conservation Assessment Council. NSW NPWS. 1994a. Vegetation Systems of North East NSW. North East Forest biodiversity Study Report No. 2b. Unpublished report, NSW National Parks and Wildlife Service. NSW NPWS. 1994b. Flora of NSW forests. North East Forests Biodiversity Study Report No.4, unpublished report, NSW National Parks and Wildlife Service NSW NPWS. 1995. Vegetation Survey and Mapping of Upper North East New South Wales. A Report by the NSW National Parks and Wildlife Service for the Natural Resources Audit Council. Forestry Commission of NSW (1989) *Forest types of New South Wales.* Resarch Note 17. Forestry Commission of NSW. Metadata on environmental variables prepared by NPWS for the CRA process. Metadata on vegetation surveys prepared by NPWS for the CRA process. Metadata on historical portion plan data prepared by SFNSW for the CRA process. Metadata on SFNSW RN17 Forest Type layer prepared for the Interim Assessment Process Metadata on NPWS Vegetation Units prepared by NPWS for the Interim Assessment Process Watson, G. 1996. *Predictive Species Modelling, A Report emanating from a consultancy to optimise and evaluate regional species distribution modelling software.* Report to Environment Australia, Canberra.

NSW CRA/RFA Metadata Proforma

CATEGORY	CORE METADATA ELEMENT	DESCRIPTION
DATASET	**Title:**	Lower North East Forest Ecosystem Layer
	Custodian:	New South Wales National Parks and Wildlife Service (NSW NPWS)
CONTACT ADDRESS	**Jurisdiction:**	NSW
	CRA Project Name:	LNE Forest Ecosystem Derivation Project Stage 2 Analysis and UNE pre-1750 Forest Ecosystem Derivation
	CRA Project Number:	NA 35/EH
	Contact organisation:	New South Wales National Parks and Wildlife Service (NSW NPWS) Northern Zone CRA Unit
	Contact position:	Northern Zone CRA Flora Co-ordinator
	Mail address 1:	PO Box 914, Coffs Harbour, NSW, 2450
	Mail Address 2:	
	Suburb/place/locality:	Coffs Harbour
	State/Locality 2:	NSW
	Country:	Australia

	Postcode:	2450
	Telephone:	0266 515 946
	Facsimile:	0266 516187
	Electronic mail address:	carmel.flint@npws.nsw.gov.au
DESCRIPTION	**Abstract:**	Map of the distribution of each forest ecosystem across the extant forest estate in the Lower North East CRA region. Three separate classifications and mapping techniques were used to derive the ecosystems in three distinct biogeographic regions and these classifications and maps were then expertly integrated and merged to create a full coverage across the region. The ecosystems were mapped for application in the Comprehensive Regional Assessment process.
	Search Words:	ECOLOGY Ecosystem
	Geographic extent, Name(s):	Lower North East Comprehensive Regional Assessment Region
	Geographic Extent, Polygon(s):	
	Type of feature:	Grid cell
	Attribute/Field List:	Value, Count, Ecosystem, Feat_ID
	Attribute/Field Description:	Value = unique ecosystem identification field, Count = area of ecosystem in hectares, Ecosystem = ecosystem name, Feat_ID = unique entity identification field for use in C-plan
	Scale/Resolution:	100m resolution
DATASET CURRENCY	**Beginning date:**	August 1998
	Ending date:	Current

DATASET STATUS	**Progress:**	Complete
	Maintenance and update frequency:	Not Known
DATASET ENVIRONMENT	**Software:**	DIGITAL Arcview Version 3.0a
	Computer Operating System:	**Windows NT**
	Dataset Size:	3.8 MB
ACCESS	**Stored Data Format:**	DIGITAL Arcview Version 3.0a
	Available Format Type:	DIGITAL Arcview Version 3.0a
	Access constraints:	Data has been compiled and manipulated for the NSW CRA process and therefore the use of this data is restricted to projects being undertaken within the NSW CRA under the CRA Data Licence Agreement

DATA QUALITY	**Lineage:**	***Eastern Portion of the CRA Region - north of the Hunter River to the northern boundary of the Lower North East region and west to the New England Highway*** Data Collecton Method: 1. Fine Scale Vegetation Mapping from Aerial Photograph Interpretation 2. Field survey 3. Mapping of ecosystems across areas covered by existing fine scale mapping 4. Modelling of ecosystems across unmapped forest and cleared land Data Set Source: 1. The following fine scale vegetation mapping from aerial photograph interpretation was utilised: • SFNSW Forest Typing • Natural Resources Audit Council Multi-attribute Mapping • Coffs Harbour Council Vegetation Mapping • Henry James Tweed Vegetation Mapping • Department of Land and Water Conservation Nambucca Vegetation Mapping • National Parks and Wildlife Service Coastal Vegetation Mapping 2. Information from the following field surveys was utilised: • Flora survey of Ben Halls Gap State Forest • Flora Survey of Broadwater National Park • Flora survey of Bundjalung National Park • Flora Survey of the Coffs Harbour Local Government Area • CRA Systematic Flora Survey • Flora Survey of Demon Nature Reserve • Vegetation Survey of the National Parks of Dorrigo District

Positional accuracy:	1. All areas with fine scale vegetation mapping were derived at a scale of 1:25,000. Areas with fine scale vegetation mapping have an estimated positional accuracy of map polygon boundaries of within 25m. 2. Survey sites are generally located using a Geographic Positioning System and 1:25,000 topographic maps and involve the use of set bearings and measured distances from known points. Survey sites are generally considered accurate to within 100m. 3. All environmental variables were derived at 1:25,000 or 1:100,000 scale except for the geological layer which was rarely used and was derived at 1:250,000 scale. All environmental variables except for the geology layer have an estimated positional accuracy of within 100m. Details of the positional accuracy of the environmental variables used to derive and model the forest ecosystems is decoumented in separate metadata statements for those layers. 4. For areas without fine scale vegetation mapping (for the eastern and western portions only) the modelled distributions were used to *predict the proportion* of a modelled ecosystem only. The nature of the random, proportional assignment process which was utilised to derive the most accurate areal figures, means that the exact spatial representation of the data is not designed to be accurate. Whilst areal calculations derived from such an approach are valid and reliable, any printed map is only one of many equally valid representations.

Attribute accuracy:	The attribute of this dataset is the forest ecosystem which is derived from analysis of full floristic survey data. Three different approaches were utilised to classify forest ecosystems in the three distinct biogeographic regions within the CRA area and these are described below. ***Eastern Portion of the CRA Region - north of the Hunter River to the northern boundary of the Lower North East region and west to the New England Highway*** The forest ecosystem classification was derived by splitting and amalgamating SFNSW mapped forest types based on an analysis of full floristic variation between field survey plots, in relation to abiotic environmental variables. The approach is described briefly below: 1. Pairs of forest types (which contained greater than 10 survey sites) within the same league were tested for initial amalgamation based on floristic similarity using the statistic described below in step 5 and testing the hypothesis described below in step 9 and utilising a canopy species cover abundance matrix. Twenty four forest types were amalgamated prior to analysis of further floristic variation. 2. All forest types or forest type amalgamations from this process which contained greater than 10 full floristic sites were assessed for floristic variation. 3. For each forest type with greater than 10 sites, a search was conducted of all possible binary environmental splits for that type which maximised floristic compositional dissimilarity between the two resulting groups of sites, relative to the floristic variation exhibited within these groups. Each binary environmental splits was defined in terms of a cutpoint which was used to map the floristic distinction within the forest type. Twenty-eight forest types and forest type amalgamations were subject to identification of floristic splits. 4. A Bray Curtis measure of dissimilarity was utilised to derive a sites by sites dissimilarity matrix based on non-standardised full floristic cover abundance data and it was from this matrix that a statistic of floristic difference was derived. 5. The statistic which was used to measure the floristic difference was $D = \bar{d}_B - \bar{d}_W$ where $\bar{d}_B$ is the average 'between group' dissimilarity and $\bar{d}_w$ is the average 'within group' similarity. 6. The statistical significance of *D* was estimated using a Monte Carlo randomization procedure (Manly 1991) in which *D* is repeatedly calculated after randomly permuting the assignment of sites to groups. The value of *D* obtained using the real grouping of sites was then compared to the distribution of *D* obtained using random permutations.

	Logical consistency:	The logical consistency tests done were: • a test of valid values within each initial forest type and derived forest ecosystem • a visual check of the initial forest type maps and derived forest ecosystem layer
	Completeness:	The spatial dataset coverage is complete for the entire extant forest in the Lower North East region as delineated by the Eastern Bushlands Database. Areas of forest less than 5ha will not be included in the extant forest layer. Since the forest ecosystem layer is derived from mapped forest types where available small areas less than 2ha in size or 50m in width, are not represented. Rainforest mapped by the BOGMP project will not be represented below a 25ha minimum and mapped by the Eastern Bushlands project will not be represented below a 50ha minimum.
NOTES	**Notes:**	
METADATA DATE	**Metadata date:**	9/8/1998
METADATA COMPLETED BY	**Metadata sheet compiled by:**	Carmel Flint, NPWS

FURTHER INFORMATION	**Further information:**	Ferrier, S, Flint, C & Binns, D in prep (1998). Methodology for forest ecosystem classification and mapping in Upper North East and Lower North East CRA Regions. Draft 4 May 1998 NSW NPWS. 1998. in prep. Draft Northern CRA Regions Forest Ecosystems Results Report. RACAC. 1996. Broad Old Growth Mapping Project: Final Report. Unpublished report prepared by NPWS for the Resource and Conservation Assessment Council. NSW NPWS. 1994a. Vegetation Systems of North East NSW. North East Forest biodiversity Study Report No. 2b. Unpublished report, NSW National Parks and Wildlife Service. NSW NPWS. 1994b. Flora of NSW forests. North East Forests Biodiversity Study Report No.4, unpublished report, NSW National Parks and Wildlife Service NSW NPWS. 1995. Vegetation Survey and Mapping of Upper North East New South Wales. A Report by the NSW National Parks and Wildlife Service for the Natural Resources Audit Council. Forestry Commission of NSW (1989) *Forest types of New South Wales.* Resarch Note 17. Forestry Commission of NSW. Metadata on environmental variables prepared by NPWS for the CRA process. Metadata on vegetation surveys prepared by NPWS for the CRA process. Metadata on historical portion plan data prepared by SFNSW for the CRA process. Metadata on SFNSW RN17 Forest Type layer prepared for the Interim Assessment Process Metadata on NPWS Vegetation Units prepared by NPWS for the Interim Assessment Process Watson, G. 1996. *Predictive Species Modelling, A Report emanating from a consultancy to optimise and evaluate regional species distribution modelling software.* Report to Environment Australia, Canberra.