Assessment of North Coast Floodplain TECs on NSW Crown Forest Estate

Survey, Classification and Mapping Completed for the NSW Environment Protection Authority

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1 Overview

This report considers the distribution of four threatened ecological communities (TECs) listed under the NSW *Threatened Species Conservation Act* 1995 (TSC Act), which are associated with coastal floodplain environments in the North Coast region of NSW; River-flat Eucalypt Forest (RFEF), Swamp Oak Floodplain Forest (SOAK), Swamp Sclerophyll Forest (SWSF) and Subtropical Coastal Floodplain Forest (SCFF). Each of the final determinations lists a species assemblage characteristic of the TEC, and explicitly references a range of existing vegetation community descriptions and maps. Collectively, the TECs on floodplains are unified by descriptions and analysis from a primary study of vegetation on floodplain environments of coastal NSW (Keith & Scott 2005).

We conferred with a TEC Project Reference Panel (TEC Panel) to establish a set of principles to guide a consistent interpretation of each TEC. We applied the agreed interpretations to identify the compositional and habitat attributes for each TEC in assessing 868,000 hectares of state forests in our northern study area. Detailed field survey and quantitative data analysis were used as a foundation to build a set of operational maps suitable for regulatory use.

On the North Coast all floodplain TECs except Swamp Oak Floodplain Forest support the frequent occurrence of eucalypts, with Melaleuca spp. a common member of the mid or upper stratum. The interpretation of the determinations for each of these TECs share two major areas of uncertainty: the definition of floodplain and alluvial environments and the assignment of plant assemblages to the characteristic species list provided. For the former, we used a combination of an existing map of coastal landforms and geology and several models of alluvial landform features to determine the likely extent of floodplains and alluvial soils in our study area. We used aerial photograph interpretation (API) to map vegetation patterns within floodplain and alluvial areas, and to map photo-patterns likely to indicate the presence of floodplain TECs within and adjoining modelled areas.

The assignment to any floodplain TEC assemblage was assessed by examining the relationship between the species list provided and more than 117 existing vegetation communities associated with alluvial environments on the North Coast. In addition, our analysis of plot data also used comparisons with plots assigned to referable communities to the TECs from Keith and Scott (2005) and existing regional vegetation classification data to allocate plots to candidate TECs. We assigned around 1100 plots (out of 14,500) to one of the four TECs, with Subtropical Coastal Floodplain Forest recording the greatest number of plots assigned to it on state forest.

We used plot data and a selection of environmental and remote-sensing variables to develop a Random Forest (RF) model of the probability of occurrence of each of the TECs. We assigned our mapped API polygons to one of the four TECs based on plot data, overstorey and understorey attributes, landform features and modelled probabilities. We also assessed predictive models to ensure that all areas of potential TEC had been checked using API, and mapped as appropriate. From these assignments, we constructed a map of each TEC. In total, we identified approximately 11,050 hectares of SCFF, 1099 hectares of SWSF, 204 hectares of SOAK and 198 hectares of RFEF on state forest in the North Coast study area.

Our mapping and assessment has significantly reduced the uncertainty associated with the interpretation of the floodplain TECs in the North Coast study area. The project adopted a precautionary approach that reduced the likelihood that candidate TEC occurred outside our mapped area. Validation of maps using independent data suggest that collectively our operational maps capture 96% of candidate TECs on floodplain and associated alluvial environments on state forest. To achieve these high levels of certainty, our maps are also likely to include 23% of forest unrelated to any of the assessed TECs. We believe our maps provide an accurate representation of the agreed interpretation used for each TEC at a scale suitable for forestry operations.

2 Introduction

2.1 Project Rationale

This project was initiated by the NSW Environment Protection Authority (EPA) and Forestry Corporation of NSW (FCNSW) as a coordinated approach to resolve long standing issues surrounding the identification, extent and location of priority NSW Threatened Ecological Communities (TECs) that occur on the NSW state forest estate included within the coastal Integrated Forestry Operation Approval (IFOA) areas.

2.2 Final Determinations

This report covers four Threatened Ecological Communities (TECs) associated with coastal floodplains: River-flat Eucalypt Forest (RFEF), Subtropical Coastal Floodplain Forest (SCFF), Swamp Oak Floodplain Forest (SOAK) and Swamp Sclerophyll Forest (SWSF). This report covers only the occurrence of these TECs north of Sydney. A further TEC associated with floodplains, lowland rainforest on floodplains, is covered in a separate report with other rainforest TECs.

An assessment of the characteristics and conservation status of vegetation on coastal floodplains and associated landforms in NSW was initially made by Keith and Scott (2005). While it was *in press* at the time, this assessment provided important information for the final determination of the TECs associated with coastal floodplains. The four TECs were first gazetted as an Endangered Ecological Communities on 17 December 2004. Minor amendments were subsequently made to the determinations which were gazetted on 17 December 2010 for SCFF and 8 July 2011 for RFEF, SOAK and SWSF.

Paragraph 6 in each of the final determinations (NSW Scientific Committee 2011) cites Keith and Scott (2005) as identifying a group of vegetation samples which belong to the TEC. In each case, the particular group is not explicitly stated, but may be inferred from the context of the report and the name of the determination. Keith and Scott describe 39 groups, five of which are attributed to floodplain TECs (Table 1). It may be inferred that the remaining 34 groups are not attributable to any of the floodplain TECs. For those which are referable to TECs, it is ambiguous whether all of the plot samples allocated to each of Keith and Scott's relevant groups are considered to belong to the community in question, as many of the samples are assessed as not floodplain vegetation.

Table 1: Keith and Scott (2005) groups attributed to TECs.

Group number	Group name	TEC
1	Swamp Sclerophyll Forest on Coastal Floodplains	Swamp Sclerophyll Forest on Coastal Floodplains
2	Swamp Oak Floodplain Forest	Swamp Oak Floodplain Forest
3	Lowland Rainforest on Floodplains	Lowland Rainforest on Floodplains
7	River-Flat Eucalypt forest on Coastal Floodplains	River-Flat Eucalypt forest on Coastal Floodplains
8	Subtropical Coastal Floodplain Forest	Subtropical Coastal Floodplain Forest

Paragraph 7 in each of the final determinations (NSW Scientific Committee, 2011) refers to other Endangered Ecological Communities which may adjoin or intergrade and states that the determinations collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. Paragraph 8 of each of the final determinations refers to communities or map units described by previous studies, which ‘include’, are ‘included within' or are otherwise related to the TEC being determined. In some cases, the communities or map units are themselves poorly defined, or are vaguely qualified in the determination and provide no useful information to help interpret a TEC. In other cases, particularly where a community has been defined from explicit plot assignments that are known, these citations offer important information of potential diagnostic value. Although not explicit, it may be inferred that a community or map unit which is described in a cited study but not mentioned in a determination is not referable to that TEC. Unfortunately for our study area, apart from those described by Keith and Scott (2005), there are few floristically well-defined cited communities north of the Hunter Valley and none for Subtropical Coastal Floodplain Forest.

2.3 Initial TEC Project Reference Panel Interpretation

Under the TSC Act, TECs are defined by two characteristics: an assemblage of species and a particular location. The TEC Project Reference Panel (the Panel) agreed that the occurrence of the four TECs is constrained to the IBRA bioregions stated in the final determination. The panel agreed that for the North Coast study area RFEF, SCFF, SOAK and SWSF are TECs that have been defined primarily from previous quantitative floristic analyses using Keith and Scott (2005).

From the final determination for each TEC, Table 2 summarises the key determining features of RFEF, SCFF, SOAK and SWSF and how they have been used in the assessment reported here, based on the interpretation of the features by the Panel. General features of potential diagnostic value, common to all four TECs, are described.

Table 2: Key features of floodplain TECs of potential diagnostic value. Most of these features are common to all four TECs but may appear in different paragraphs in each final determination.

Feature	Diagnostic value and use for this assessment
NSW occurrences fall within specified IBRA bioregions	Explicitly diagnostic in most cases, but used with some allowance for occurrence outside. This assessment focuses on the region north of Sydney and as a result only the Sydney Basin (in part) and North Coast bioregions are considered
Associated with specified soil types	Indicative, not used
On periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (also lake margins and estuarine fringes for SOAK)	Diagnostic, depending on agreed definition of landform features
Generally occurs below specified elevation 20 m for SOAK, 50 m for others), but RFEF and SCFF may occur on localised river flats up to 250 m	Implicitly diagnostic; 250 m elevation used as a threshold unless there is clear evidence otherwise
Structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees and some TECs include treeless vegetation	Indicative, but used to exclude treeless vegetation where indicated by the determination
Characterised by the plant species listed in paragraph 1	Potentially diagnostic, in the context of previously described communities cited in the determination
Known from specified LGAs but may occur elsewhere.	Indicative, not used

Feature	Diagnostic value and use for this assessment
Specified most frequent, common, dominant or locally abundant tree species	Indicative, not used except to separate closely similar communities which could otherwise be considered to belong to more than one TEC
General description of understorey	Indicative, not used
Description of differences in tree species composition and environmental differences from other EECs on coastal floodplains	Indicative, but used to distinguish areas which are floristically similar to two or more EECs
Explicit citation of previously described map units or communities	For communities that can be adequately defined, these citations are used as the main comparative diagnostic feature, including qualifications of individual communities relating to tree species composition and environmental features, to the extent that those features can be recognised. Vaguely defined communities or map units are regarded as indicative and not used for diagnosis

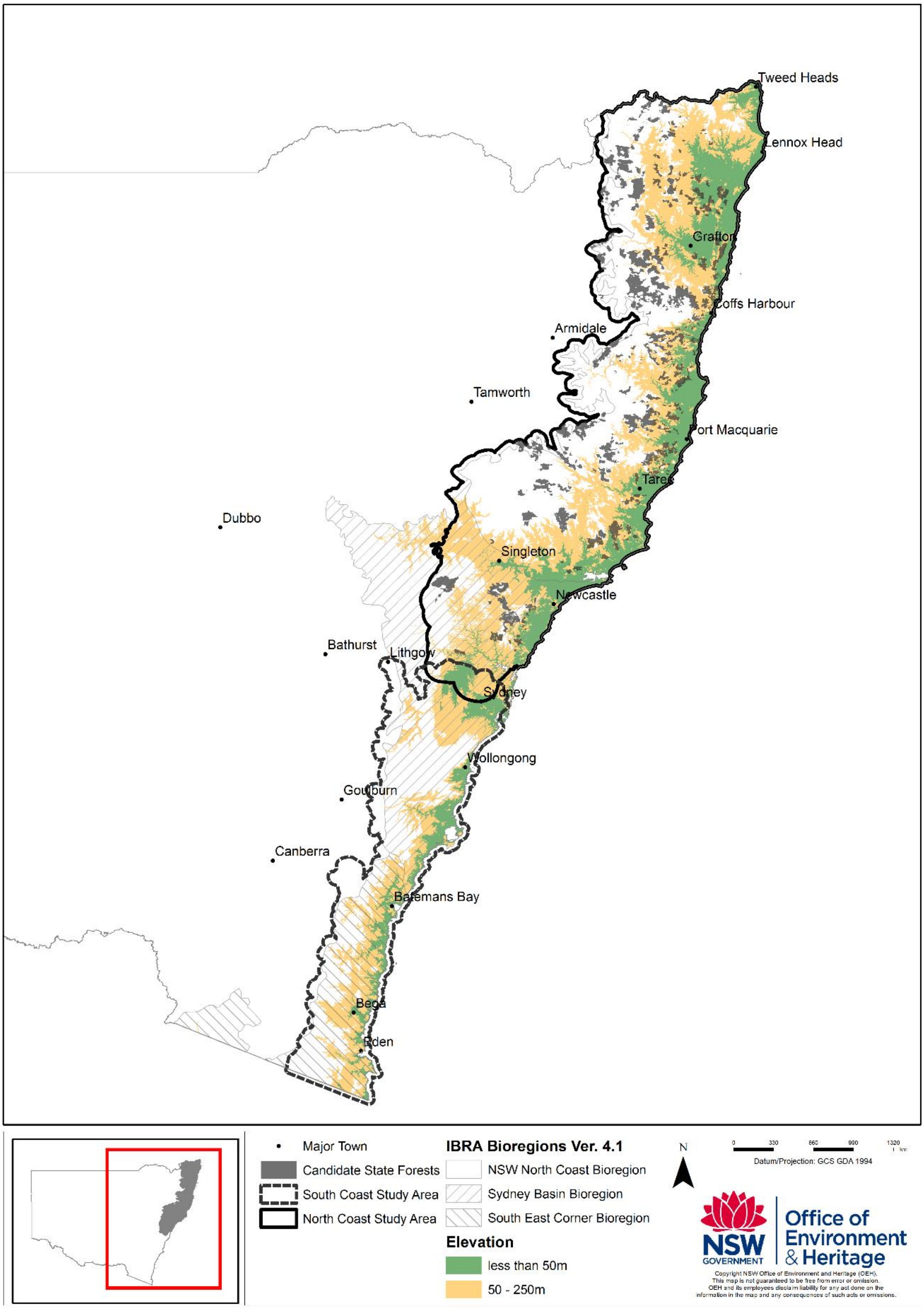
2.4 Assessment Area

Location and study area boundaries

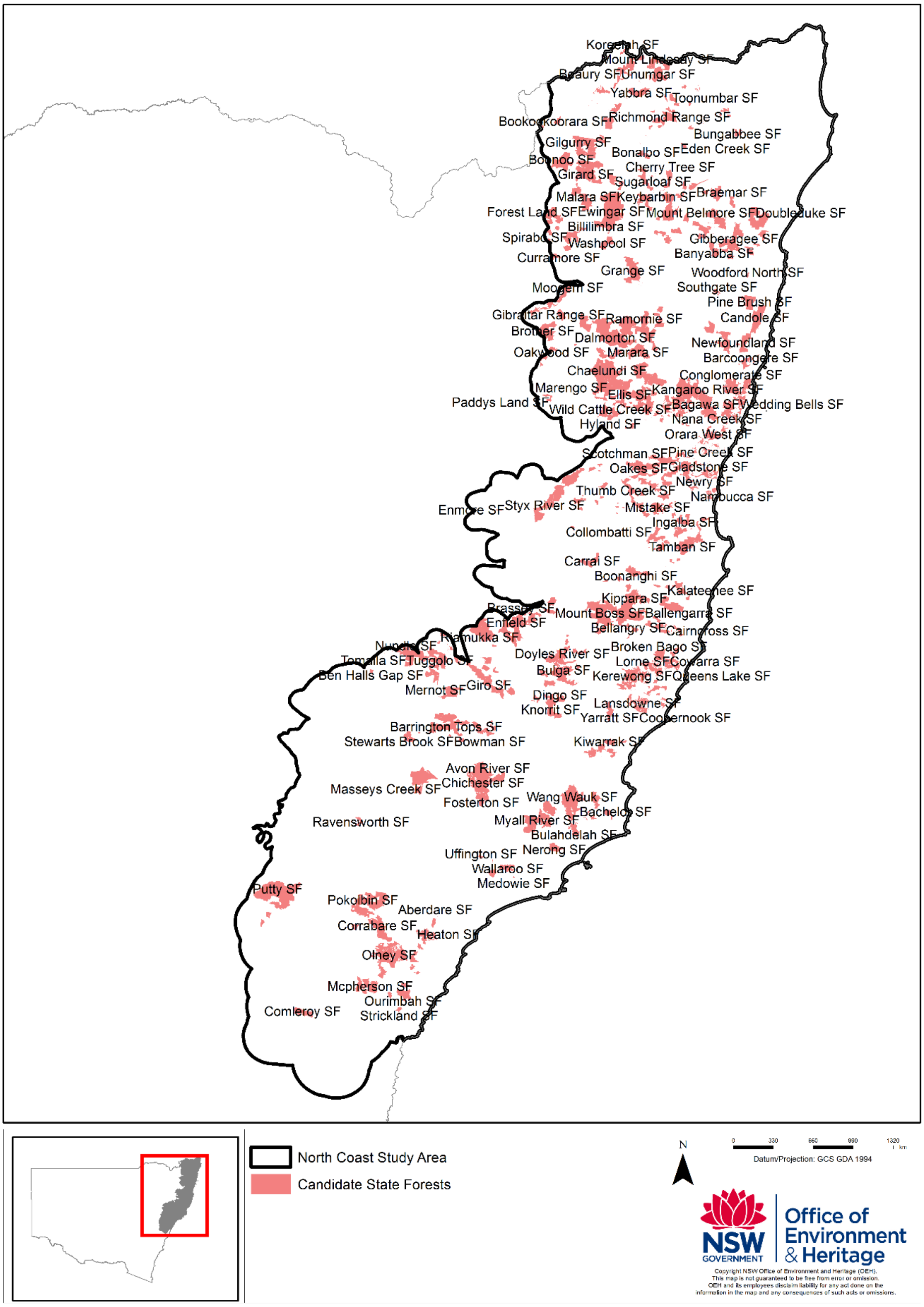
We partitioned the assessment of the floodplain TECs into two study areas: the North Coast and South Coast. We did this to minimise the risk that relationships between regional vegetation communities and the TECs would be confounded or masked by geographical variation or other major ecological gradients, which might otherwise be a significant risk if we had treated the full latitudinal range of each TEC as a single study area. We have previously reported assessments of RFEF, SWSF and SOAK for the South Coast (OEH 2016a, OEH 2016b, OEH 2016c). SCFF is determined only for the North Coast bioregion; however, we have considered its entire distribution within our North Coast study area. For our purpose, the Sydney metropolitan area provides a convenient boundary because it approximates a significant ecological boundary and because it is a highly modified landscape that does not contain any state forest to be assessed for our project.

Our North Coast study area is shown in Maps 1 and 2. This area includes all of the North Coast bioregion and all IBRA subregions north from the Hawkesbury River in Sydney Basin bioregion. We considered that this would include all vegetation relevant to any floodplain TEC likely to occur in state forests on the NSW North Coast, from Sydney north to the Queensland border. Within our North Coast study area, there are no lowland state forests south of Hawkesbury River.

Map 1: North and South Coast assessment areas showing elevation thresholds less than 50 metres and 50 - 250 metres.



<u>Map 2</u>: Candidate state forests in the North Coast study area.



State forests subject to assessment

Table 3: List of candidate state forests to be assessed in the North Coast study area.

Candidate State Forest (SF)	Area (Ha)	Candidate State Forest (SF)	Area (Ha)
Aberdare SF	6	Lansdowne SF	4,118
Avon River SF	5,061	Little Newry SF	189
Awaba SF	1,784	London Bridge SF	118
Bachelor SF	2,642	Lorne SF	3,257
Bagawa SF	5,384	Lower Bucca SF	2,621
Bald Knob SF	1,695	Lower Creek SF	1,270
Ballengarra SF	6,106	Malara SF	3,352
Banyabba SF	2,674	Marara SF	5,351
Barcoongere SF	320	Marengo SF	10,128
Barrington Tops SF	12,588	Maria River SF	1,815
Beaury SF	4,568	Masseys Creek SF	3,127
Bellangry SF	6,411	Mcpherson SF	6,488
Ben Halls Gap SF	351	Medowie SF	50
Billilimbra SF	3,853	Mernot SF	4,338
Boambee SF	821	Middle Brother SF	2,131
Bom SF	872	Mistake SF	5,638
Bonalbo SF	1,456	Moogem SF	1,135
Bookookoorara SF	915	Moonpar SF	1,821
Boonanghi SF	3,817	Mororo SF	379
Boonoo SF	3,968	Mount Belmore SF	9,181
Boorabee SF	914	Mount Boss SF	17,165
Boorook SF	2,990	Mount Lindesay SF	3,046
Boundary Creek SF	2,539	Mount Marsh SF	3,636
Bowman SF	3,187	Mount Mitchell SF	2,323
Braemar SF	2,002	Mount Pikapene SF	553
Brassey SF	745	Mount Seaview SF	1
Bril SF	2,333	Muldiva SF	687
Broken Bago SF	3,543	Myall River SF	13,611
Brother SF	6,179	Myrtle SF	4,303
Buckra Bendinni SF	1,766	Nambucca SF	1,510
Bulahdelah SF	7,799	Nana Creek SF	1,793
Bulga SF	14,254	Nerong SF	2,173
Bulls Ground SF	2,010	Never Never SF	3
Bungabbee SF	1,097	Newfoundland SF	5,939
Bungawalbin SF	1,204	Newry SF	2,841
Burrawan SF	2,040	North Branch SF	796
Cairncross SF	4,487	Nowendoc SF	3,765
Camira SF	4,009	Nulla-five Day SF	3,370
Candole SF	6,574	Nundle SF	3,279

Candidate State Forest (SF)	Area (Ha)	Candidate State Forest (SF)	Area (Ha)
Carrai SF	3,028	Nymboida SF	6,400
Carwong SF	603	Oakes SF	7,639
Chaelundi SF	18,238	Oakwood SF	2,135
Cherry Tree SF	1,636	Old Station SF	230
Cherry Tree West SF	321	Olney SF	17,795
Chichester SF	20,539	Orara East SF	3,983
Clouds Creek SF	10,241	Orara West SF	4,459
Cochrane SF	231	Ourimbah SF	3,571
Collombatti SF	4,126	Paddys Land SF	907
Comboyne SF	2,576	Pappinbarra SF	1,181
Comleroy SF	2,904	Pee Dee SF	62
Coneac SF	777	Pine Brush SF	3,966
Conglomerate SF	5,162	Pine Creek SF	1,219
Coopernook SF	871	Pokolbin SF	14,030
Corrabare SF	5,197	Putty SF	22,252
Cowarra SF	1,687	Queens Lake SF	576
Curramore SF	84	Ramornie SF	6,175
Dalmorton SF	27,937	Ravensworth SF	901
Devils Pulpit SF	1,484	Riamukka SF	10,029
Diehappy SF	1,275	Richmond Range SF	6,340
Dingo SF	3,555	Roses Creek SF	1,790
Divines SF	1,524	Royal Camp SF	2,203
Donaldson SF	2,331	Scotchman SF	4,158
Doubleduke SF	5,824	Sheas Nob SF	4,333
Doyles River SF	7,744	Skillion Flat SF	5
Dyke SF	6	South Toonumbar SF	410
Eden Creek SF	1,179	Southgate SF	628
Edinburgh Castle SF	949	Spirabo SF	4,138
Ellangowan SF	1,179	Stewarts Brook SF	2,417
Ellis SF	9,736	Strickland SF	485
Enfield SF	12,973	Styx River SF	17,148
Enmore SF	169	Sugarloaf SF	3,151
Ewingar SF	18,433	Tabbimoble SF	2,627
Forest Land SF	6,372	Tamban SF	7,632
Fosterton SF	823	Tarkeeth SF	530
Fullers SF	1,053	Thumb Creek SF	3,944
Gibberagee SF	10,574	Tomalla SF	2,107
Gibraltar Range SF	3,113	Toonumbar SF	1,528
Gilgurry SF	9,531	Tuckers Nob SF	1,885
Girard SF	18,851	Tuggolo SF	14,004

Candidate State Forest (SF)	Area (Ha)	Candidate State Forest (SF)	Area (Ha)
Giro SF	9,933	Uffington SF	325
Gladstone SF	6,230	Unumgar SF	3,563
Glen Elgin SF	682	Upsalls Creek SF	923
Glenugie SF	4,952	Urbenville SF	3
Grange SF	7,802	Viewmont SF	702
Gundar SF	119	Wallaroo SF	3,487
Hanging Rock SF	38	Wallingat SF	1,240
Heaton SF	2,236	Wang Wauk SF	8,330
Hyland SF	4,577	Washpool SF	2,961
Ingalba SF	6,632	Watagan SF	3,502
Irishman SF	2,733	Way Way SF	1,268
Johns River SF	725	Wedding Bells SF	4,645
Kalateenee SF	1,344	Whiporie SF	1,109
Kangaroo River SF	11,399	Wild Cattle Creek SF	9,667
Kendall SF	354	Willsons Downfall SF	317
Kerewong SF	3,665	Woodenbong SF	306
Kew SF	897	Woodford North SF	219
Keybarbin SF	3,707	Wyong SF	726
Kippara SF	5,554	Yabbra SF	8,417
Kiwarrak SF	6,535	Yango SF	684
Knorrit SF	5,081	Yarratt SF	2,381
Koreelah SF	708	Yessabah SF	1,887
Total			**828,639**

2.5 Project Team

This project was completed by the by the Ecology and Classification Team in the OEH Native Vegetation Information Science Branch. It was initiated and funded by the NSW Environment Protection Authority under the oversight of the Director Forestry.

The project was managed by Daniel Connolly. Doug Binns undertook the floristic analysis of survey plots, and has interpreted the relationships and relatedness between relevant vegetation communities. Allen McIlwee performed the spatial analysis including fine scale modelling of alluvial floodplain extent, and broad scale predictive distribution modelling. Owen Maguire, Craig Harré and Bob Wilson undertook API mapping using 3D stereo imagery across the study area. Flora survey plots were completed by Andy Baker, Stephen Bell, Andrew Benwell, Lachlan Copeland, Liz Brown and Stephen Griffith, with additional samples completed by Doug Binns.

3 Methodology

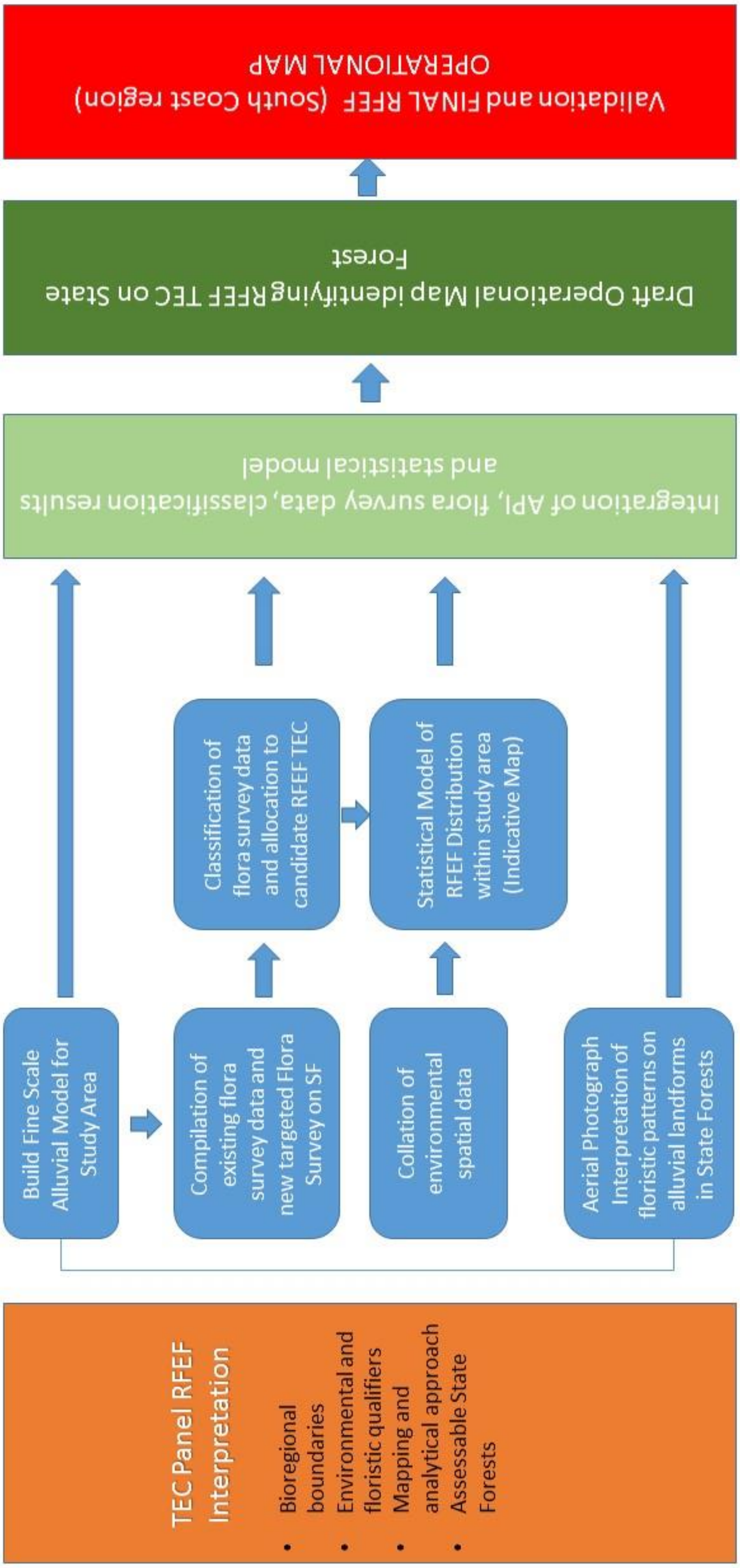
3.1 Approach

Diagram 1 provides a schematic overview of our approach. Analysis and mapping was guided by the general principles and particular interpretation of the TECs adopted by the TEC Reference Panel, described in Section 2.3. For the purpose of this project, RFEF, SCFF, SOAK and SWSF are interpreted to be defined primarily by floristic plot data. A major part of our assessment is to allocate all relevant plot data to currently defined floristic communities, or to new communities where required. We then assess those communities in relation to floristic information given in the final determinations, including any floristic communities that are explicitly cited. For the southern part of our study area, in the lower Hunter River valley, the determinations for RFEF, SOAK and SWSF explicitly cite vegetation communities that have been previously described from quantitative floristic analysis (NPWS 2000). However, for SCFF and for RFEF, SOAK and SWSF in the remainder of our study area, there are no quantitatively described vegetation communities that are explicitly cited in the determinations. In the absence of explicit reference communities, we have relied on comparisons with the groups described by Keith and Scott (2005) and with the determination assemblage lists, to make an assessment of the extent to which vegetation communities belong to a TEC. In any case, both Keith and Scott (2005) and NPWS (2000) have been superseded by more recent studies using a larger pool of data and this sometimes creates inconsistencies between currently recognised communities and those that were previously described.

The final determinations do not cite a map resource that can be used as a primary layer to guide the location of suitable landscape features used in the TEC definitions. Since the date of the initial determinations, a set of maps of landform features has been developed which allows parts of the cited communities that are mapped on floodplains or mapped on alluvial soils to be distinguished to some extent, although the scale is not always suitable for our purpose and finer-scale alluvial features are omitted (Troedson & Hashimoto 2008). There is no reference to these maps in any of the amended determinations. In addition to these maps, we have developed a fine scale alluvial model, described in Section 3.2, to map areas of potential alluvial features.

Plots in which standard floristic data have been collected (comprising data already held in the OEH VIS flora survey database over all tenures and data collected specifically for this project in state forests) were compared with plots assigned to previously defined communities relevant to the determinations. A number of methods were used for comparison, comprising both dissimilarity-based methods and methods based on multivariate regression. The results were then used to assess the likelihood that plots in state forests belonged to one or more of the communities listed in or otherwise related to each determination. There is no single preferred method of making these comparisons and no objective threshold to determine whether or not a plot belongs to a community (and thus a TEC). Options for different methods and thresholds represent narrower or broader interpretations of TECs, but this approach using plot-based floristic comparison provides a means of consistently allocating plots to being either TEC or not for a range of interpretation options.

<u>Diagram 1</u>: Example work flows for River-flat Eucalypt Forest.

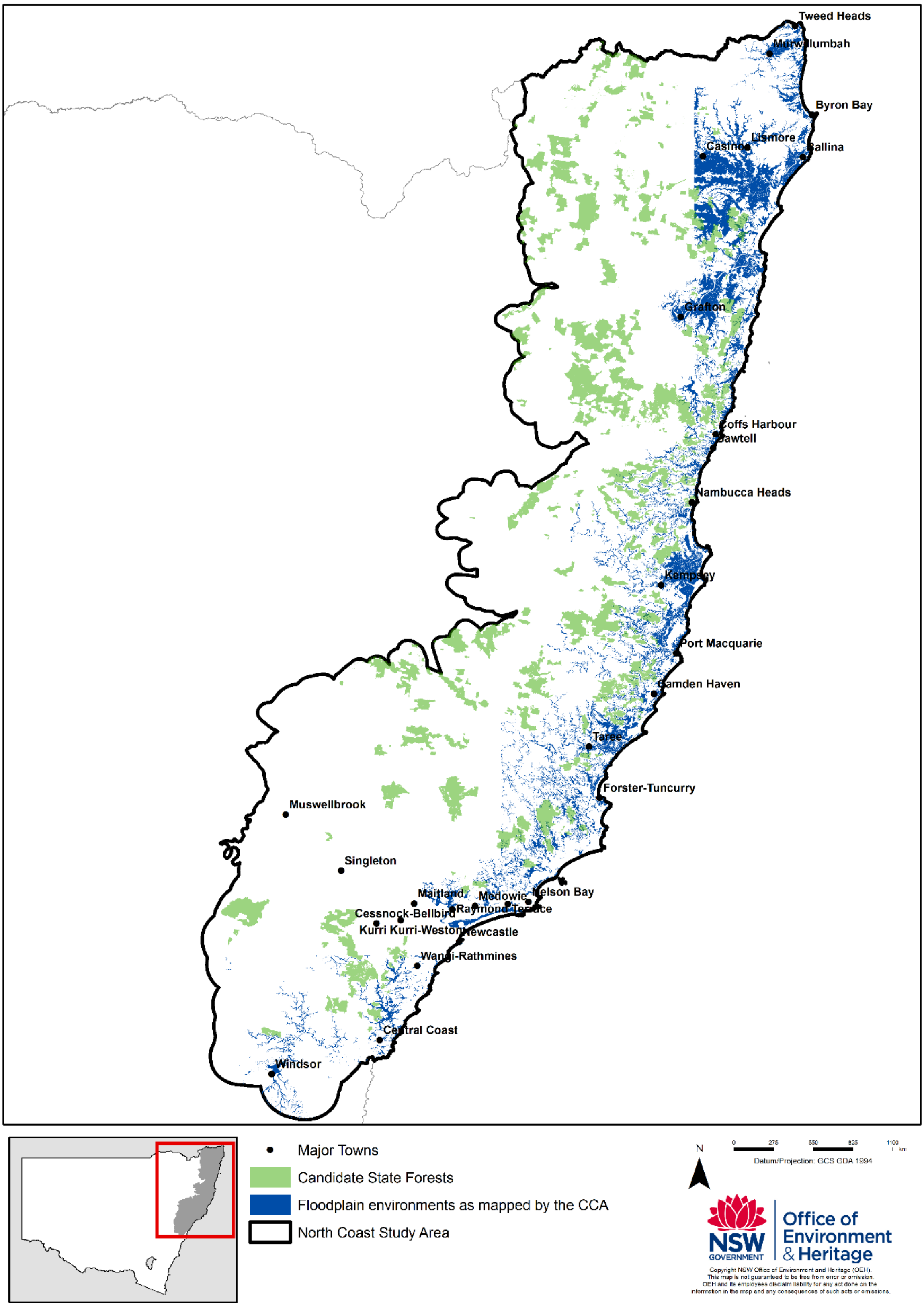


3.2 Identifying Alluvial Landforms

Coastal comprehensive assessment floodplain maps

Troedson and Hashimoto (2008) describe a series of maps of Quaternary geology and related features, used for a comprehensive coastal assessment. We have used all the alluvial surface geology units from these maps to define areas of mapped alluvium and we have used map unit descriptors to define areas of coastal floodplains at 1:25 000 scale (shown at a smaller scale in Map 3).

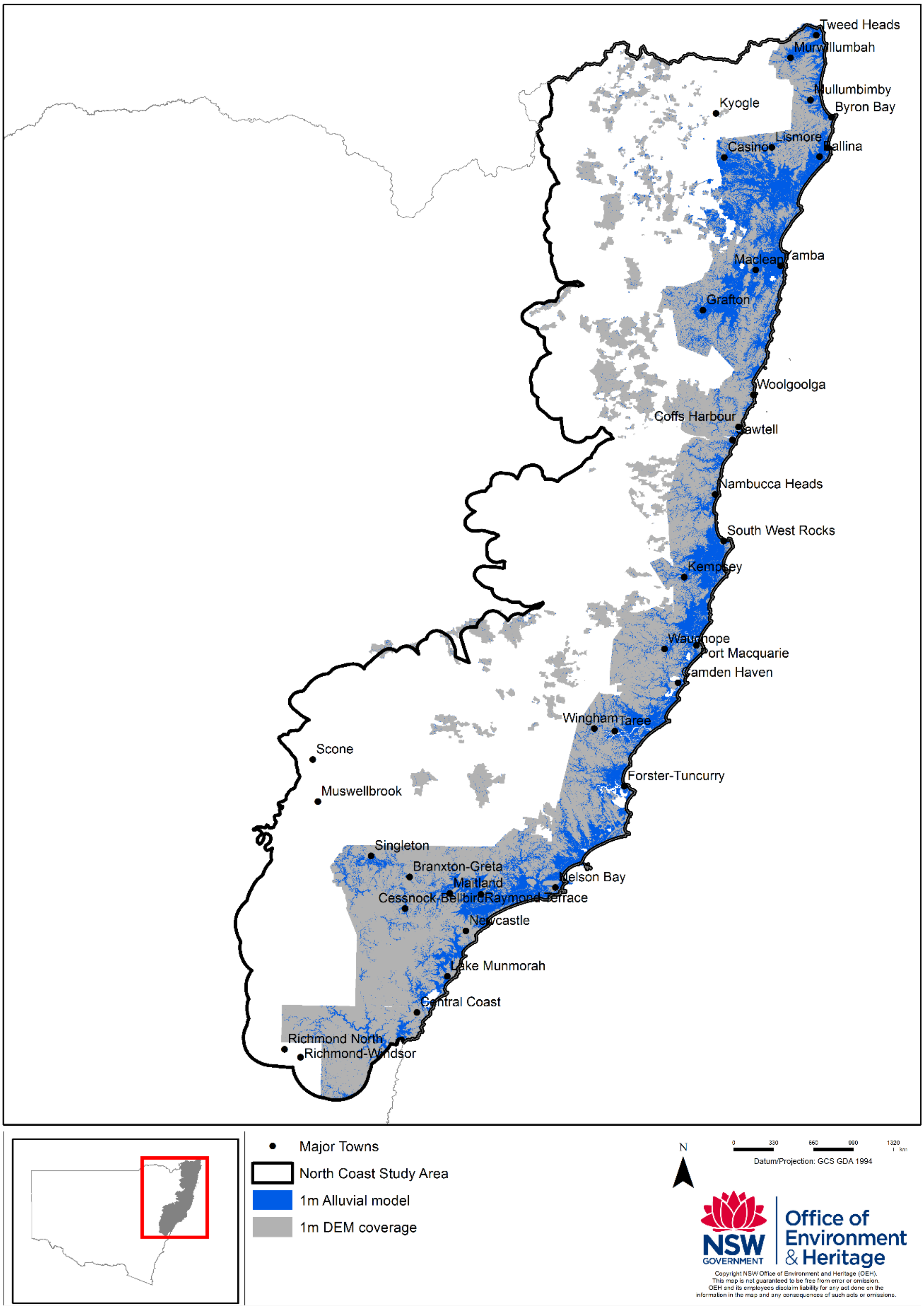
<u>Map 3</u>: Floodplain environments as mapped by the comprehensive coastal assessment program.



Fine scale alluvial model

We generated a fine scale digital representation of landscape elements in the study area that are likely to be associated with the range of floodplain and alluvial descriptors offered by the floodplain TEC final determinations (Map 4). The concept for the model is that floodplain and alluvial environments relevant to floodplain TECs occur in areas which are flat or have low slope and which receive either run-on flow, pooling or overbank flow at above particular thresholds, which vary with slope and catchment size. The model uses a 1-metre resolution, filled DEM derived from LiDAR data to calculate flow accumulation, elevation above stream channels along the lines of flow, and slope. Stream channels are defined at catchments >= 0.5 hectares. Thresholds are applied to combinations of the three variables to delineate areas of alluvial/floodplain landforms. We used these maps in conjunction with the CCA maps as a basis of habitat assessment for River-flat Eucalypt Forest, Swamp Oak Floodplain Forest, Subtropical Coastal Floodplain Forest and Swamp Sclerophyll Forest. The set of mapped polygons in Map 4 were used as a starting point to identify plots for new floristic surveys, as well as API digitising and mapping.

Map 4: Distribution of alluvium as modelled from a 1 metre DEM.



3.3 Compilation of Existing Vegetation Data

3.3.1 Vegetation classifications

Keith and Scott (2005) conducted a quantitative analysis of vegetation on coastal floodplains and associated landforms in eastern NSW. Their results were the basis for, or at least contributed to, developing final determinations for coastal floodplain TECs. They used a heterogeneous set of data, which they reduced to species presence/absence, to minimise inconsistencies among recording methods. Keith and Scott described 34 floristic groups. They considered five of these groups as floodplain vegetation. As described in Section 2.2, the five groups correspond by name with five floodplain vegetation TECs (Table 1) and although not explicit, it may be inferred that these groups are included in the TEC with similar name. Despite being regarded as floodplain vegetation, a comparison with landform units mapped by Troedsen and Hashimoto (2008) shows only 25% of these floodplain units are mapped strictly on floodplain and by Keith and Scott's own assessment (according to allocations in OEH files), only 40% of these plots are assessed as 'floodplain'. However, this is consistent with the vague language used in the determinations, to include areas 'associated with' coastal floodplains. Other frequent landform units mapped for the floodplain vegetation groups are backswamps and tidal delta flats.

Three recent regional classifications overlap our study area: Northern Rivers (OEH 2012), Hunter-Central Rivers (Sivertsen et al. 2011) and Sydney Basin (OEH in prep). These classifications post-date the final determinations and the vegetation communities are not cited in any of the determinations and cannot be used directly as reference points for TEC assessment. However, they provide an existing framework within which we were able to analyse and assign floristic plots, including the data originally used for the classifications, existing data collected from plots not previously assigned to a vegetation community and data collected specifically for our project. Some plots were used in two or more classifications, where they occurred in the zone of geographic overlap along a common boundary. In the case of Hunter-Central Rivers and Sydney Basin, there is a very large zone of overlap. We reviewed these classifications to determine their overall consistency and to identify communities which may be poorly sampled, poorly characterised, heterogeneous or not distinct from other communities. We needed to understand these characteristics to allow new data to be allocated to existing communities in a consistent manner.

3.3.2 Existing vegetation data

A recent review of OEH systematic flora survey data holdings in eastern NSW (OEH in prep) was available for the project. The review identified a subset of data suitable for use in quantitative vegetation classification on the basis that it met a set of predefined criteria, namely that plots:

- provided location co-ordinates with a stated precision of less than 100 metres in accuracy
- covered a fixed survey search area of approximately 0.04 hectares
- supported an inventory of all vascular plants
- provided a documented method that assigns a quantitative and/or semi quantitative measure of the cover and abundance of each species recorded.

A total of 23,670 plots within the study area, including 520 plots surveyed specifically for our project, were in the OEH VIS Flora Survey Database at 20 June 2016. We used 15,065 of these for floristic analysis, including all data assessed as suitable for quantitative vegetation classification. The data included 5521 plots previously used in the Northern Rivers classification, 3687 used in the Hunter-Central Rivers classification and 6792 used in the

Sydney Basin classification. A substantial number of plots were used in more than one of these classifications.

3.3.3 Data preparation and taxonomic review

All species in the pooled dataset were standardised for analysis using a review completed for all flora survey data compiled for the Eastern NSW Classification (OEH in prep). Nomenclature was standardised to follow Harden (1990-93; 2000-2002) and updated to reflect currently accepted revisions using the PlantNETWebsite (Royal Botanic Gardens 2002). The data was amended to:

- exclude exotic species
- exclude species identified to genus level only
- improve consistency in assignment of subspecies or varieties to species.

Cover and abundance score data extracted from the pooled data set was standardised to a six class modified braun-blanquet score. The transformation algorithm available within the OEH VIS Flora Survey data analysis module was applied to the analysis dataset.

3.4 New Survey Effort

3.4.1 Survey stratification and design

We used the alluvial model with a 50-metre perimeter buffer as the basis for new survey. We applied a systematic grid across the area mapped as alluvium using the alluvial model, including the buffer zone. We randomly selected plots from the grid, with a higher sample intensity within the mapped alluvium compared to buffer. We applied an exclusion zone based on existing plots by rejecting a new plot location if it was within 250 metres of an existing plot assessed as suitable for quantitative analysis. Our aim was to ensure, as far as practicable, that as many state forests across the extent of our study area included plots located on and adjoining our alluvial model.

3.4.2 Survey method

Systematic surveys

Systematic flora survey were conducted in accordance with OEH standard methods (Sivertsen 2009). Preselected sample points were located in the field using a global positioning system (GPS). In the field, plots were assessed for the presence of heavy disturbance (such as severe disturbance through clearing or weed infestation) and were either abandoned or moved to an adjoining location in matching vegetation.

Systematic floristic sample plots were fixed to 0.04 hectares in size. The area was marked out using a 20 by 20 metre tape, although in some communities (such as riparian vegetation) a rectangular configuration of the plot (e.g. 10 by 40 metres) was required. Within each sample plot, all vascular plant species were recorded and assigned estimates for foliage cover and number of individuals. Raw scores were later converted to a modified 1-8 braun-blanquet scale (Poore 1955) as shown in Table 4.

Table 4: Braun-blanquet-to-cover abundance conversion table.

Modified braun-blanquet 6 point scale	Raw cover score	Raw abundance score
1 (<5% and few)	<5%	≤3
2(<5% and many)	<5%	≥3
3 (5-25%)	≥5 and <25%	any
4 (25%-50%)	≥25% and <50%	any

5 (50%-75%)	≥50% and <75%	any
6 (75%-100%)	≥75%	any

Species that could not be identified in the field were recorded to the nearest possible family or genus and collected for later identification. Species that could not be identified confidently were lodged with the NSW Herbarium for identification. At each plot, estimates were made of the height range, projected foliage cover and dominant species of each vegetation stratum recognisable at the plot. Measurements were taken of slope and aspect. Notes on topographic position, geology, soil type and depth were also compiled. Evidence of recent fire, erosion, clearing, grazing, weed invasion or soil disturbance was recorded. The location of the plot was determined using a hand held GPS or a topographic map where a reliable reading could not be taken. Digital photographs were also taken at each plot.

Non-systematic surveys

Informal field observation points were collected using a range of methods during reconnaissance to support aerial photo interpretation or during traverses to designated sample points. No fixed assessment area was used and the number of species recorded was subject to time and visibility constraints. Observations were supported by a georeferenced location using brief descriptions of vegetation composition and pattern.

3.5 Classification Analyses

3.5.1 Clustering

There is a range of methods available for quantitative classification of vegetation communities. Results may vary depending on which method is used and which parameters are chosen for a particular method. There is no single best method, but the most widely used method is clustering of plots based on pairwise dissimilarities. As results vary with varying dissimilarity measures, comparisons with previous classification require use of the same measures. Relationships among plots vary depending on the data pool used, so that introducing additional data may change the composition of previously defined groups.

Most clustering methods result in a plot being allocated to a single vegetation community. A plot may also be related to other communities, but these interrelationships are not evident from allocations. As an alternative, fuzzy clustering methods assign a membership value to each plot for each community, which provides a measure of the likelihood that a plot belongs to any particular community. For this project, Noise Clustering (De Cáceres, Font & Oliva, 2010; Wiser & De Cáceres 2013) was selected as the most appropriate fuzzy clustering method for three reasons: it allows specification of fixed clusters defined from previously described groups and provides direct allocations to those groups; it is relatively robust to outliers (which have a large difference from all previously defined groups or communities) and allows clustering into new groups; and it is robust to the prevalence of transitional plots with relationships to two or more previously defined communities. The latter are both characteristic of data for the study area. Noise Clustering requires specification of a fuzziness coefficient (where a coefficient of 1 is equivalent to hard clustering which allocates each plot to only one community) and a threshold distance for outliers. Following a number of trial runs with different subsets of data, different fixed groups and different parameters, we chose a fuzziness coefficient of 1.1 and an outlier threshold of 0.8. These parameters resulted in results which were relatively robust to different sets of data and which had a high degree of consistency with previous classifications. Analyses were completed using functions in the ‘vegclust’ package in R 3.1.1.

We conducted a number of analyses using different subsets of data and different sets of previously defined communities, as follows:

1. A subset of 7864 plots which comprised all plots within our study area previously allocated to a vegetation community by Northern Rivers classification (OEH 2012), plus all previously unallocated plots north of -32°.91 latitude (the approximate southern extent of the Northern Rivers study area).
2. A subset of 9089 plots which comprised all plots within our study area previously allocated to a vegetation community by Hunter-Central Rivers classification (Sivertsen et al. 2011), plus all previously unallocated plots south of -31.25° latitude (the approximate northern extent of the Hunter-Central Rivers study area).
3. A subset of 5100 plots which comprised all plots within our study area previously allocated to a vegetation community by Sydney Basin classification (OEH in prep), plus all previously unallocated plots south of -32.91 (the approximate northern extent of the Sydney Basin study area).

3.5.2 Multivariate regression

We used multivariate regression to make pair-wise comparisons of selected pairs of communities to test their degree of floristic similarity to other pairs, using the 'mvabund' package in R3.1.1 (Warton, Wright & Wang 2012). This method does not rely on calculation of dissimilarities so provides an independent comparison with distance-based methods. For each pair, the difference in summed AIC is calculated, summed across all species in both communities combined, between a null model and a model using community as the factor. The difference in summed AIC provides a relative measure of the extent to which recognising two separate communities provides a better model of species occurrence than does a single combined group. A higher difference indicates communities that are more clearly distinct. A difference close to zero, or negative, indicates no distinction between groups. We also used the results of multivariate regression to identify species that are most strongly characteristic of difference between groups. Species with the highest difference between AIC for the group model and that for the null model are those with most diagnostic value.

3.5.3 Other methods

For comparisons with Keith and Scott communities, we calculated mean Bray-Curtis dissimilarity between each Keith and Scott community and each of the communities derived from analyses described in Section 3.5.1, using plots which had Keith and Scott groups assigned, based on an assignment list provided by David Keith. For this purpose, we used only those plots assigned to a Keith and Scott group that were assessed by the OEH review (2.3.2) as suitable for quantitative floristic analysis, consistent with our other analyses.

We made a comparison between the assemblage as listed in the final determinations and each of the communities derived from analyses described in Section 3.5.1. For these comparisons we used plots which could be allocated to a community with a high degree of confidence (membership >=0,5 from fuzzy clustering results) and excluded ambiguous plots. We also made a similar comparison based on original allocations. We based the comparisons on the mean proportion of the assemblage species for each TEC per plot for each community. These measures cannot be used in an absolute sense since the determination does not provide any indication of thresholds. However, they are potentially useful in a relative sense, particularly when used in the context of communities, if any, which are cited in a determination.

3.5.4 Assessment of vegetation communities as TEC

There are very few relevant vegetation communities that occur in our study area which are cited in any of the final determinations, and all of these communities have been revised in more recent classifications. We examined relationships between each of these cited communities and vegetation communities used in our project (those previously defined in the Northern Rivers, Hunter-Central Rivers and Sydney Basin classifications plus new groups formed from our analyses). If a community used in our project includes plots from a cited community, we assessed it as TEC unless it included a single, or very few, plots that belonged to a larger group of plots that were not part of any cited community, and the community to which they belonged was relatively highly dissimilar to any TEC.

In the majority of cases, for which communities used in our classification comprised new data or data from outside the range of any cited community, we made the assessment in relation to the group of TECs based on the similarity to the assemblage lists cited in the final determinations, and the similarity to groups described by Keith and Scott (1995) which were inferred to be included in each of the determinations. In cases where there was inconsistency among relationships with cited communities, determination assemblage lists and Keith and Scott groups, a subjective assessment was required to resolve the inconsistency. We took a precautionary approach and we were guided by the TEC Panel in deciding whether a particular community belonged to a TEC.

3.5.5 Allocation of floristic plots to vegetation communities

We assessed plots as belonging to a previously defined floristic community if their membership of the community was 0.5 or above. We considered that plots which were assigned to new groups in all our analysis subsets and which did not have membership >=0.5 of any existing community belonged to potentially new vegetation communities. We have described these where they are related to one of the TECs using the assessment methods described in 2.5.4, but have made no further attempt to do so otherwise.

3.6 Indicative TEC Distribution Map

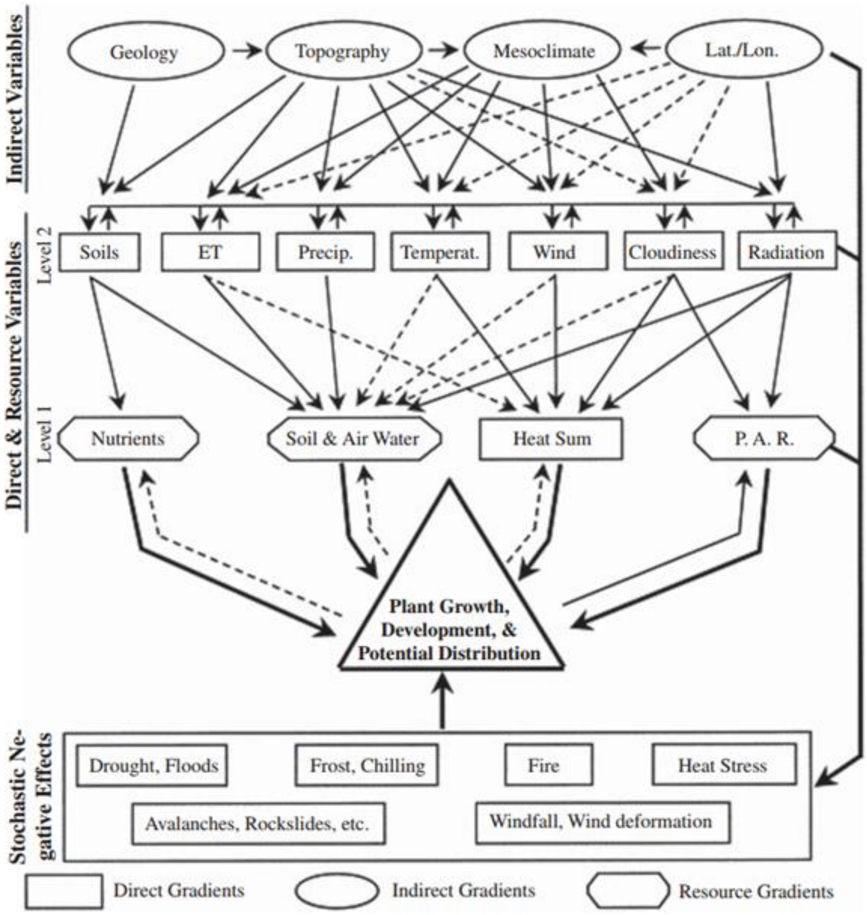
3.6.1 Background

A niche modelling approach (also known as species or habitat distribution modelling) was used to create indicative potential distribution map of each of the TEC communities. This approach attempts to extrapolate the fundamental niche of the TEC in question outside the locations where it is known to be present (its realised niche), by relating known occurrence and absence to environmental predictors.

Modelling the distribution of a TEC requires the characterisation of environmental conditions that are suitable for the community to exist. The inclusion of the absence data from the plot allocation allows us to constrain the potential distribution model to a narrow set of favourable environmental conditions that are not occupied by other vegetation communities. Nonetheless, without API and associated on-ground validation, it is difficult to determine the extent to which potentially suitable habitat is actually occupied by the TEC.

Ecological niche modelling involves the use of environmental data describing factors that are known to have either a direct (proximal) or indirect (distal) impact on a species or ecological community. Proximal variables directly affect the distribution of the biotic entity, while distal variables are correlated to varying degrees with the causal ones (Austin 2002). Austin & Smith (1989) differentiate between indirect gradients, which have no physiological effects on plants, and direct or resource gradients, which directly influence plant growth or distribution. Direct or resource gradients mainly concern light, temperature, water and nutrients, whereas the main indirect gradients are altitude, topography and geology (Austin & Van Niel 2011). An environmental variable may act both as a resource that provides building blocks for growth processes and as a condition that fulfils the requirements for physiological processes to function effectively.

Diagram 2 provides a basic conceptual framework for how plant communities are likely to respond to their environment. Arrows in the figure show how particular indirect variables interact to generate more direct environmental drivers through biophysical processes. It should be noted that plant distributions are also influenced by stochastic processes such as extreme heat or cold, landslip or erosion, high winds, drought, flood and fire. However, in niche modelling, we assume that the composition of vegetation is primarily determined by environment rather than successional status or by time since last disturbance (Franklin 1995). It is also assumed that vegetation is in equilibrium with the environment, or at least a quasi-equilibrium where change is slow relative to the life span of the biota.

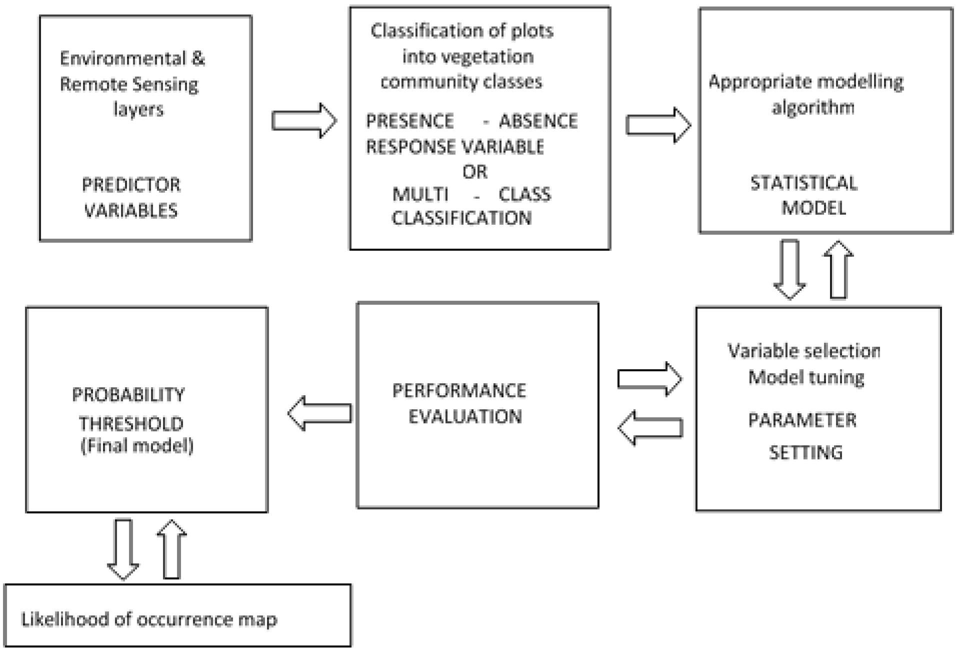


<u>Diagram 2</u>: Conceptual model of relationships between resources, direct and indirect environmental gradients and their influence on growth, performance and geographical distribution of plants and vegetation communities in general. Source: Guisan and Zimmermann (2000; Figure 3).

Diagram 3 provides an overview of the step-by-step modelling process, which involves a ‘classification-then-modelling’ approach (Ferrier et al. 2002) with two distinct stages. In the first stage, the biological survey data is subjected to a vegetation classification and full-floristic vegetation plots are allocated to presence/absence category for each TEC. This classification is run without any reference to the environmental data. In the second stage, the community-level TEC entities defined by the classification are modelled as a function of environmental predictors. Each of the TEC communities have been modelled separately by relating the observed presence or absence of the community to available environmental predictors. Alternatively, it is possible to fit a model to all communities simultaneously by treating community membership as a multinomial response (e.g. using multinomial boosted regression trees).

The statistical model refers to the choice of (i) a suitable machine learning algorithm for predicting a presence-absence response variable and its associated theoretical probability distribution, and (ii) choice of an appropriate variable selection procedure that either has the goal of optimising prediction accuracy or interpretability.

Diagram 3: Process for creating indicative TEC distribution maps.



3.6.2 Modelling complex ecological systems

The niche modelling community has made considerable headway in developing machine learning algorithm to predict the occurrence of species and communities using presence-absence data (Evans & Cushman 2009). The methods model vegetation patterns as continuous measures of site suitability or probability of occupancy. Non-parametric approaches such as Classification and Regression Trees (CART) have gained widespread use in ecological studies (De'ath & Fabricius 2000). However, CART suffers from problems such as over-fitting and difficulty in parameter selection. Solutions to deal with these issues have been proposed that incorporate iterative approaches (Breiman 1996). One approach, Random Forests (Breiman 2001), has risen to prominence due to its ability to handle large numbers of predictors and find signal in noisy data (Cutler et al. 2007). Another advantage of Random Forests is that, by permutation of independent variables, it provides local and global measures of variable importance.

Random Forests is an algorithm that developed out of CART and bagging approaches. By generating a set of weak-learners based on a bootstrap of the data, the algorithm converges on an optimal solution while avoiding issues related to CARTs and parametric statistics (Cutler et al. 2007). Ensemble-based weak learning hinges on diversity and minimal correlation between learners. Diversity in Random Forest is obtained through a Bootstrap of training, randomly drawing selection of M (independent variables) at each node (defined as m), and retaining the variable that provides the most information content. To calculate variable importance, improvement in the error is calculated at each node for each randomly selected variable and a ratio is calculated across all nodes in the forest.

The algorithm can be explained by:

1. Iteratively construct *N* Bootstraps (with replacement) of size *n* (36%) sampled from *Z*, where *N* is number of Bootstrap replicates (trees to grow) and *Z* is the population to draw a Bootstrap sample from.
2. Grow a random-forest tree T_b at each node randomly select *m* variables from *M* to permute through each node to find best split by using the Gini entropy index to

assess information content and purity. Grow each tree to full extent with no pruning (e.g., no complexity parameter).
3. Using withheld data (OOB, out-of-bag) to validate each random tree T_b (for classification OOB Error; for regression pseudo R^2 and mean squared error).
4. Output ensemble of random-forest trees

$$\{T_b\}\frac{B}{1}$$

To make a prediction for a new observation x_i:
Regression:

$$\hat{f}_{\mathrm{rf}}^{B}(x) = \frac{1}{B}\sum_{b=1}^{B} T_b(x)$$

Classification: Let $\hat{C}_b(x)$ be the class prediction of the Bth random-forests tree then

$$\hat{C}_{rf}^{B}(x) = \text{majorityvote}\left\{\hat{C}_b(x)\right\}\frac{1}{B}$$

Commonly, the optimal m is defined for classification problems as sqrt (M); and for regression M/3, where M is a pool of independent variables. It is widely recognised that Random Forest is robust to noise even given a very large number of independent variables (Hastie et al. 2009).

All Random Forest modelling was performed in the statistical software package R version 3.3.0.

3.6.3 Spatial data and the variable selection process

A set of 175 variables were available for modelling. These include a set of:

1) 130 continuous environmental variables relating to climate, topography and Euclidean distance to features such as the coastline, permanent water bodies and various stream orders
2) 32 variables derived from Landsat and Spot 5 imagery, and
3) 13 categorical variables such as great soil group and single dominant lithology type, which were extracted from state-wide corporate GIS layers.

All variables were in the form of gridded Erdas Imagine rasters (*.img), with exactly the same cell size (30 x 30 metres) and extent.

The raster layers were stacked in R using the Raster Package (Hijmans & van Etten 2014). The grid cell values for each of the 175 potential predictor variables were extracted for each site in the allocation file using a customised script in R, and the resulting csv file loaded into R. To improve model fit we tested for multicollinearity between the site values across the predictors using the ‘multicollinear’ function in the rfUtilities library using a significance value of 0.001. To check whether the collinear variables were in fact redundant, we performed a ‘leave one out’ test that identifies whether any variables are forcing other variables to appear multicollinear.

Random Forest models are a good starting point for making inferences about the factors driving the distribution of a plant species or ecological community. However, they are data driven models, whose purpose is to give the best possible predicted extent for the data available, and the complexity of spatial pattern. Variable selection is a crucial step in the modelling process. We used a variable selection procedure developed by Murphy et al. (2010) which standardises the relative importance values of predictors to a ratio and iteratively subsets variables within a given ratio, running a new model for each subset of variables. Each resulting model is compared with the original model, which is held fixed. Model selection is achieved by optimising model performance based on a minimisation of both 'out-of-bag' error and largest 'within-class' error for classification. There is also a penalty for the number of variables selected in a model, resulting in a preference for the lowest number of predictors from closely competing models.

For each model generated, we also checked whether the shape of the fitted functions made sense based on our knowledge of the types of environments that the TECs are constrained to. When a TEC did not model well into the environments we expected it to occur, we went back and re-examined the site allocation, and made a decision on whether to split the TEC into different communities or sub-types, that each may respond to different environmental drivers.

We also ran Random Forest models using three types of predictor sets. The first used the full set of continuous environmental variables, with the aim of predicting the potential distribution (realised niche) of the TEC in its broadest sense. The second used a combination of continuous environmental and remote sensing variables. The inclusion of remote sensing variables added information about the spectral characteristics of vegetation itself, and its dynamics through time, giving a better reflection of the actual as opposed to potential distribution of the TEC. Categorical variables were not incorporated into the models directly, but the data was occasionally used to compare frequency histograms across presence and absence sites to see if a distinct preference for particular soil type or fertility class existed. However, since the number of absence sites greatly outnumbered the presences, there is generally insufficient data to draw conclusions about clear preferences for one group of soil classes over another.

Through a series of initial trials, we found a third hybrid approach produced the best set of predictors for modelling. Here we used the variable selection process described above to identify a subset of 30 environmental predictors out of the 130 available. We then added the 32 remote sensing variables and reran the same variable selection process, selecting out two subsets, one with 15 and the other with 30 predictors. These numbers were set *a priori* since previous modelling had suggested that a minimum of around 12 predictors (those with the highest relative influence values) was generally needed to get a levelling out of the performance curves (see 3.4 below). Beyond this stabilisation point, one could double or triple the number of predictors in a model, but this would have little effect on overall performance since the new predictors tended to have a very small influence on the model.

3.6.4 Model performance and TEC-habitat relationships

As a means to assess model performance, we plot the predicted probability of occurrence (PO) values for all plots allocated to a TEC (in descending order) against the same number of highest ranked absence plots. A good model was defined as having high PO values across the majority of TEC presence sites, dropping sharply at the end for those plots that occupy marginal environmental space (these could potentially be misclassified false positives). If there is no overlap in PO values for the lowest ranked presence sites and the highest ranked absence sites, performing a classification using any number between these two values will result in the correct prediction of 100% of presence and absence sites. In such a case, there was no need to present a confusion matrix describing the percentage of sites correctly classified.

In most cases, environmental variables strongly dominated the set of 15 predictors, although occasionally one or two remote sensing variables were selected. However, in the set of 30 predictors, it was common for a number of the original environmental variables to drop out and be replaced with remote sensing variables. We found that models with 15 predictors generally had very good performance with 100% of sites allocated to the TEC and 100% of absence sites correctly classified. However, we also found that doubling the number of predictors generally resulted in a better model. Although a tighter fitting, finer threaded potential distribution map was produced, it was sometimes unclear as to whether the additional variables picked up important variation not captured in the main set of 15 predictors, or whether they simply account for noise in the dataset.

To understand and evaluate the habitat relationships for each TEC, we used a combination of the scaled variable importance values for predictors and shape of the response functions in partial plots as a measure of the strength and nature of interactions. From this, we assessed whether the models were likely to predict onto floodplain environments, as we expected them to.

3.6.5 Spatial interpolation

We used the Random Forest models with 15 and 30 variables to create two 30 x 30 metre probability of occurrence maps covering the entire study area. Using the performance plots described above, we selected a single threshold just below the maximum PO across all absence sites to represent the cut off above which the TEC has the potential to occur, and below which, we assumed the TEC is absent. Setting the threshold at the high end of probability of occurrence values for absence sites resulted in a relatively narrow predicted extent. This created a model that matched finer habitat characteristics around known presences but was often a constrained model that also failed to capture some areas we considered likely to include presences in locations with limited survey data. To capture the broader extent, we also created a probability of occurrence map with a threshold 0.05 below the first. This had the effect of selectively extending the model out to cover a larger area (onto a number of sites classified in the site allocation as absent). However, at the slightly lower threshold, we felt more confident that we were capturing the broadest possible extent of the TEC, allowing us to make the decision as to which state forests had the potential to support the TEC, and which did not.

3.7 Operational EEC Map

3.7.1 Initial aerial photograph interpretation

The mapped extent of coastal floodplain by the comprehensive coastal assessment and alluvial model derived from the 1-metre DEM were used as starting point for mapping the distribution of floodplain TECs on state forest using API techniques. Aerial photograph interpretation (API) was used to assess both floristic and structural attributes found on modelled alluvial and related environments. In addition, API was used to modify the boundaries of the modelled alluvial area using a prescribed list of eucalypt, casuarina and melaleuca species in combination with the interpretation of landform elements relevant to alluvial and floodplain environments.

API technicians, experienced in interpretation of NSW forest and vegetation types, used recent high-resolution (50 centimetre GSD) stereo digital imagery, in a digital 3D GIS environment, to delineate observable pattern in canopy species dominance, understorey characteristics and landform elements. Interpreters adopted a viewing scale between 1:1000 and 1:3000 to mark boundaries to infer changes in canopy and/or understorey composition. A mapping pathway and a set of attributes were established to ensure consistency in approach between interpreters. New classes were established where recurring image patterns and species composition did not match predefined classes. Appendix A presents a table of API map classes for the lower and mid North Coast south of Port Macquarie. For the region north of Port Macquarie, we applied a similar approach but identified unique species combinations based on the three most dominant species in the upper stratum. Mappers extended or modified the boundaries of the supplied alluvial models based on interpretable image patterns. Interpretations were guided by a prescribed list of tree species extracted from the TEC determinations and habitat qualifiers interpreted by the TEC reference panel.

A minimum map polygon size of 0.25 hectares was used to inform the detection and delineation of image patterns. Interpreters were supplied with a range of environmental variables to accompany interpretation including substrate and existing vegetation maps. They were also supplied with contextual layers such as roads, trails and tenure boundaries. All relevant georeferenced floristic data held in OEH databases was extracted and supplied to aid interpretation. Floristic data was supplemented by interpreter field traverse using an iterative process to boost interpretation confidence by relating field observations to image patterns. A crown separation ratio of 3 or greater (approx. 5% crown cover (Walker and Hopkins 1990) was adopted, as the cut-off density between woody and non-woody vegetation.

3.7.2 Integration of spatial data

We used the final API line work, in combination with prediction probabilities from the spatial model and floristic plot data, to develop an operational map using the following procedure:

We used the methods described under Section 3.5 to determine the most strongly diagnostic canopy species (both positively and negatively diagnostic) for each TEC, using plots from all tenures. We calculated the likelihood that API units were TEC, based on the extent to which these diagnostic species occurred as dominants.

For each polygon code (including understorey assessment) we assessed the extent of plot sampling and the proportion of plots which we had assigned to a TEC. For codes which had been sampled but for which all plots had been assigned to non-TEC communities, we excluded all polygons with that code from the TEC map where (a) the API description was consistent with the API type not being TEC and (b) if there was little or no overlap with the relevant predictive model at the chosen probability threshold.

We believe that this procedure provides a precautionary operational map of each TEC and is consistent with the objective to capture the full extent of TECs on state forests. Polygons mapped as TEC will include a proportion with a relatively very low probability of being TEC, which may indicate low likelihood for the whole polygon or that only part of the polygon is TEC. These uncertainties represent the limits of the available data upon which our interpretation and mapping is based.

3.8 Validation

We conducted validation to assess the extent, if any, to which native vegetation situated in suitable habitat for the TEC has been overlooked by our mapping. We collected an independent data set by choosing plots located in mapped alluvial and floodplain environments or within 50 metre of the boundary of those mapped environments. We applied a regular systematic grid over this area to provide approximately 400 plots and randomly selected 150 of these for sampling. We sampled 94 plots using the OEH standard survey methods (Section 3.4.2), allowing the surveyors to give preference to those which were most accessible, but subject to minimum numbers in geographic zones to ensure a good geographical spread. We used the same fuzzy clustering methods that we used in our initial analyses (described in Section 3.5.1) to determine whether plots belonged to vegetation communities which we had included as TECs, or to other communities not included in any TEC.

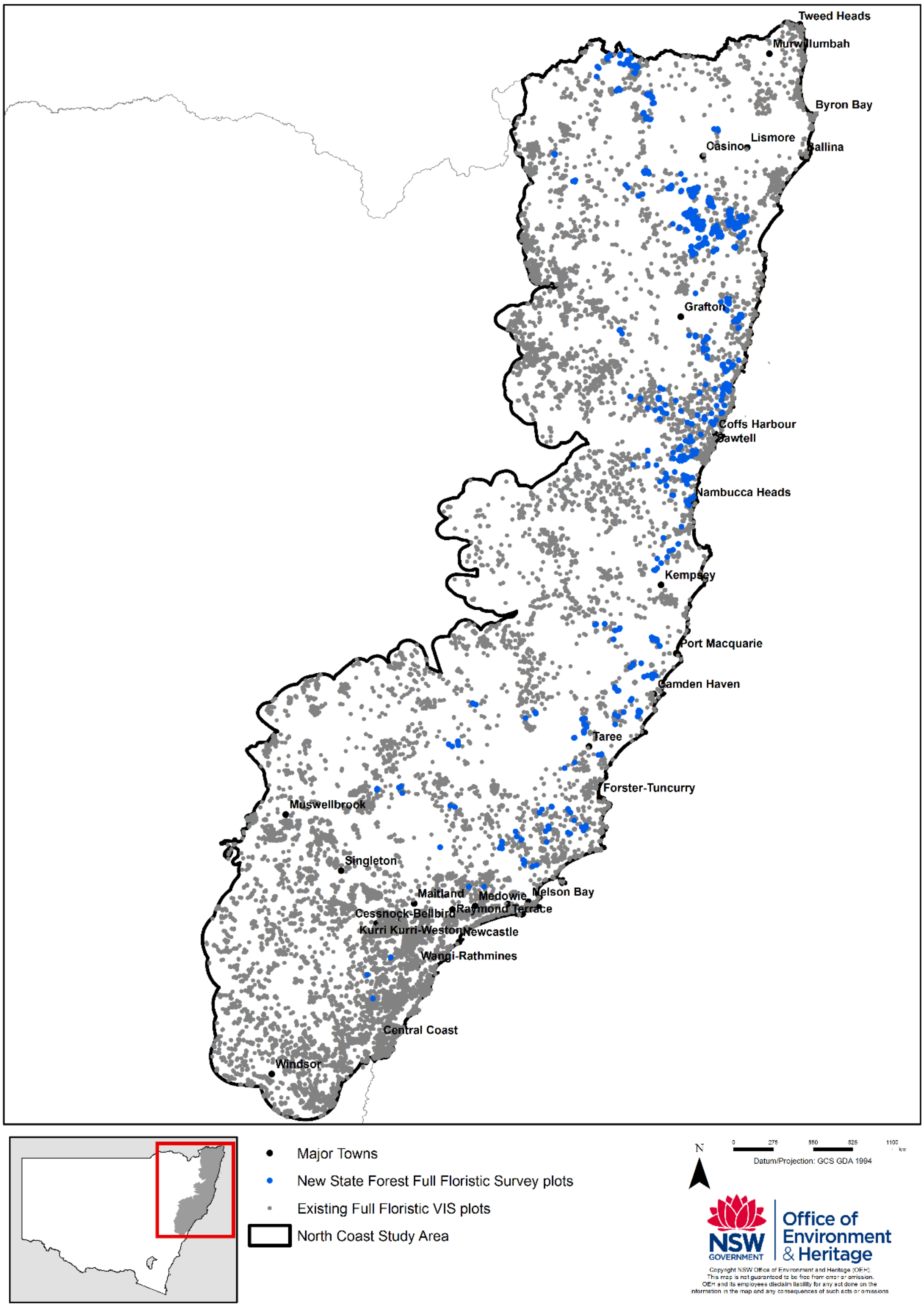
4 Results

4.1 Survey Effort

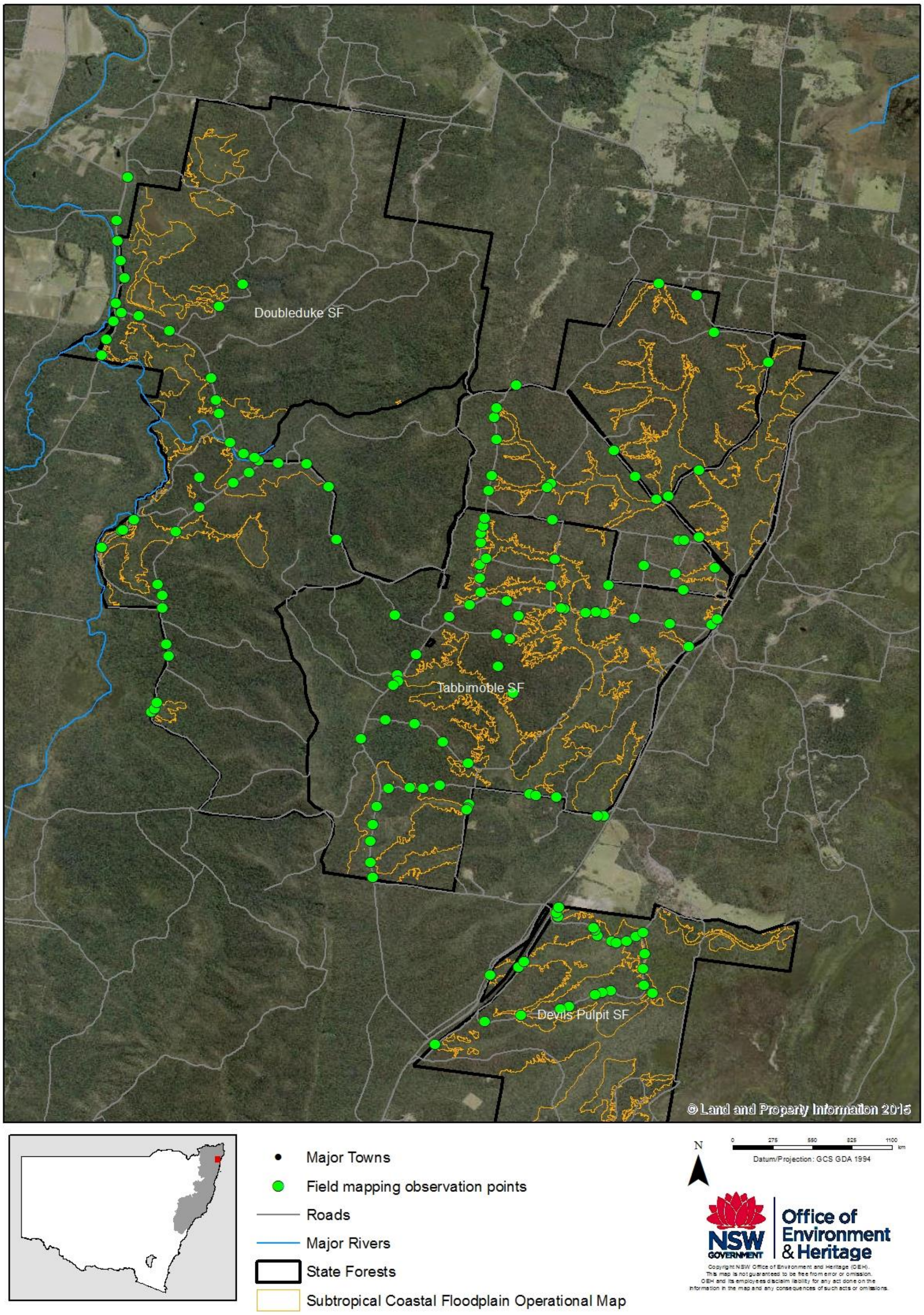
Within our study area, there were 14,970 standard full-floristic plots in the OEH VIS database which we used for our initial analysis, 2009 of which are in state forest. This includes 545 plots that were surveyed specifically for our project. We collected standard full-floristic data from a further 95 plots for validation, primarily targeting Subtropical Coastal Floodplain Forest TEC. Map 5 shows plots surveyed for our project, including plots surveyed as validations plots.

We collected over 1500 field observation points in alluvial environments to support aerial photo interpretation in state forests north of Newcastle. In the area south of Newcastle, we accessed 800 rapid data points from an existing library of privately held data (Bell & Driscoll 2016) which contained floristic attributes describing vegetation in and adjoining alluvial environments on state forest. An example of coverage is shown in Map 6.

<u>Map 5</u>: Location of new full floristic vegetation survey plots undertaken on state forest as part of this project and other (existing) full floristic plot data used in the analysis.



<u>Map 6</u>: Example area showing collection of field observation points to support aerial photograph interpretation of vegetation patterns in alluvial environments.



4.2 Classification Analyses

4.2.1 Relationships to existing classifications

Of the 14,970 plots analysed (excluding validation plots), 8925 (60%) could be allocated with a high degree of confidence to an existing community described for one or more of the Northern Rivers, Hunter-Central Rivers or Sydney Basin classifications. A further 1548 (10%) were not closely related to any of the communities used in the analysis, but formed additional floristic groups. Some of these most likely represent previously undescribed communities. We have assigned one of these groups, which is partly derived from segregation of a previous large Northern Rivers community, as SCFF. We have assessed the other potentially new groups as not related to any floodplain TEC.

4.2.2 Floristic communities in alluvial environments

Appendix B lists the 117 communities that occur to a significant extent in floodplain, alluvial or potentially alluvial environments, in all tenures. We have derived occurrence in floodplain and associated environments from a combination of the CCA map, alluvial model and in instances where mapping data are not available, on descriptions of the environment of the previously defined community. Where map data are available, we have used a threshold of at least 30% of plots occurring on floodplain or alluvium as a basis to include the community in TEC assessment. We have used only CCA map units assessed as alluvial for our summary of plots on alluvium data in Appendix B (e.g. estuarine deposits are excluded). However, the alluvial model derived from a 1-metre DEM covers all flat or gently sloping areas where water periodically accumulates or floods and may include non-alluvial areas such as estuarine flats. We have allocated plots to communities from the results of each of the relevant fuzzy clustering analyses (Section 2.5.1), using a threshold membership value of 0.5. Plots below this threshold for a community are not included in the proportion of plots which are assigned as alluvial for the community in Appendix E. We did not have complete CCA floodplain data or a complete fine-scale alluvial model for the Hunter River valley and areas to the south. We used the existing Sydney Basin classification to determine communities in this area which occur in floodplain, alluvial or related environments. Appendix C lists the 85 such communities.

4.2.3 Floristic relationships of alluvial and other communities to TEC cited communities, determination assemblages and Keith and Scott groups

The final determination assemblage is one of the two legally prescribed descriptors of any TEC. No guidance is available on how it could be used for assessment. We chose to make comparisons between the assemblage list and related communities defined by plot data by using mean proportions of assemblage species in plots for each community, as described in Section 3.5. Appendices B and C show the results for the communities relevant to our analyses. In each of the four TEC determinations, there is a strong implication that the TEC includes or otherwise relates to a particular Keith and Scott group. There is also an implication that the TECs do not include other Keith and Scott groups. We have used these relationships to assess the likelihood that communities used or derived in our analysis belong to one or more of the TECs. In some cases, there are contradictions or inconsistencies between one of more of these comparisons. These inconsistencies are briefly described in Appendix A (and also Tables 14-17). With guidance of the TEC Panel, we resolved most inconsistencies by giving preference to explicitly cited communities as a first priority, then assemblage list as second priority. This may not be consistent with the notion of the determination assemblage being the primary legal descriptor, except that determinations are vague on how the assemblage list should be interpreted.

4.2.4 Assessment of communities and plots as TEC

From the comparisons described in Section 4.2.3 and considering other relevant factors and advice from the TEC panel, we have assigned each vegetation community as either (a) one of the floodplain TECs (b) possibly another TEC or (c) not TEC. The results are shown in Appendices B, with comments on rationale for decisions. We assessed Sydney Basin communities separately only in respect of RFEF and communities FoW56 and FrW30 relating to SWSF, because we considered that plots in these communities may not have been adequately described in the context of Northern Rivers or Hunter classifications. Otherwise, our assessment of Sydney Basin communities is based on the equivalent Hunter community using the extent of shared plots. Although we have assigned each community to a single TEC, in some cases communities have characteristics of two or more TECs and may be transitional in a floristic sense. Individual plots in such transitional communities may be best assigned to one or other TEC depending on other features described in the final determinations. An example is 700-638, which has characteristics of both SOAK and SWSF. We assigned plots of this community to SWSF if they occurred in inland areas with no saline influence. The numbers and distribution of TEC vegetation communities are summarised in Table 5 and Map 7. From our floristic analysis we regard as TEC all plots with a membership >=0.5 of any of the communities which we have assessed as TEC. For operational mapping purposes we also considered that some plots with lower membership of these TEC communities (between 0.25 and 0.5) also be regarded as TEC, unless they clearly have characteristics which are not consistent with features described in the relevant determination (e.g. not situated on alluvium).

Appendices C-F provides a list of full floristic plots in state forest that we assigned to one of the floodplain TECs.

Table 5: TEC vegetation communities described in, or relating to, previous regional classifications.

TEC	Northern Rivers communities	Hunter-Central Rivers communities	Sydney Basin communities
RFEF	0	1	8
SCFF	6	1	0
SOAK	3	3	3
SWSF	6	8	15

Table 6: identifies the number of plots assigned to each TEC across all tenures sampled by the regional data set.

TEC Name	Number of plots assigned with high confidence (membership >=0.5)	Number of plots assigned with lower confidence (membership 0.25-0.5)	Total
SCFF	195	59	254
RFEF	116	72	188
SWSF	380	119	499
SOAK	170	27	197

We identified over 1100 plots from a dataset of 14,000 plots that met our thresholds to one of four TECs. A small number of plots met thresholds for more than one TEC.

SWSF recorded the highest number of plots of all the TECs across our study area. The greatest density of plots occurred in the Lower Hunter and Central Coast regions and this is likely to relate to greater survey effort in this region. SCFF was identified across the north-south extent of our study area with the Casino-Grafton region a focal point. Our results indicate that floristic assemblages related to SCFF extend south of the nominated bioregion in the final determination south to the Wyong area. Plots assigned to SOAK occupied a narrow band of low elevation along the entire eastern seaboard. RFEF recorded the fewest plots. This arose because both the cited vegetation communities and the species assemblage list achieved comparatively weak relationships with plots located on floodplain and alluvial environments of coastal regions of our study area. The highest number of plots occur within dry valleys such the Cumberland Plain, Putty Valley and Hunter Valley.

4.2.5 Field key and/or defining floristic attributes

As we have interpreted them, each of the floodplain TECs in our NSW North Coast study area comprise a number of different floristic communities. On state forest, the major communities for SCFF are Northern Rivers community 700-493 and a new community that we defined for our project (N-M1) (*Casino Creek Flats Red Gum-Swamp Box Forest*), which includes part of 1000-1106, part of 700-488 and a set of previously unclassified plots. We identified the modified community 700-488, excluding plots transferred to N-M1, as also belonging to SCFF. Without the N-M1 component, modified 1000-1106 is a predominantly non-alluvial community that we assessed as not belonging to any TEC. We also identified other potentially distinct new communities, in both the Northern Rivers and Hunter analyses, but we have assessed all of these as not related to any floodplain TEC. Tables 7 and 8 list the 30 most strongly characteristic species of N-M1 and 700-493 respectively. For N-M1, over 70% of the 30 species are listed as characteristic species in the final determination. Such a high proportion is consistent with the relatively high degree of similarity of plots to the determination assemblage list and the relatively close relationship with K&S group 8 and provides a high degree of confidence that community N-M1 belongs to SCFF. Community N-M1 also includes six eucalypt species that are listed in the determination assemblage list, but these also occur frequently in other non-TEC communities are not strongly characteristic of N-M1. Community 700-493 has a substantially lower proportion (40%) of determination assemblage species among its most characteristic species and less clearly belongs to SCFF than does N-M1. The only Hunter community that we assigned to SCFF is MU 198, which is relatively widespread on state forest but only south of Kempsey. The 30 most strongly characteristic species are listed in Table 9. As described elsewhere in this report, there is considerable doubt regarding the extent to which MU 198 belongs to SCFF, but over 50% of its 30 most characteristic species are in the determination assemblage list.

We have included two field keys for identifying SCFF: one key for areas north of Kempsey (Appendix F) and one for areas south of Kempsey (Appendix G), to account for the latitudinal gradient in floristic composition. The latitudinal boundary at Kempsey corresponds with the distributional limit of *Lophostemon suaveolens*, the most clearly diagnostic species of northern SCFF community N-M1. Both field keys include some assemblage list species (e.g. *Pteridium esculentum*) as negative diagnostic species. These species occur to a limited extent in SCFF, but much more frequently in other, non-TEC communities. This may indicate inconsistencies between our interpretation of SCFF and the assemblage list, or between the assemblage list and other characteristics of the determination, but we are unable to resolve the inconsistencies because there is no information available on the source of the assemblage list.

<u>Table 7</u>: The 30 most strongly characteristic species of North Coast SCFF, floristic community N-M1, in order of decreasing contribution to ΔsumAIC, plus all eucalypts recorded in N-M1 with frequency >=0.05, using 52 plots assigned to N-M1 with a high degree of confidence compared to the remaining 7829 plots allocated to Northern Rivers communities, excluding those assigned to possible N-M1. Species annotated with '(D)' are listed in the determination assemblage. Mean is mean cover score over all plots including zeros. Median is derived from non-zero scores only. Zeros may represent small values, due to rounding.

Species	N-M1 freq	N-M1 mean	N-M1 median	other freq	other mean	other median	ΔAIC
Lophostemon suaveolens **(D)**	0.85	2.2	3	0.05	0.1	2	-216
Melaleuca alternifolia **(D)**	0.4	0.8	2	0.01	0	2	-113
Acacia concurrens **(D)**	0.54	1	1	0.04	0.1	2	-112
Alphitonia excelsa **(D)**	0.77	1.8	3	0.13	0.2	1	-106
Parsonsia straminea **(D)**	0.75	1.1	1	0.17	0.2	1	-83
Centella asiatica **(D)**	0.48	0.9	2	0.05	0.1	2	-76
Vernonia cinerea **(D)**	0.77	1.4	2	0.21	0.3	2	-71
Gahnia aspera **(D)**	0.54	0.9	1	0.08	0.1	1	-68
Phyllanthus virgatus **(D)**	0.37	0.4	1	0.03	0	1	-66
Acacia leiocalyx	0.29	0.7	2	0.01	0	2	-63
Melaleuca nodosa **(D)**	0.35	0.8	3	0.03	0.1	2	-62
Murdannia graminea	0.29	0.4	1	0.02	0	1	-60
Hydrocotyle tripartita	0.27	0.4	2	0.01	0	2	-58
Ottochloa gracillima	0.4	1	2	0.05	0.1	2	-56
Eucalyptus seeana **(D)**	0.19	0.4	2.5	0.01	0	2	-50
Hybanthus stellarioides	0.42	0.6	1.5	0.07	0.1	1	-50
Entolasia marginata **(D)**	0.5	1	2	0.1	0.2	2	-50
Imperata cylindrica **(D)**	0.87	2.1	2	0.38	0.9	2	-50
Eucalyptus tereticornis **(D)**	0.44	1.2	3	0.09	0.2	2	-44
Dichondra repens **(D)**	0.6	1.1	2	0.19	0.4	2	-39
Paspalum orbiculare	0.19	0.4	2	0.01	0	1	-39
Melaleuca decora **(D)**	0.12	0.2	2	0	0	1	-36
Pratia purpurascens **(D)**	0.69	1.2	2	0.3	0.5	2	-33
Eclipta platyglossa	0.12	0.2	2	0	0	1	-32
Chrysopogon filipes	0.12	0.1	1	0	0	2	-32
Persoonia stradbrokensis **(D)**	0.35	0.4	1	0.07	0.1	1	-32
Eucalyptus siderophloia **(D)**	0.4	1	3	0.1	0.2	2	-30
Themeda triandra **(D)**	0.67	1.5	2	0.3	0.8	2	-28
Panicum simile **(D)**	0.37	0.6	2	0.09	0.2	2	-28
Entolasia stricta **(D)**	0.65	1.6	2	0.29	0.6	2	-27
Eucalyptus bancroftii	0.08	0.2	2	0	0	3	-13
Angophora woodsiana **(D)**	0.1	0.2	2	0.02	0	3	-8

Species	N-M1 freq	N-M1 mean	N-M1 median	other freq	other mean	other median	ΔAIC
***Eucalyptus moluccana* (D)**	0.12	0.3	3	0.04	0.1	3	-4
Corymbia variegata* or *C. henryi	0.15	0.4	3	0.1	0.3	3	1
***Eucalyptus resinifera* (D)**	0.08	0.1	1	0.05	0.1	2	1
***Corymbia intermedia* (D)**	0.19	0.2	1	0.15	0.3	2	1
***Angophora subvelutina* (D)**	0.08	0.2	2	0.05	0.1	2	1
***Eucalyptus propinqua* (D)**	0.08	0.1	1.5	0.09	0.2	3	2

Table 8: The 30 most strongly characteristic species of North Coast SCFF, floristic community 700-493, in order of decreasing contribution to ΔsumAIC, plus all eucalypts recorded in 700-493 with frequency >=0.05, using 21 plots assigned to 700-493 with a high degree of confidence compared to the remaining 7856 plots allocated to Northern Rivers communities, excluding those assigned to possible 700-493. Species annotated with '(D)' are listed in the determination assemblage. Mean is mean cover score over all plots including zeros. Median is derived from non-zero scores only. Zeros may represent small values, due to rounding.

Species	700-493 freq	700-493 mean	700-493 median	other freq	other mean	other median	ΔAIC
***Melaleuca alternifolia* (D)**	0.95	2.2	2.5	0.01	0	1	-165
***Lophostemon suaveolens* (D)**	0.95	3	3	0.05	0.1	2	-107
Paspalum orbiculare	0.62	1.4	2	0.01	0	1	-88
***Eucalyptus tereticornis* (D)**	0.9	1.8	2	0.09	0.2	3	-77
Philydrum lanuginosum	0.52	0.7	1	0.01	0	1	-77
Sacciolepis indica	0.48	1	2	0	0	1	-76
***Centella asiatica* (D)**	0.76	1.1	1.5	0.05	0.1	2	-69
Stylidium debile	0.33	0.6	2	0	0	1	-61
Baumea articulata	0.48	0.9	2	0.01	0	2	-57
Chorizandra cymbaria	0.38	1	2.5	0	0	2	-55
Goodenia paniculata	0.43	0.7	2	0.01	0	2	-53
Baumea rubiginosa	0.38	0.9	2.5	0.01	0	3	-42
Fimbristylis dichotoma	0.48	0.8	2	0.03	0	1	-38
Acmella grandiflora* var. *brachyglossa	0.19	0.3	2	0	0	1	-37
Ischaemum australe	0.33	0.8	3	0.01	0	2	-36
***Parsonsia straminea* (D)**	0.76	1.5	2	0.17	0.2	1	-33
Hydrocotyle tripartita	0.33	0.6	2	0.01	0	2	-31
Isotoma armstrongii	0.19	0.3	1.5	0	0	2	-30
Fimbristylis cinnamometorum	0.24	0.5	2	0	0	2	-30
***Melaleuca quinquenervia* (D)**	0.52	1.8	4	0.07	0.2	3	-28
Hemarthria uncinata	0.29	0.8	2.5	0.01	0	2	-28
Juncus polyanthemus	0.14	0.1	1	0	0	2	-22
Carex gaudichaudiana	0.19	0.4	2	0.01	0	4	-19

Species	700-493 freq	700-493 mean	700-493 median	other freq	other mean	other median	ΔAIC
Stylidium tenerum	0.1	0.2	2	0	0	2	-18
Cyperus pilosus	0.1	0.1	1	0	0	3	-18
Ranunculus inundatus	0.19	0.2	1	0.01	0	1.5	-18
Cyperus haspan	0.14	0.1	1	0	0	1	-18
***Casuarina glauca* (D)**	0.33	0.6	2	0.04	0.1	3	-17
Melaleuca sieberi	0.29	0.4	1	0.03	0.1	2	-17
Eclipta platyglossa	0.14	0.2	2	0	0	2	-16
***Angophora paludosa* (D)**	0.05	0.1	3	0	0	1	-1
***Eucalyptus seeana* (D)**	0.05	0	1	0.01	0	2.5	0
***Corymbia intermedia* (D)**	0.1	0.1	1	0.15	0.3	2	1
***Eucalyptus acmenoides* (D)**	0.05	0.1	2	0.08	0.2	3	2
***Eucalyptus resinifera* (D)**	0.05	0	1	0.05	0.1	2	2

Table 9: The 30 most strongly characteristic species of North Coast SCFF, floristic community MU 198, in order of decreasing contribution to ΔsumAIC, plus all eucalypts recorded in MU 198 with frequency >=0.05, using 64 plots assigned to MU 198 with a high degree of confidence compared to the remaining 8748 plots allocated to Hunter communities, excluding those assigned to possible MU 198. Species annotated with '(D)' are listed in the determination assemblage. Mean is mean cover score over all plots including zeros. Median is derived from non-zero scores only. Zeros may represent small values, due to rounding.

Species	MU 198 freq	MU 198 mean	MU 198 median	other freq	other mean	other median	ΔAIC
***Melaleuca nodosa* (D)**	1	5	5	0.08	0.2	2	-309
***Eucalyptus resinifera* (D)**	0.52	1.1	2	0.04	0.1	2	-119
***Parsonsia straminea* (D)**	0.7	1.2	2	0.13	0.2	1	-106
***Gahnia clarkei* (D)**	0.53	0.8	1	0.08	0.2	2	-87
Melaleuca sieberi	0.44	0.8	2	0.05	0.1	2	-83
***Pratia purpurascens* (D)**	0.88	1.6	2	0.32	0.6	2	-83
Polymeria calycina	0.38	0.6	2	0.03	0	1	-79
***Dichondra repens* (D)**	0.77	1.6	2	0.25	0.5	2	-73
***Melaleuca decora* (D)**	0.33	0.8	2	0.03	0.1	2	-63
***Dianella caerulea* (D)**	0.91	1.5	2	0.43	0.6	1	-62
Hydrocotyle sibthorpioides	0.38	0.7	2	0.05	0.1	2	-56
***Entolasia stricta* (D)**	0.86	2.7	3	0.41	0.9	2	-54
***Lagenifera stipitata* (D)**	0.45	0.8	2	0.1	0.2	2	-50
***Entolasia marginata* (D)**	0.53	1.1	2	0.14	0.3	2	-50
***Centella asiatica* (D)**	0.34	0.6	2	0.05	0.1	2	-50
***Imperata cylindrica* (D)**	0.67	1.6	2	0.26	0.6	2	-45
Eucalyptus longifolia	0.12	0.3	2.5	0	0	3	-44

Species	MU 198 freq	MU 198 mean	MU 198 median	other freq	other mean	other media n	ΔAIC
Melaleuca linariifolia	0.3	0.6	2	0.05	0.1	2	-36
***Microlaena stipoides* (D)**	0.7	1.9	2	0.33	0.7	2	-36
***Oplismenus hirtellus* (D)**	0.47	0.9	2	0.16	0.3	2	-31
Gonocarpus tetragynus	0.42	0.8	2	0.13	0.2	2	-31
***Callistemon salignus* (D)**	0.23	0.4	2	0.04	0.1	2	-30
Pultenaea villosa	0.27	0.4	1	0.05	0.1	2	-30
Echinopogon ovatus	0.36	0.7	2	0.1	0.2	2	-28
Acacia longifolia	0.39	0.5	1	0.12	0.2	1	-27
Pultenaea retusa	0.17	0.2	1	0.02	0	1	-25
Caladenia catenata	0.12	0.3	2	0.01	0	1	-24
***Glochidion ferdinandi* (D)**	0.36	0.6	1	0.12	0.2	1	-23
Acacia irrorata	0.25	0.4	1	0.06	0.1	1	-22
Veronica plebeia	0.3	0.5	2	0.08	0.1	1	-22
***Eucalyptus amplifolia* (D)**	0.09	0.2	2.5	0.01	0	3	-11
Eucalyptus globoidea	0.12	0.3	3	0.04	0.1	2	-7
***Eucalyptus tereticornis* (D)**	0.17	0.4	3	0.07	0.2	3	-6
Eucalyptus parramattensis	0.06	0.1	2.5	0.02	0	2	-3
Angophora costata	0.31	0.7	2	0.2	0.5	2	-2
Angophora floribunda	0.19	0.4	2	0.11	0.2	2	-1
Eucalyptus fibrosa	0.14	0.3	2	0.08	0.2	3	-1
Eucalyptus paniculata	0.06	0.1	1	0.03	0.1	2	1
***Eucalyptus propinqua* (D)**	0.05	0.1	2	0.03	0.1	3	1
Eucalyptus capitellata	0.05	0.1	2	0.03	0.1	3	2
Eucalyptus umbra	0.05	0	1	0.07	0.2	2	2
***Eucalyptus robusta* (D)**	0.06	0.1	1	0.05	0.1	2	2
Corymbia maculata	0.16	0.3	1	0.13	0.4	3	2
***Eucalyptus acmenoides* (D)**	0.06	0.1	1.5	0.06	0.2	3	2

The two major communities which represent SWSF on state forest are Northern Rivers communities 700-477 and 700-634, but in each case the extent on state forest is relatively limited compared to total extent. Tables 10 and 11 show the most strongly characteristic species for these communities. In both cases, over 50% of the most strongly characteristic species are listed in the final determination assemblage list. We have not prepared field keys for these communities because dominance by the single canopy species, *Eucalyptus robusta*, is an excellent indicator of the presence of SWSF on state forest in most areas. On state forests north of Coffs Harbour, *E. robusta* may be co-dominant with *Casuarina glauca* or the latter may be dominant in stands of SWSF or in vegetation transitional between SWSF and SOAK. These stands may not be identified as SWSF if dominance of *E. robusta* is used as the diagnostic feature, but they will be correctly identified as TEC (either SWSF or SOAK) in any case. Dominance by *E. robusta* may not be a good indicator on other tenures, where non-TEC communities which are dominated by *E. robusta* may occur outside alluvial environments.

Table 10: The 30 most strongly characteristic species of North Coast SWSF, floristic community 700-477, in order of decreasing contribution to ΔsumAIC, plus all eucalypts recorded in 700-477 with frequency >=0.05, using 19 plots assigned to 700-477 with a high degree of confidence compared to the remaining 7836 plots allocated to Northern Rivers communities, excluding those assigned to possible 700-477. Species annotated with '(D)' are listed in the determination assemblage. Mean is mean cover score over all plots including zeros. Median is derived from non-zero scores only. Zeros may represent small values, due to rounding.

Species	700-477 freq	700-477 mean	700-477 median	other freq	other mean	other median	ΔAIC
Gahnia clarkei (D)	0.84	3.9	5	0.04	0.1	2	-81
Callistemon salignus (D)	0.84	2.1	3	0.05	0.1	2	-76
Eucalyptus robusta (D)	0.68	2.3	3	0.03	0.1	2	-68
Smilax glyciphylla	0.74	0.8	1	0.09	0.1	1	-44
Callicoma serratifolia	0.58	1	1	0.04	0.1	2	-41
Melaleuca linariifolia (D)	0.42	0.6	1	0.01	0	2	-40
Glochidion ferdinandi (D)	0.63	1.2	1.5	0.12	0.2	1	-26
Cordyline stricta	0.58	1.3	2	0.1	0.2	1	-24
Syncarpia glomulifera	0.63	1.4	2.5	0.13	0.3	2	-24
Elaeocarpus reticulatus (D)	0.58	0.9	1	0.12	0.2	1	-21
Polyscias sambucifolia (D)	0.58	0.7	1	0.13	0.2	1	-19
Angophora costata	0.37	0.8	3	0.04	0.1	3	-19
Parsonsia straminea (D)	0.63	1	1	0.17	0.2	1	-18
Livistona australis (D)	0.32	0.5	1	0.03	0.1	1	-16
Morinda jasminoides (D)	0.58	0.8	1	0.16	0.2	2	-15
Leptospermum polygalifolium (D)	0.42	0.7	1	0.08	0.2	2	-14
Calochlaena dubia (D)	0.53	0.9	2	0.14	0.3	2	-14
Geitonoplesium cymosum	0.68	0.8	1	0.27	0.4	1	-12
Baumea arthrophylla	0.05	0.1	2	0	0	0	-10
Baloskion fimbriatum	0.11	0.2	2	0	0	2	-9
Eucalyptus resinifera (D)	0.26	0.7	3	0.05	0.1	2	-8
Schoenus melanostachys	0.16	0.3	2	0.02	0	2	-6
Baumea nuda	0.05	0.1	2	0	0	2	-6
Eucalyptus grandis	0.21	0.3	1	0.04	0.1	3	-6
Cryptostylis erecta	0.11	0.2	2	0.01	0	1	-6
Acmena smithii (D)	0.37	1	3	0.12	0.2	1	-6
Doryanthes excelsa	0.05	0	1	0	0	1	-6
Dodonaea triquetra (D)	0.21	0.3	1	0.04	0.1	2	-5
Pteridium esculentum (D)	0.63	1	1	0.33	0.7	2	-5
Billardiera rubens	0.42	0.6	1	0.17	0.2	1	-5
Eucalyptus piperita	0.05	0.1	2	0	0	3	-2
Corymbia intermedia	0.05	0.1	2	0.15	0.3	2	0
Eucalyptus umbra	0.05	0.2	3	0.01	0	2	1

Species	700-477 freq	700-477 mean	700-477 median	other freq	other mean	other median	ΔAIC
Eucalyptus globoidea	0.05	0.2	3	0.01	0	2	1
Corymbia gummifera	0.11	0.1	1	0.06	0.1	2	1
Eucalyptus propinqua	0.11	0.1	1	0.09	0.2	3	2
Eucalyptus pilularis	0.11	0.1	1	0.1	0.3	3	2
Eucalyptus microcorys	0.21	0.4	1.5	0.21	0.5	2	2

Table 11: The 30 most strongly characteristic species of North Coast SWSF, floristic community 700-634, in order of decreasing contribution to ΔsumAIC, plus all eucalypts recorded in 700-634 with frequency >=0.05, using 23 plots assigned to 700-634 with a high degree of confidence compared to the remaining 7837 plots allocated to Northern Rivers communities, excluding those assigned to possible 700-634. Species annotated with '(D)' are listed in the determination assemblage. Mean is mean cover score over all plots including zeros. Median is derived from non-zero scores only. Zeros may represent small values, due to rounding.

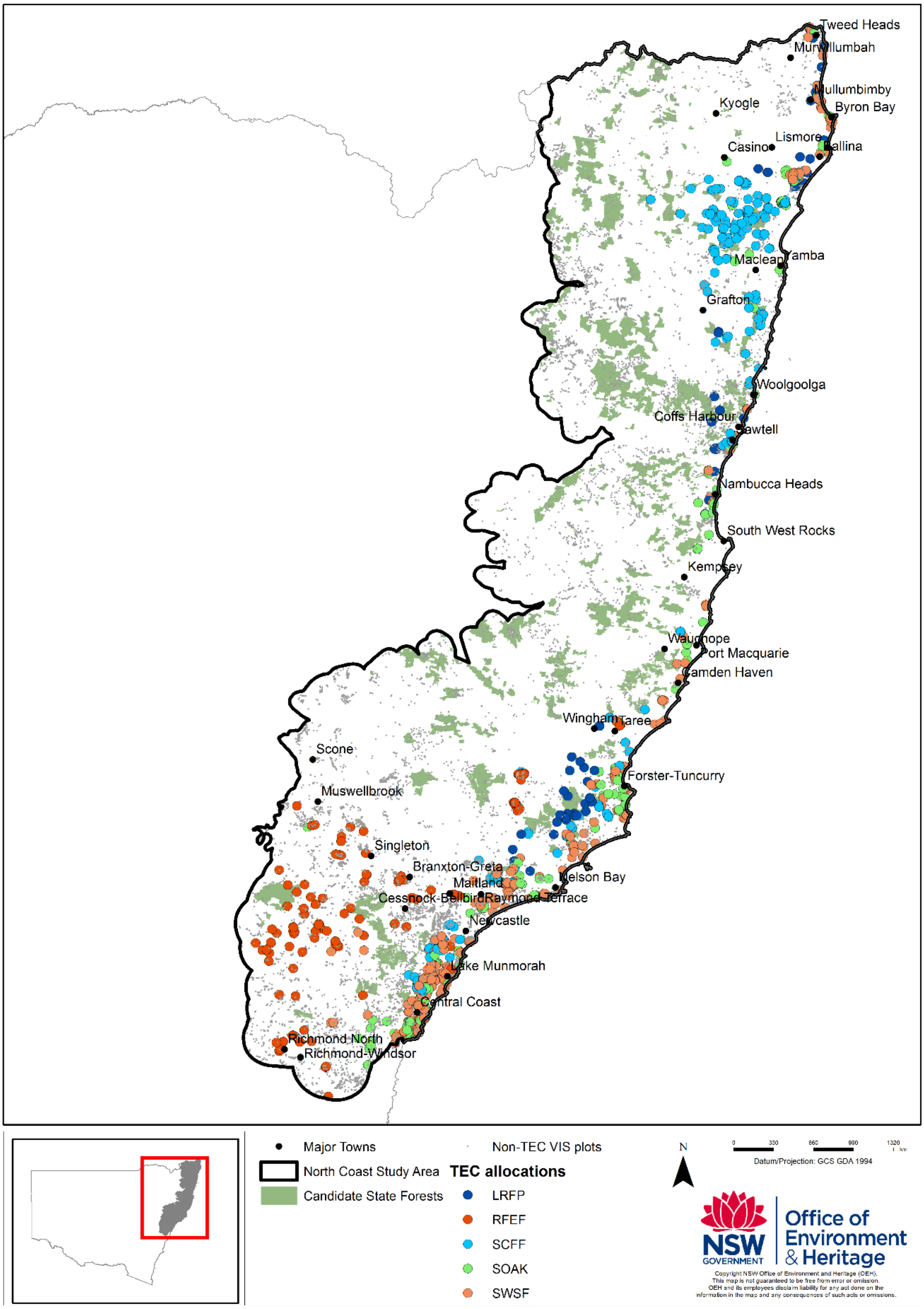
Species	700-634 freq	700-634 mean	700-634 median	other freq	other mean	other median	ΔAIC
***Gahnia clarkei* (D)**	1	3.7	3	0.04	0.1	2	-140
***Blechnum indicum* (D)**	0.91	2.5	3	0.02	0	2	-140
***Melaleuca quinquenervia* (D)**	1	3.9	4	0.07	0.2	3	-119
***Eucalyptus robusta* (D)**	0.7	2	3	0.03	0.1	2	-85
***Casuarina glauca* (D)**	0.65	1.6	3	0.04	0.1	3	-66
***Baumea articulata* (D)**	0.48	0.6	1	0.01	0	2	-63
***Phragmites australis* (D)**	0.39	0.9	2	0.01	0	2	-45
Cyclosorus interruptus	0.26	0.4	1.5	0	0	2	-45
***Glochidion ferdinandi* (D)**	0.7	1	1	0.12	0.2	1	-40
***Parsonsia straminea* (D)**	0.78	1.4	2	0.17	0.2	1	-39
***Entolasia marginata* (D)**	0.65	1.4	2	0.1	0.2	2	-38
***Melaleuca linariifolia* (D)**	0.35	0.7	1.5	0.01	0	2	-36
Hemarthria uncinata	0.3	0.6	2	0.01	0	2	-34
***Acacia longifolia* (D)**	0.39	0.6	2	0.04	0.1	1	-27
Baumea rubiginosa	0.26	0.8	3	0.01	0	3	-26
***Livistona australis* (D)**	0.35	0.7	2	0.03	0.1	1	-23
***Hypolepis muelleri* (D)**	0.3	0.8	2	0.02	0	2	-23
Baumea gunnii	0.13	0.2	1	0	0	2	-22
Persicaria strigosa	0.22	0.4	2	0.01	0	2	-20
***Baumea juncea* (D)**	0.22	0.7	3	0.01	0	3	-18
Hibiscus diversifolius	0.13	0.3	2	0	0	1	-16
***Viola banksii* (D)**	0.57	1.1	2	0.18	0.3	2	-15
***Homalanthus populifolius* (D)**	0.26	0.4	1.5	0.03	0	1	-15
Lobelia anceps	0.17	0.3	2	0.01	0	1	-14

Species	700-634 freq	700-634 mean	700-634 median	other freq	other mean	other median	ΔAIC
Pseudoraphis paradoxa	0.13	0.3	2	0	0	2	-14
Cuscuta australis	0.09	0.1	1.5	0	0	1	-14
Juncus kraussii	0.17	0.4	1.5	0.01	0	3	-14
Baumea teretifolia	0.13	0.2	1	0	0	2	-14
Ischaemum australe	0.17	0.4	1.5	0.01	0	2	-13
Myrsine howittiana	0.26	0.4	1.5	0.04	0	1	-12
***Eucalyptus resinifera* (D)**	0.13	0.1	1	0.05	0.1	2	-1
Eucalyptus grandis	0.09	0.3	3	0.04	0.1	3	1

South of Taree, Hunter community MU131 is included within our definition of SWSF. It is most common in Awaba State Forest south of Newcastle. We found this community to have a relatively weak association with the species assemblage list, but we included it on the basis that MU131 includes plots assigned to MU42 (NPWS, 2000), a community explicitly included in SWSF. We did not include tables of characteristic species or keys for this community.

We have also not compiled tables of characteristic species or field keys for Swamp Oak Floodplain Forest TEC, because of its very limited extent on state forest. Occurrences on state forest can usually be identified by the dominance of *Casuarina glauca*. However, north of Coffs Harbour, *C. glauca* can be dominant in areas which are relatively remote from the coast and from estuaries and which do not have saline influence, which belong to Northern Rivers community 700-638 and which we have assigned to SWSF. Community 700-638 may be regarded as floristically transitional between SWSF and SOAK.

Map 7: Site allocation for floodplain TECs.



4.3 Evidence of occurrence on state forest

Table 12 shows the number of plots on state forest assigned to each of the TECs. We identified 33 state forests that record plots that have at least one plot allocated to one or more TECs. Numbers in parentheses are plots with ambiguous relationships, allocated as possible TEC.

Table 12: Numbers of plots of each TEC on state forest.

State Forest	RFEF	SCFF	SOAK	SWSF
Awaba State Forest				(1)
Bachelor State Forest				1
Banyabba State Forest		3 (1)		
Braemar State Forest		4 (2)		
Bulahdelah State Forest				1
Bungawalbin State Forest		2 (1)		1 (1)
Cairncross State Forest		1 (1)	1	1 (2)
Camira State Forest		2 (1)		
Candole State Forest		8		
Coopernook State Forest				1
Cowarra State Forest				1
Devils Pulpit State Forest		3 (2)		
Doubleduke State Forest		3 (2)		1
Gibberagee State Forest		12 (1)		1
Glenugie State Forest		3 (1)		
Johns River State Forest				5 (1)
Keybarbin State Forest		1		
Kiwarrak State Forest		1 (1)		
Myall River State Forest		2 (1)		(1)
Myrtle State Forest		17 (4)		
Nambucca State Forest			1	1 (1)
Nerong State Forest		1		(1)
Newry State Forest			2 (1)	1
Ourimbah State Forest		(1)		
Pine Brush State Forest		3 (2)		
Pine Creek State Forest				(2)
Putty State Forest	1			
Royal Camp State Forest		2		
Wallaroo State Forest		2 (1)	1 (1)	1
Wallingat State Forest				3
Wedding Bells State Forest		2 (2)		
Whiporie State Forest		4 (3)		
Yarratt State Forest		1 (1)		

4.3.1 Subtropical coastal floodplain forest

Subtropical coastal floodplain forest is by far the most extensive of the floodplain TECs on state forest in the North Coast. We allocated 77 plots to SCFF and a further 28 plots, with less certain relationships (membership 0.25-0.5) to possible SCFF. The majority of plots on state forest are located between Grafton and Casino. However, we identified a scatter of plots assigned to SCFF across the coastal extent of the study area with the southernmost plot located within Wallaroo State Forest. We identified additional plots just outside state forest boundaries near Wyong on the Central Coast.

Photo 1: Gibberagee State Forest in the Casino area of Northern NSW is located within a low-lying landscape where there are extensive areas of Subtropical Coastal Floodplain Forest TEC. At reference site (BAN03J0F) the forest is dominated by *Eucalyptus tereticornis* and *Eucalyptus siderophloia* with a smaller tree layer featuring *Lophostemon suaveloens*, *Melaleuca alternifolia* and *Melaleuca nodosa.* These forests are typically grassy and here *Entolasia stricta* is common**.**

<u>Photo 2</u>: Some alluvial flats in Myall River State Forest carry examples of Subtropical Coastal Floodplain Forest that approach the southern end of its range. Reference site (BLH04C5F) is an open forest of *Eucalyptus tereticornis*, *E. resinifera* and *Angophora floribunda* with a prominent layer of paperbarks including *Melaleuca linarifolia* and *Melaleuca nodosa*. The ground cover has a high cover of sedges and grasses. We found evidence that sites such as these are very similar to sites located south of the Hunter River in the Wyong area in the

Sydney Basin bioregion.

<u>Photo 3</u>: While red gums such as *Eucalyptus tereticornis* are frequently recorded in the canopy of Subtropical Coastal Floodplain Forest they are not always present. Here in Kiwarrak State Forest near Berady Creek this reference site (CDL02D0F) is dominated by *Eucalyptus resinifera subsp hemilampra*, *Eucalyptus globoidea* and *Eucalyptus propinqua.* A mid layer of paperbarks, typical of the TEC, is present as are the frequently recorded grasses and sedges including *Gahnia* spp and *Ottochloa gracillima.*

4.3.2 River-flat Eucalypt Forest

A single plot located in Putty State Forest in the south-western corner of our study area was the only confirmed location of RFEF in our northern study area. Putty State Forest fringes one of the few low-lying dry hinterland valleys in the northern study area.

<u>Photo 4</u>: We identified RFEF on alluvial soils that form part of the catchment of the Putty and Howes Valleys located south of the Hunter Valley. The TEC presents as a tall forest dominated by *Angophora floribunda*, *Eucalyptus saligna, E. deanii* and sometimes *E. tereticornis* are found above a small tree layer of wattles such as *Acacia parramattensis* and an abundant cover of grass mainly *Microlaena stipoides* var *stipoides*. These forests have fewer mesic species than vegetation communities associated with Subtropical Coastal Floodplain Forests. The Putty Valley experiences an annual rainfall of less than 800 mm, which is similar to the Cumberland Plain in Western Sydney, a primary source for the species assemblage list for RFEF.

4.3.3 Swamp Sclerophyll Forest

We allocated 10 plots with a high confidence to SWSF. These plots occurred within five state forests that occupied very low elevations along the North Coast. Most plots were located in the lower to mid North Coast state forests.

<u>Photo 5</u>: On the North Coast, Swamp Sclerophyll Forest is typically dominated by *Eucalyptus robusta* and *Melaleuca quinquinervia*. At this reference site (MCK02A7V) in Nambucca State Forest these two tree species occupy the largest proportion of the tree cover. Beneath them is a dense ground layer of plants that prefer waterlogged soils including sedges from the genera *Carex*, *Baumea* and *Gahnia*. This plot is situated at just 15 metres above sea level and falls within the general elevation parameters described in the final determination for this TEC.

4.3.4 Swamp Oak Forest

We allocated six plots with high confidence to SOAK. These plots were situated within six state forests that occupied very low elevations, generally less than 10 metres above sea level. Plots were located in state forests near the northern and southern extents of the study area.

Photo 6: Newry State Forest includes a plot (MSB03Q0V) we assigned to Swamp Oak Forest on Floodplain TEC. The plot includes both *Casuarina glauca* and *Melaleuca quinquinervia* in the tree layer and has an equally strong relationship to the assemblage used to describe Swamp Sclerophyll Forest TEC. This can be common in these highly gradational floodplain environments where boundaries between two or more communities are rarely abrupt.

4.4 Indicative TEC Mapping

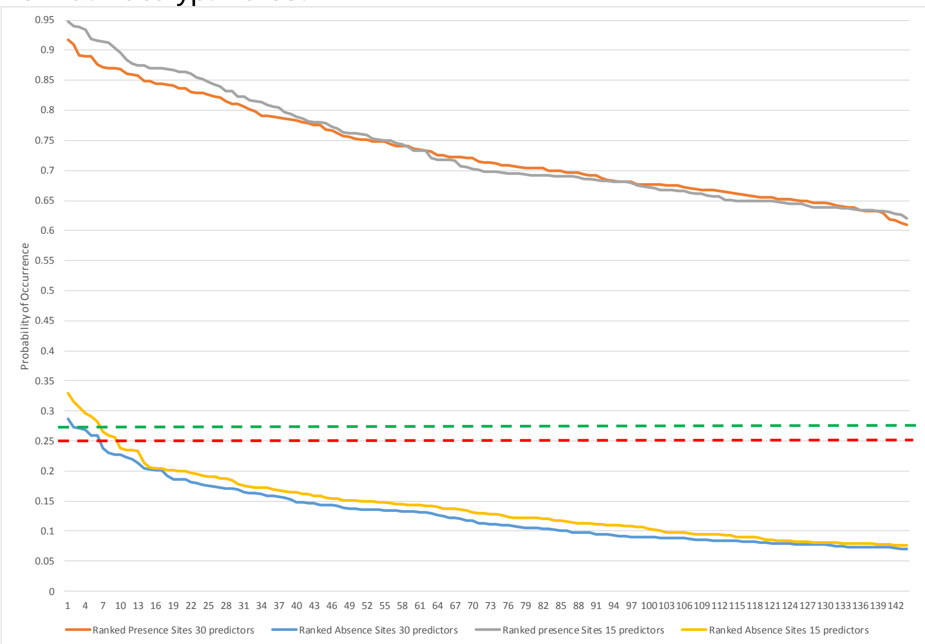
4.4.1 Model performance

A single set of Random Forest models were constructed for RFEF, SWSF and SOAK. However, in the case of SCFF, we developed two separate sets of models because our analyses suggested that our interpretation of SCFF included two floristically distinct groups of communities, which we thought were likely to have different environmental relationships and which were related to the final determination with different degrees of likelihood. One was a group with a more northerly distribution (SCFF-N) including communities 1000-1107 and N-M1, which we assessed as highly likely to belong to SCFF and which occurred both on floodplains and in associated alluvial environments. The other was a more southerly group (SCFF-S), comprising only community MU 198, which we assessed as belonging to SCFF with a lower degree of confidence arising from inconsistent relationships with various elements of the SCFF determination. The distribution of plots that we assigned to this group suggested that it occurred frequently in alluvial environments but much less frequently on floodplains.

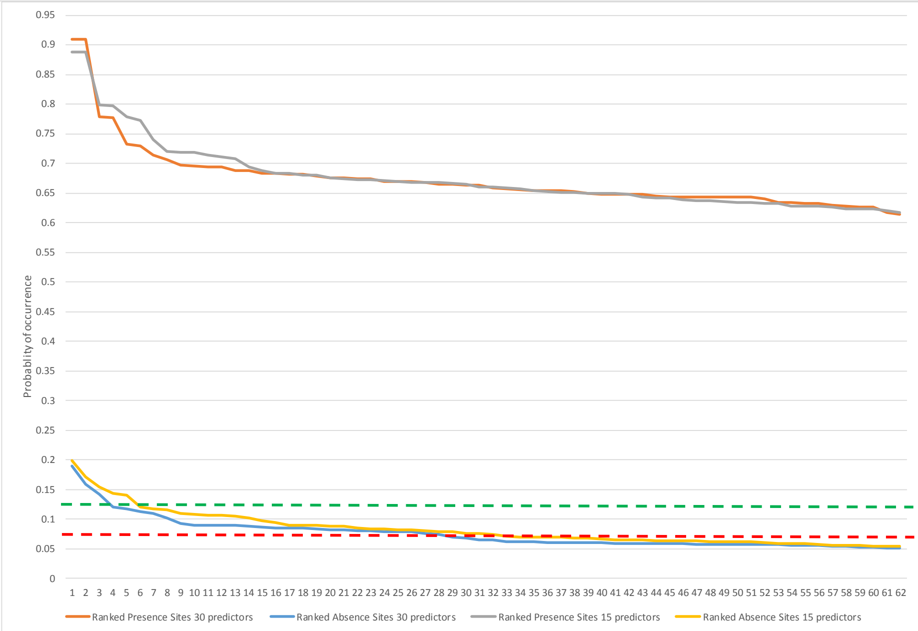
Figure 1 shows plots of the predicted probability of occurrence for sites allocated to a TEC (in order of descending probability) plotted against the same number of highest ranked absence plots. Across the ten sets of models (five with 15 predictors and five with 30 predictors) there was no overlap between the lowest probability of occurrence value for a TEC present site, and the highest probability of occurrence for a TEC absent site. Thus choosing any threshold between these two values results in 100% of all present and absent sites being correctly classified. Each set of plots also shows two thresholds, resulting in two possible points of view on where the TEC has the potential to occur, and where it has little to no chance of occurrence.

<u>Figure 1</u>: Predicted probability of occurrence (PO) values for sites allocated to each TEC (in order of descending probability) plotted against the PO values for the same number of highest ranked absence plots. The double lines represent models with 15 and 30 predictors. The order of plots are: a) Subtropical Coastal Floodplain Forest (North), b) Subtropical Coastal Floodplain Forest (South), c) Swamp Sclerophyll Forest, d) Swamp Oak Forest, and e) River-flat Eucalypt Forest.

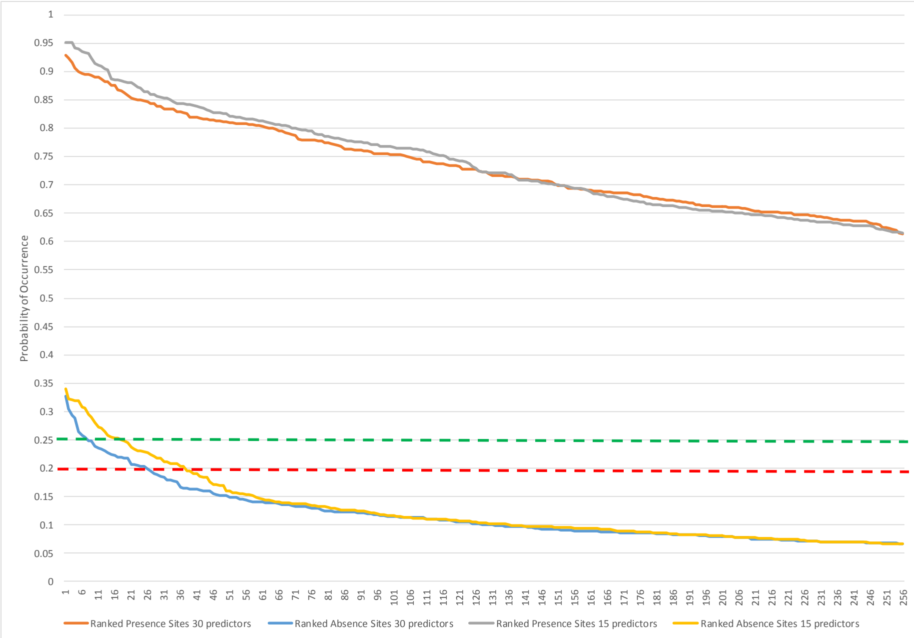
a) SCFF-N



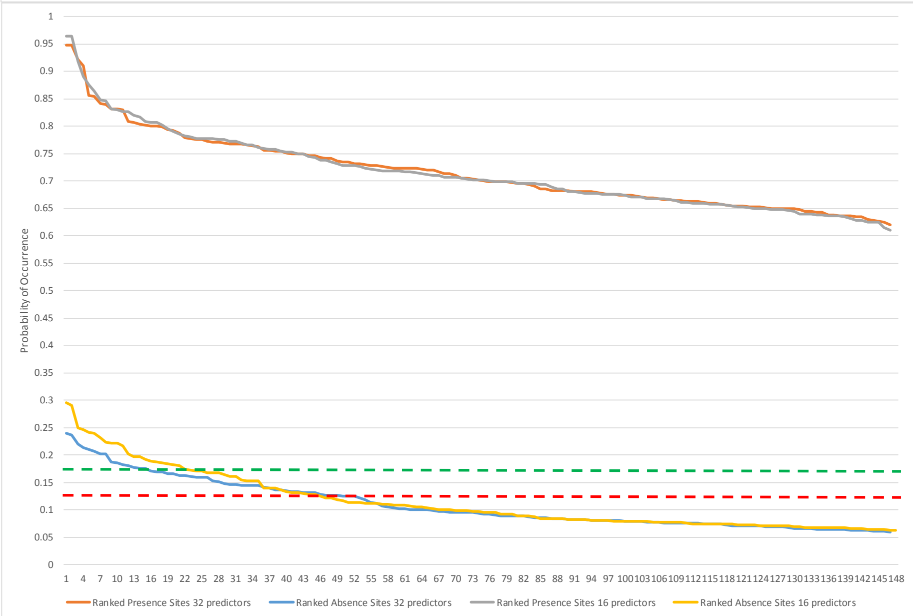
b) SCFF-S



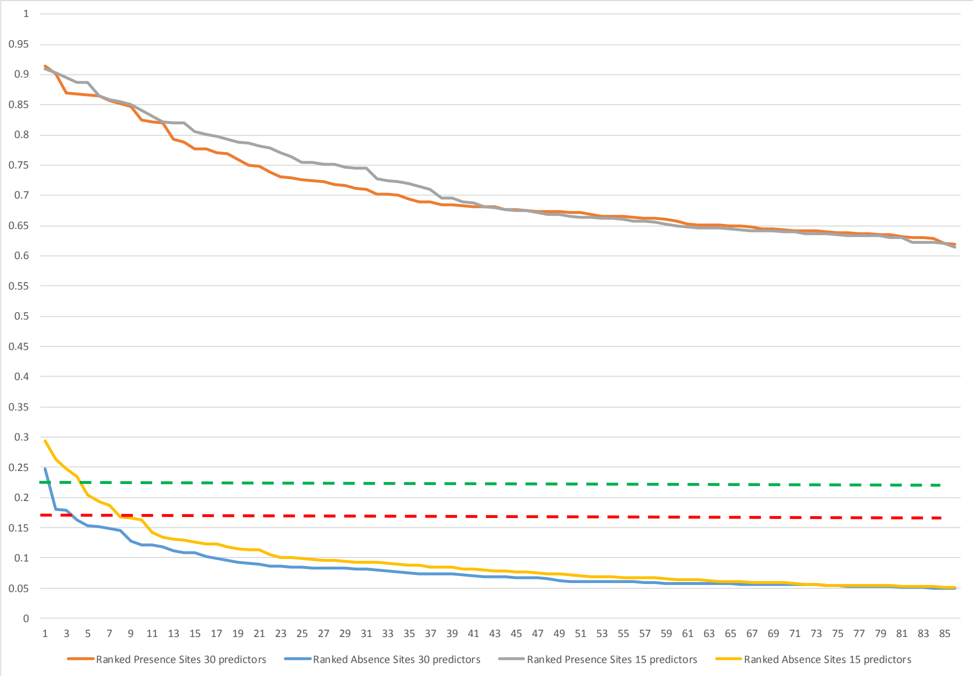
c) SWSF


Probability of Occurrence
Ranked Presence Sites 30 predictors
Ranked Absence Sites 30 predictors
Ranked Presence Sites 15 predictors
Ranked Absence Sites 15 predictors

d) SOAK


Probability of Occurrence
Ranked Presence Sites 32 predictors
Ranked Absence Sites 32 predictors
Ranked Presence Sites 16 predictors
Ranked Absence Sites 16 predictors

e) RFEF



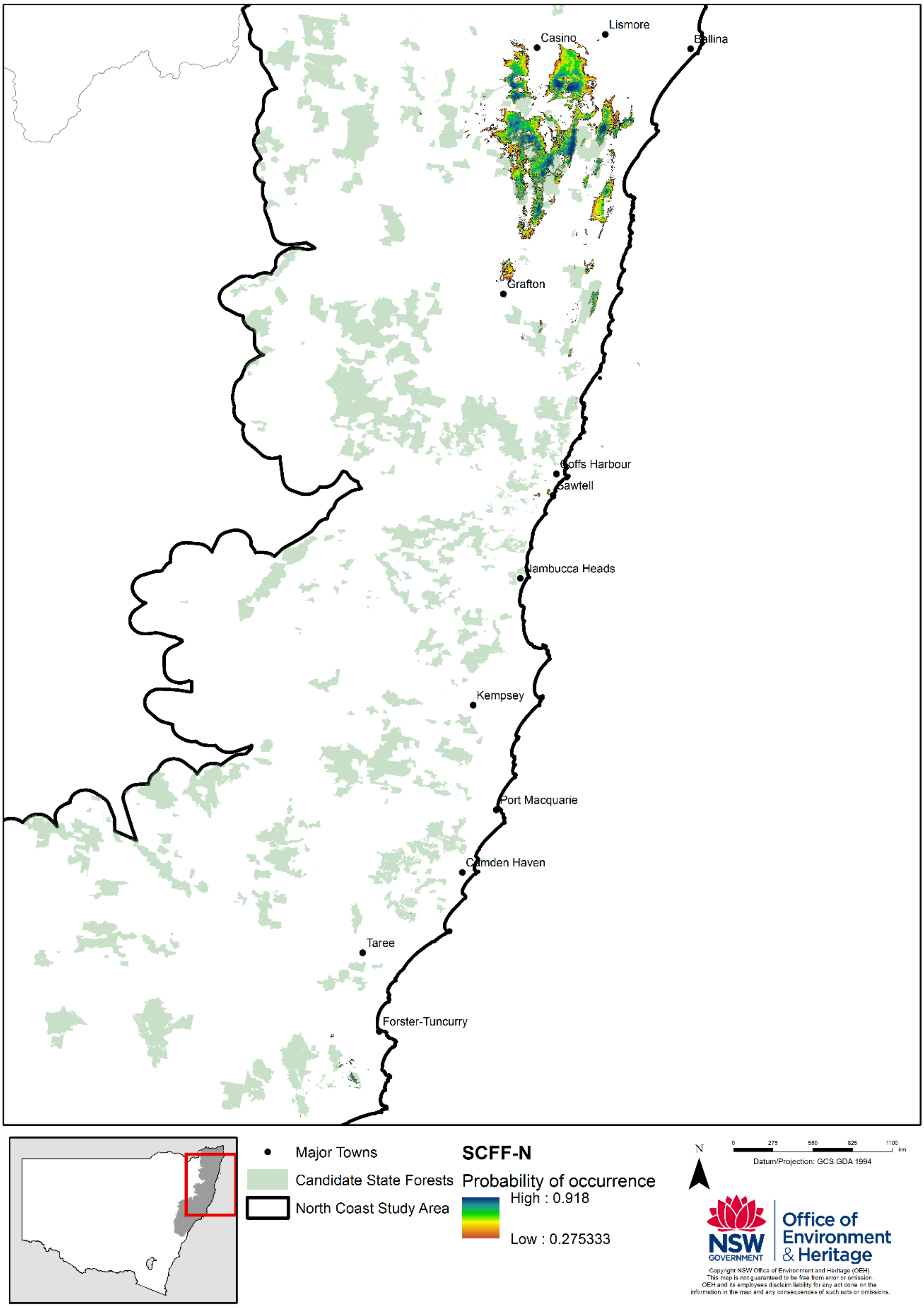
4.4.2 TEC indicative maps

The indicative maps predict the distribution of a TEC based on the probability of occurrence values above a particular threshold. For the thresholds marked in Figure 1, we accept a very small level of misclassification of absence sites. This has the effect of expanding out the models just enough to account for spatial inaccuracies that may exist in the data. In the case of RFEF and SCFF-N this includes only 10-15 of the 14,000+ absence sites, while for SOAK and SWSF it is up to 50.

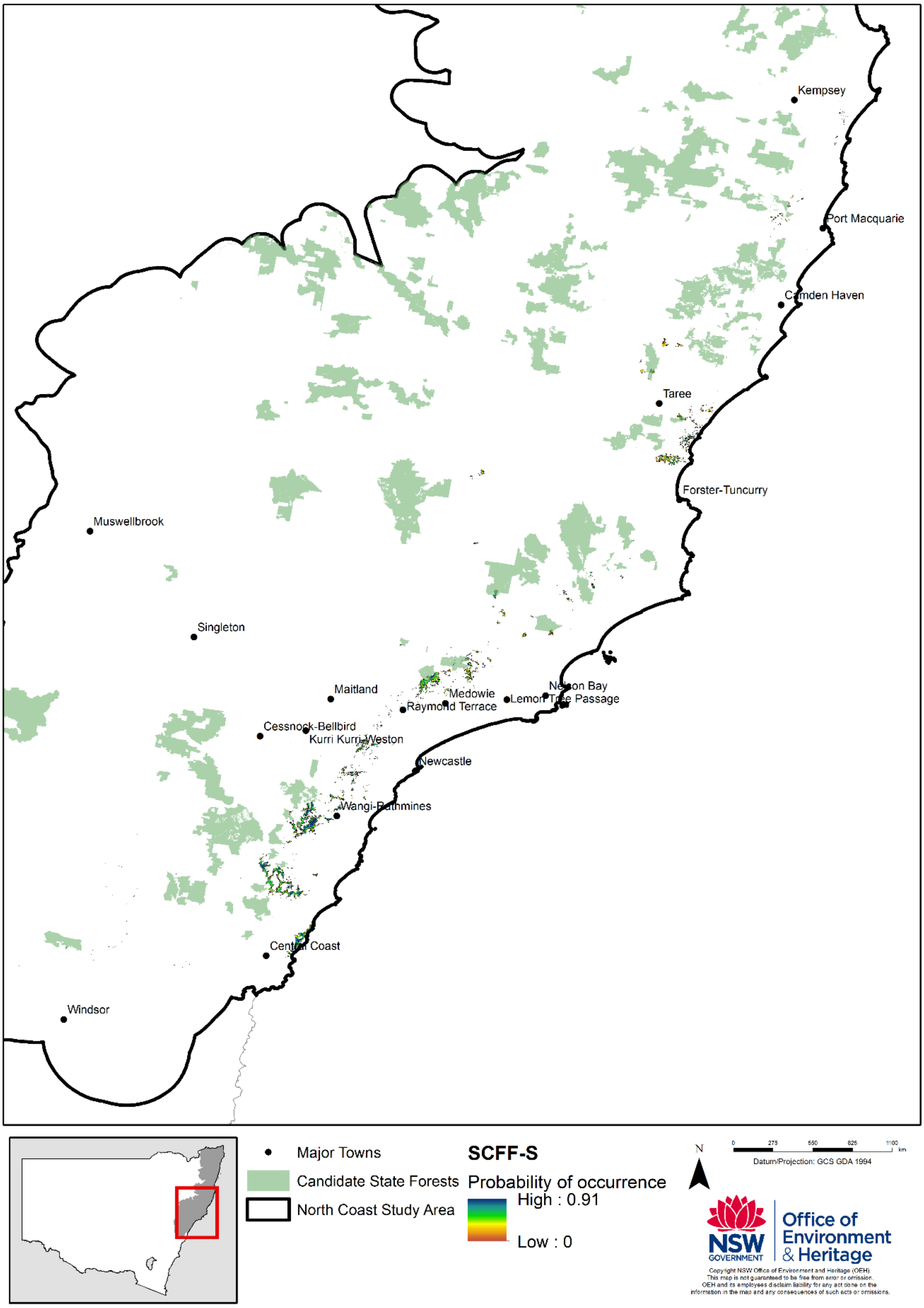
From the modelling, we identified four possible indicative maps for each TEC. This included two sets of models (each with 15 and 30 predictors), and two thresholds to predict the potential extent of the TEC. All four sets of predicted occurrence maps were examined in ArcGIS using ADS40 imagery as the backdrop, and an assessment made as to which model/threshold best discriminated the underlying habitat features and our understanding of the vegetation patterns. Our models were also compared against any existing vegetation mapping and new API mapping completed during our project. In most cases (but not always), the models with 30 predictors and the higher of the two thresholds (narrower distribution) produced the models that aligned with our knowledge and these formed the basis for new survey and mapping efforts.

Maps 8-12 show the predicted distribution of the TECs across all tenure.

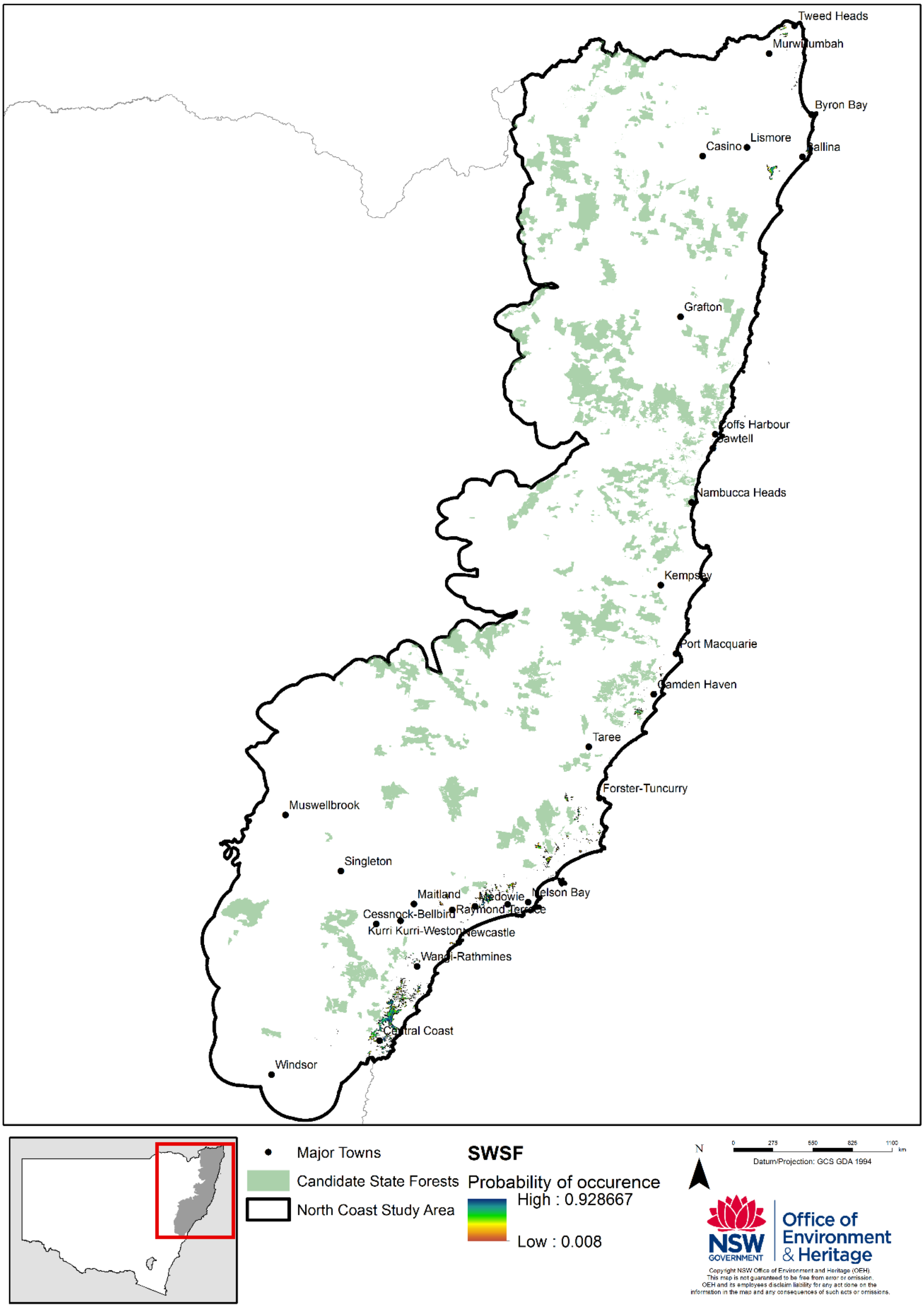
<u>Map 8</u>: Indicative map showing the potential distribution of SCFF-N.



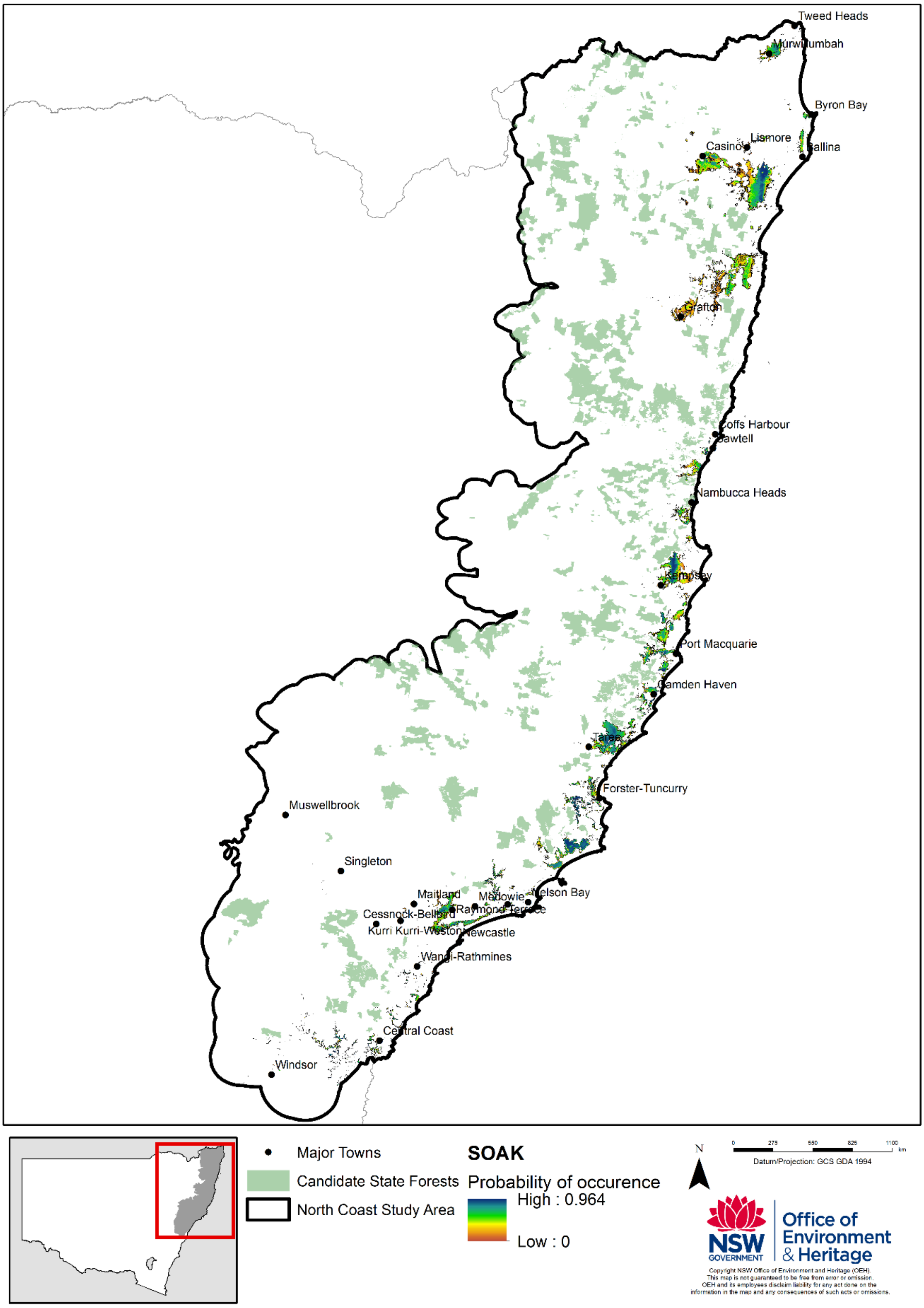
Map 9: Indicative map showing the potential distribution of SCFF-S.



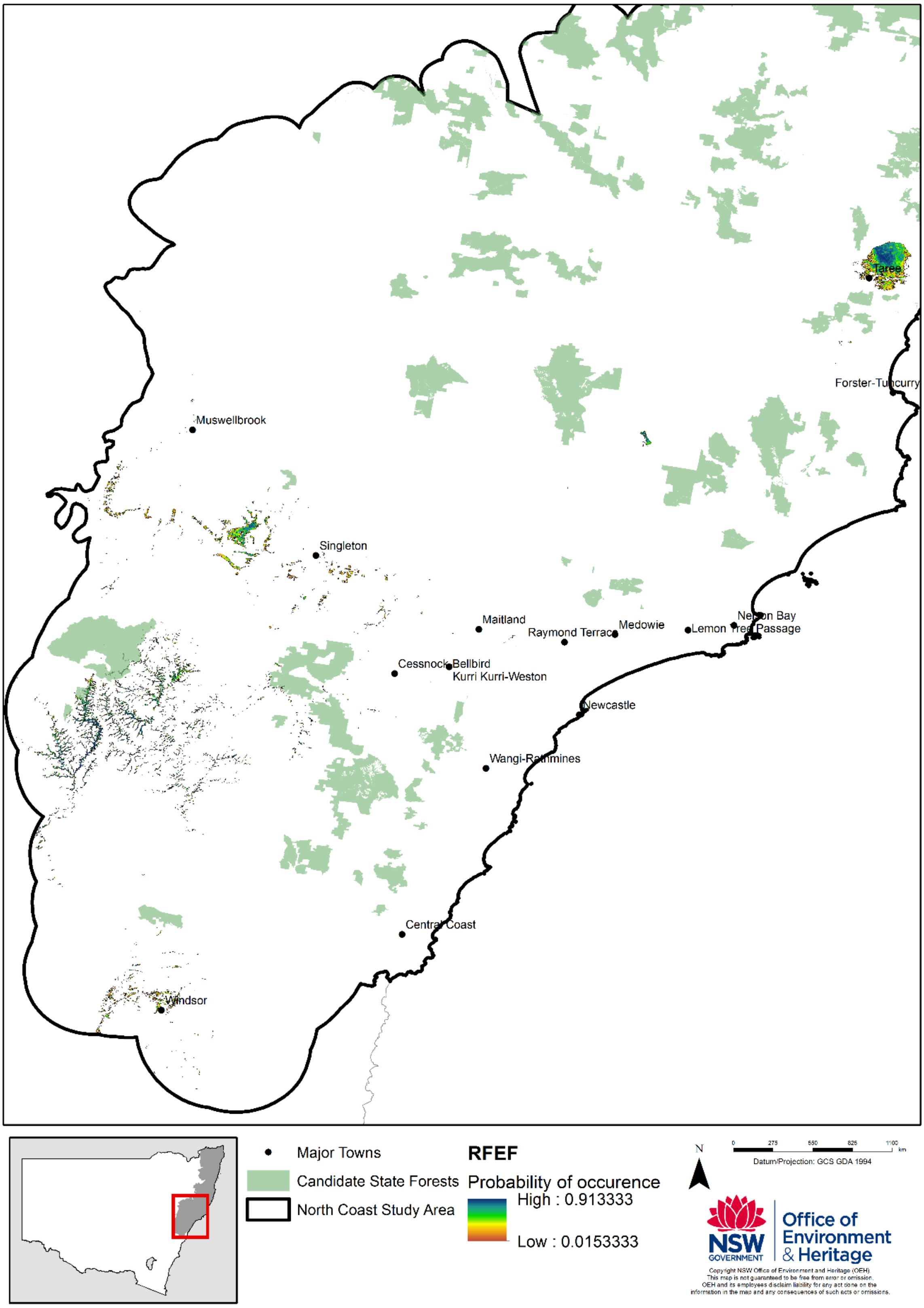
Map 10: **Indicative map showing the potential distribution of SWSF.**



Map 11: **Indicative map showing the potential distribution of SOAK.**



Map 12: **Indicative map showing the potential distribution of RFEF.**



4.4.3 Environmental relationships

Individual fitted functions for predictors in the Random Forest models are useful for determining whether the models match what we know about the broad distribution and habitat requirements of a TEC. For example, we know from the final determination that RFEF '*Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level' and is associated with 'silts, clay-loams and sandy loams on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains*'.

Table 13 lists the variables selected in models with 15 predictors (16 in the case of SOAK) across the four TECs. The scaled variable importance values for each model are provided in Figure 2. These give a measure of the relative contribution each variable has on the overall model, with low standardised variable importance values having relatively little impact on the probability of occurrence values.

Across all five models, elevation or its surrogate distance from the coast emerged as the strongest (or in the case of RFEF second strongest) predictor. The next most important set included a range of climate variables, that when combined constrain the broad distribution of the TECs. Other predictors that are important for individual TECs include topographic roughness (SOAK), distance to permanent and seasonally flooded water bodies (SCFF), soil pH (SCFF) and remote sensing variables that relate to long-term seasonal patterns in vegetation greenness (RFEF). The shape of the individual fitted functions for each model are shown in Figure 3. The response functions for variables are, by and large, consistent across the different TEC models, and follow the responses one would expect for floodplain communities.

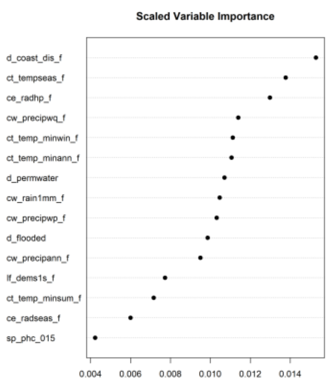
Table 13: List of variables selected in Random Forest models associated with 15 predictors.

Code	Parameter	SCFF	SWSF	SOAK	RFEF
ct_tempseas_f	Temperature Seasonality: Coefficient of Variation (bio4)	1	1	1	1
d_coast_dis_f	Distance from NSW East Coast Euclidian Distance	1	1	1	1
ce_radseas_f	Radiation of Seasonality: Coefficient of Variation (bio23)	1	1		1
ct_temp_minsum_f	Average daily min temperature - Summer	1	1	1	
ct_temp_minwin_f	Average daily max temperature - Winter	1	1	1	
cw_precipwq_f	Precipitation of Warmest Quarter (bio18)	1	1		1
lf_dems1s_f	Elevation from 1 sec SRTM smoothed DEM (DEM-S)	1	1	1	
ce_radhp_f	Highest Period Radiation (bio21)	1			1
ce_radlp_f	Lowest Period Radiation (bio22)		1		1
ct_temp_maxwin_f	Average daily max temperature - Winter		1	1	
ct_temp_minann_f	Average daily min temperature - Annual	1	1	1	
ct_tempannrnge_f	Temperature Annual Range: difference between bio5 and bio6 (bio7)		1	1	
ct_tempmtcp_f	Min Temperature of Coldest Period (bio6)		1	1	
cw_precipann_f	Annual Precipitation (bio12)	1			1
cw_precipseas_f	Precipitation of Seasonality: Coefficient of Variation (bio15)		1		1
cw_precipwp_f	Precipitation of Wettest Period (bio13)	1			1
cw_rain1mm_f	Average Number of days with rainfall greater than 1mm Annual	1			1

Code	Parameter	SCFF	SWSF	SOAK	RFEF
ct_temp_maxsum_f	Average daily max temperature - Summer				1
ct_tempann_f	Annual Mean Temperature (bio1)			1	
ct_tempdiurn_f	Mean Diurnal Range (Mean(period max-min)) (bio2)			1	
cw_precipdp_f	Precipitation of Driest Period (bio14)		1		
cw_prescott_f	Prescott Index				1
cw_rain_sumwin_f	Average Rainfall - Summer Winter Ratio		1		
d_flooded	Distance (Euclidean) from seasonally flooded water bodies	1			
d_permwater	Distance (Euclidean) from permanent water bodies	1			
gp_grav_bougb1	Bouguer gravity			1	
lf_logre10_f	Cold air drainage			1	
lf_rough0100_f	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 100 m neighbourhood. Derived from DEM-S			1	
lf_rough0500_f	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 500 m neighbourhood. Derived from DEM-S			1	
lf_rough1000_f	Neighbourhood topographical roughness based on the standard deviation of elevation in a circular 1000 m neighbourhood. Derived from DEM-S			1	
sp_phc_015	pH (calcium chloride) (5 - 15cm)	1			
xrs88_sspr_g_05p	Landsat 25-year seasonal greenesss in spring (5th percentile)				1
xrs88_ssum_g_05p	Landsat 25-year seasonal greenesss in spring (50th percentile)				1
xrs88_ssum_g_50p	Landsat 25-year seasonal greennesss in summer (5th percentile)				1
Total		**15**	**15**	**16**	**15**

<u>Figure 2</u>: Scaled variable importance values in relation to models with 15 predictors. The order of plots are a) Subtropical Coastal Floodplain Forest (North), b) Subtropical Coastal Floodplain Forest (South), c) Swamp Sclerophyll Forest, d) Swamp Oak Forest, and e) River-flat Eucalypt Forest.

a)



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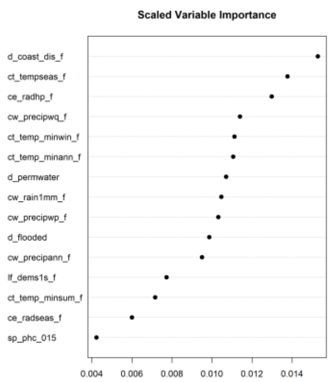
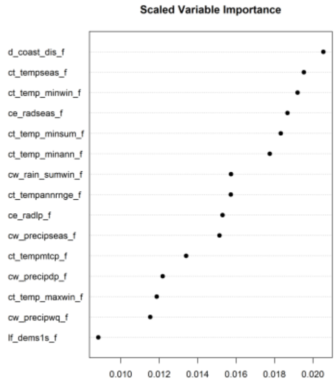
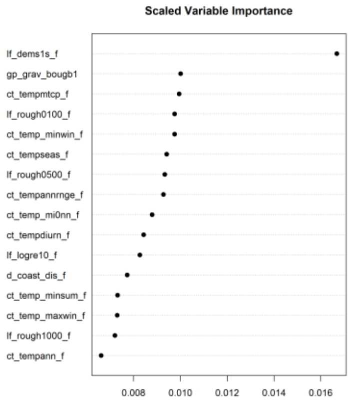


c)


Scaled Variable Importance
d_coast_dis_f
ct_tempseas_f
ct_temp_minwin_f
ce_radseas_f
ct_temp_minsum_f
ct_temp_minann_f
cw_rain_sumwin_f
ct_tempannrnge_f
ce_radlp_f
cw_precipseas_f
ct_tempmtcp_f
cw_precipdp_f
ct_temp_maxwin_f
cw_precipwq_f
lf_dems1s_f
0.010
0.012
0.014
0.016
0.018
0.020

d)


Scaled Variable Importance
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lf_rough0500_f
ct_tempannrnge_f
ct_temp_mi0nn_f
ct_tempdiurn_f
lf_logre10_f
d_coast_dis_f
ct_temp_minsum_f
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ct_tempann_f
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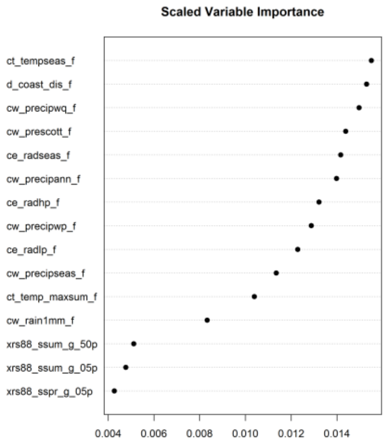
0.010
0.012
0.014
0.016

e)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cw_prescott_f
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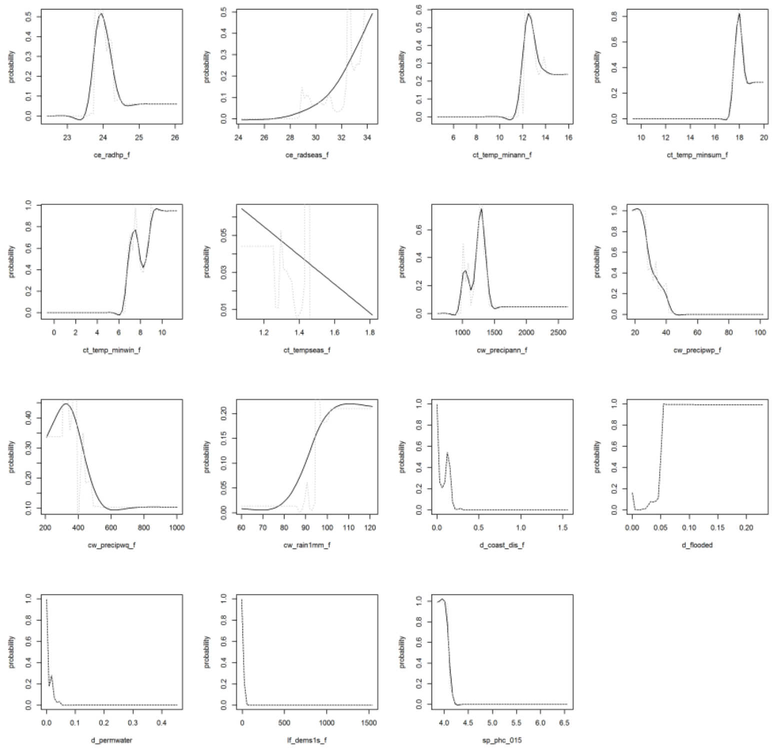
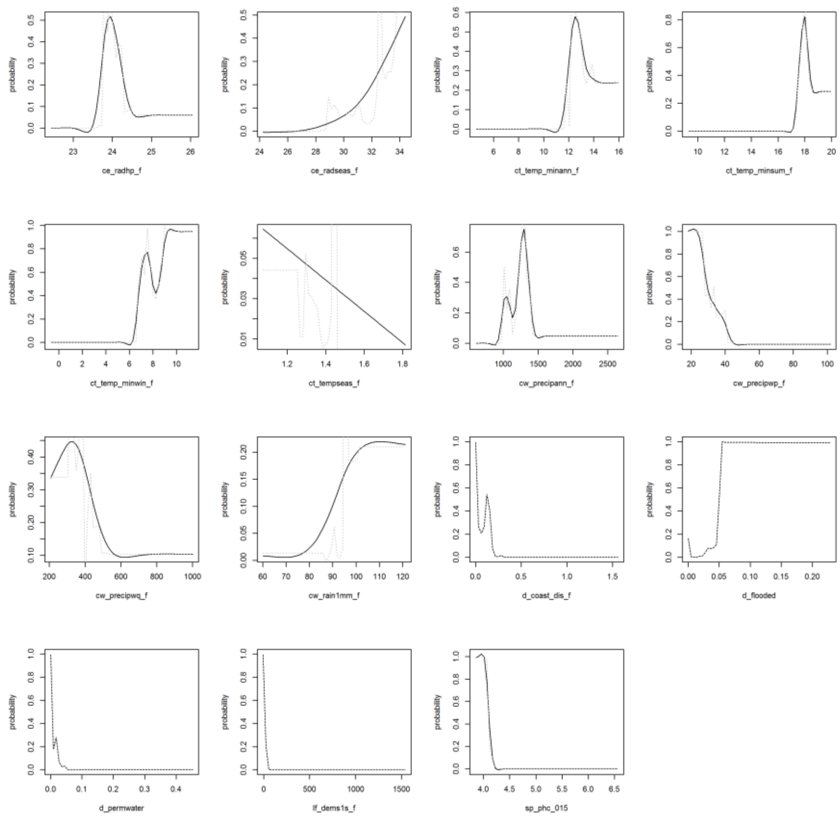
ce_radhp_f
cw_precipwp_f
ce_radlp_f
cw_precipseas_f
ct_temp_maxsum_f
cw_rain1mm_f
xrs88_ssum_g_50p
xrs88_ssum_g_05p
xrs88_sspr_g_05p
0.004
0.006
0.008
0.010
0.012
0.014

<u>Figure 3</u>: Shape of individual fitted functions in relation to models with 15 predictors. The order of plots are: a) Subtropical Coastal Floodplain Forest (North), b) Subtropical Coastal Floodplain Forest (South), c) Swamp Sclerophyll Forest, d) Swamp Oak Forest, and e) River-flat Eucalypt Forest.

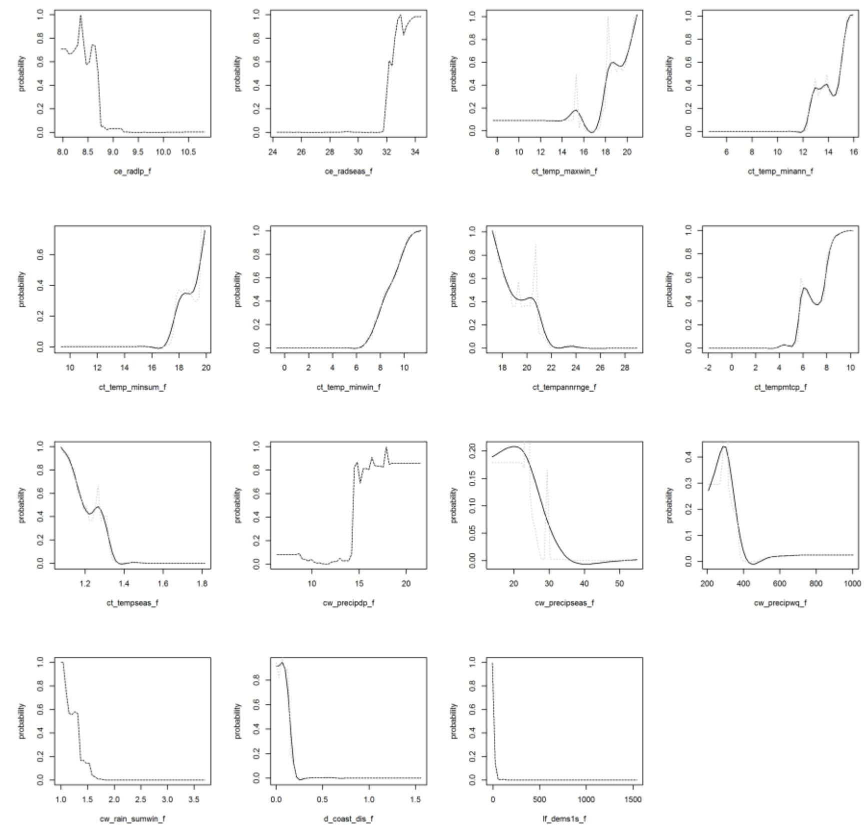
a)



b)



c)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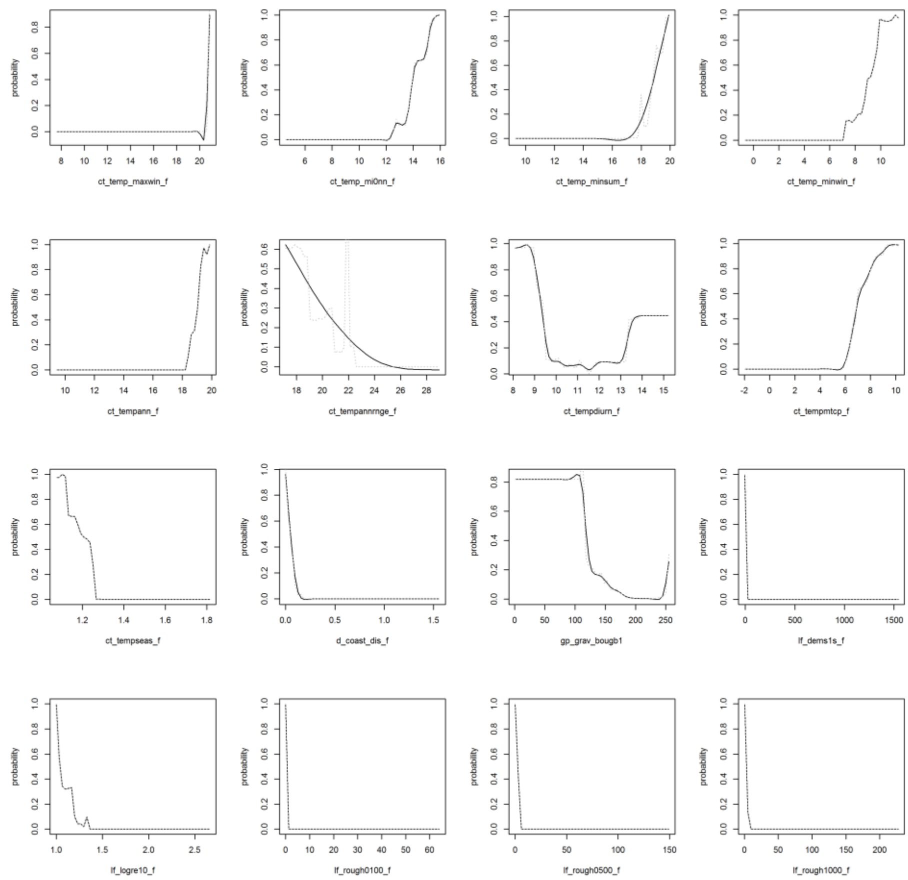
ct_temp_minwin_f
ct_tempannrnge_f
ct_tempmtcp_f
ct_tempseas_f
cw_precipdp_f
cw_precipseas_f
cw_precipwq_f
cw_rain_sumwin_f
d_coast_dis_f
lf_dems1s_f

d)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ct_tempdiurn_f
ct_tempmtcp_f
ct_tempseas_f
d_coast_dis_f
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lf_dems1s_f
lf_logre10_f
lf_rough0100_f
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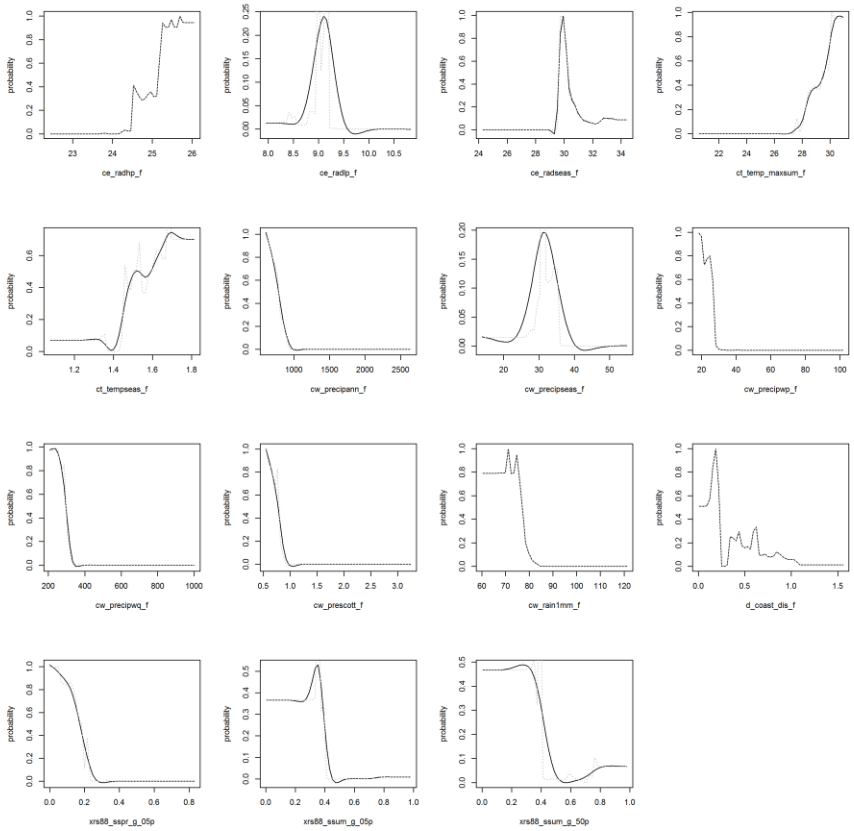
lf_rough1000_f

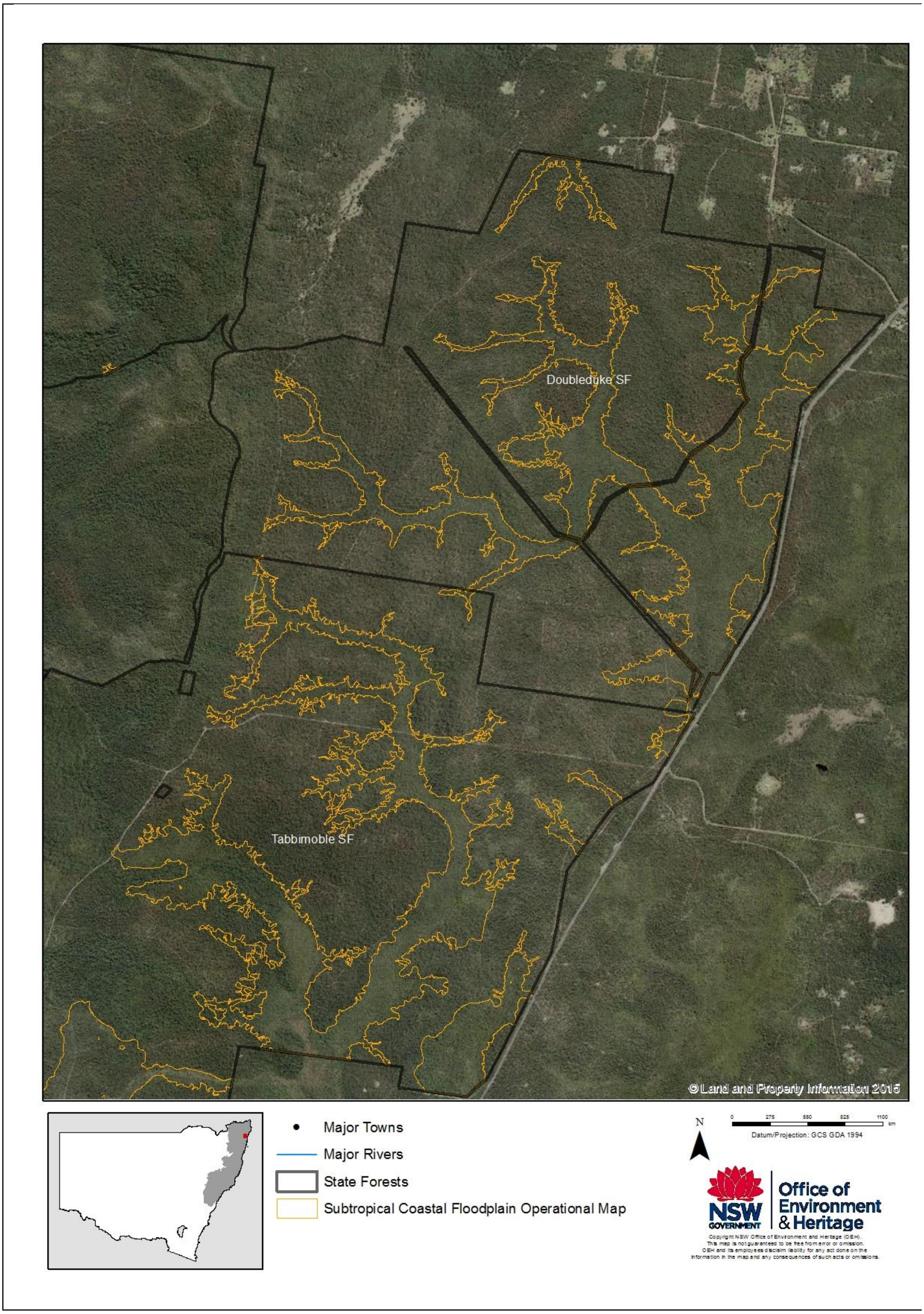
e)



4.5 Operational TEC Mapping

We constructed four operational map to describe and define the extent of each of the floodplain TECs within state forests. Maps 13-17 show examples of the maps for each of the TECs in selected locations while the total number of forests that include each of the TECs are shown in Maps 18-20. We identified 50 state forests within our North Coast study area that include one or more of the floodplain TECs. In total, we identified approximately 11,050 hectares of SCFF, 1099 hectares of SWSF, 204 hectares of SOAK and 198 hectares of RFEF on state forest in the North Coast study area.

Map 13: **Example of operational map for SCFF-N.**

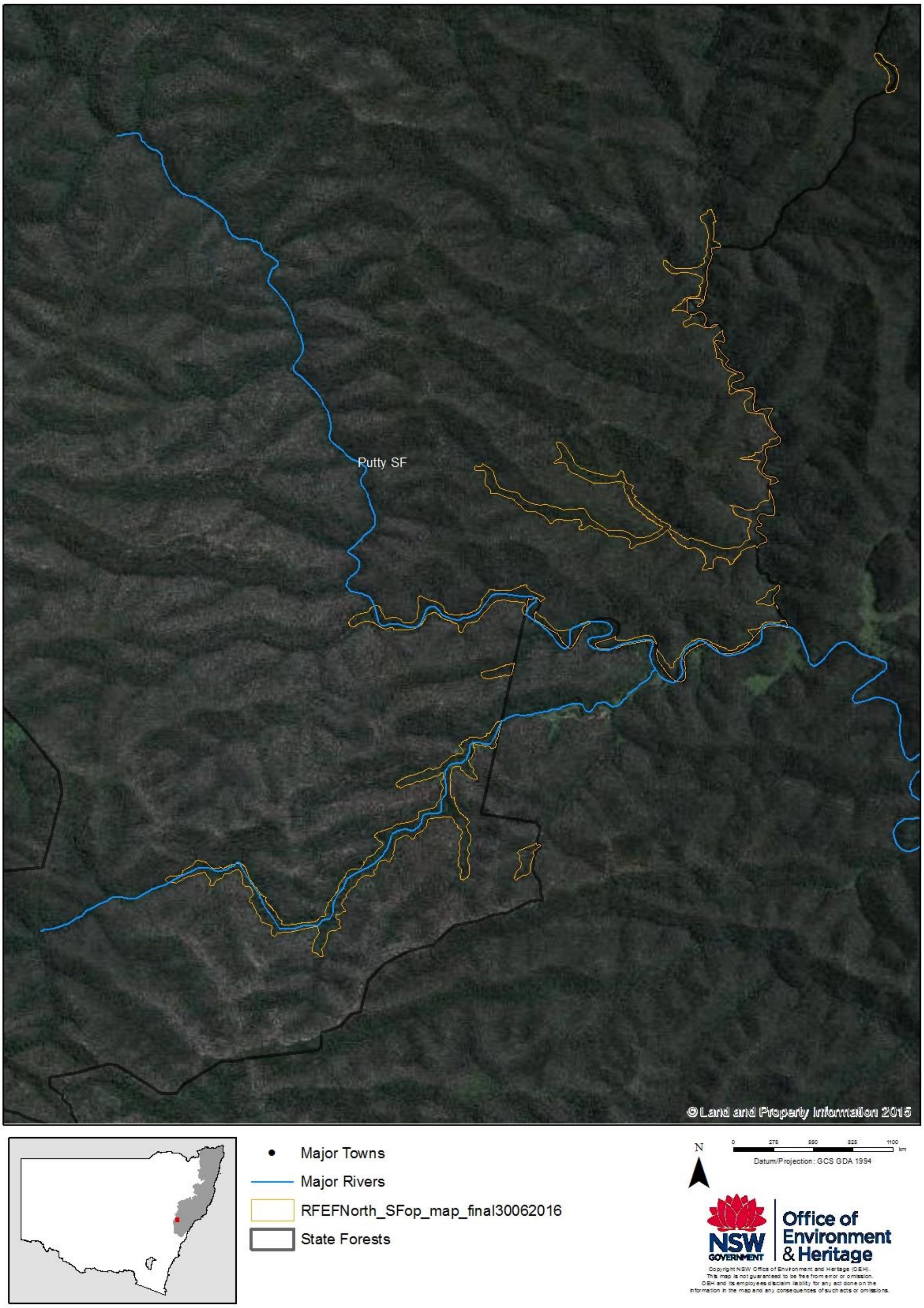


<u>Map 14</u>: **Example of operational map for SCFF-S.**

Map 15: **Example of operational map for SWSF.**

Map 16: **Example of operational map for SOAK.**

Map 17: **Example of operational map for RFEF.**



4.6 Validation

Of the 94 validation plots, we were able to assign 56 plots to either TEC or not with a high degree of confidence. Results for the remaining 38 plots were ambiguous. In some cases, they were ambiguous because they were ambiguously related to a TEC community, because they had a low membership value. In other cases, they were ambiguous because they were allocated to a new group in the revised fuzzy clustering analysis, which comprised approximately equal proportions of plots previously allocated to a TEC community and a non-TEC community. A summary of validation plot assignments is provided in Table 13 and details are shown in Appendix G.

Table 13: Distribution of plots among mapped floodplain TECs.

Rows and columns labelled 'any TEC' are the totals of all plots assigned to any of the three TECs.

	Mapped TEC					
Plot TEC	SCFF	SOAK	SWSF	any TEC	not TEC	Total plots
SCFF	16	0	1	17	1	18
SOAK	0	1	0	1	0	1
SWSF	4	0	2	6	0	6
any TEC	20	1	3	24	1	25
ambiguous	15	2	0	17	21	38
not TEC	5	0	2	7	24	31
Total	40	3	5	48	46	94

The validation results indicate that on average we have achieved approximately 96% inclusion of floodplain TECs in mapped areas of TEC. However, we have achieved a substantially lower likelihood (approximately 75%) of mapping the particular TEC consistent with the TEC assigned to plot data. This is most likely due to several factors:

- the variation within vegetation communities and the extent of floristic overlap between TECs, especially SCFF and SWSF;
- the difficulty of assigning vegetation communities to a particular TEC because of ambiguity and uncertainty of TEC interpretation;
- and different spatial scales of plot data and mapping so that map units may include a mosaic of vegetation communities at the plot scale.

We assigned approximately 23% of plots as not TEC in areas that we mapped as TEC, which indicates the likely extent that we have mapped non-TEC areas as TEC. This may be partly due to the difference in spatial scale, whereby these plots may represent small areas of non-TEC in larger TEC map units (i.e. the vegetation pattern is too small to map using either our modelled probabilities or API). However, we believe it is most likely a consequence of our precautionary assignment of API units as TEC or not.

While this project has significantly enhanced the availability of plot data in alluvial environments, the study area encompasses a very large area with significant environmental variation. In cases where there were little or no plot data for an API unit, or plot allocations to TEC for an API unit, or where API units with similar canopy dominants comprised both TEC and non-TEC plots, we allocated the unit to the most likely TEC. A precautionary assessment was necessary to minimise the likelihood that TEC occurred outside mapped areas so that it was at or below the 5% threshold that we aimed to achieve. This inevitably increases the likelihood that non-TEC is mapped as TEC. It may be possible to refine our API mapping with more intensive field checking. However, this is unlikely to substantially reduce uncertainty over assignment of map units with existing plot data. To reduce the extent to which we have mapped non-TEC while still achieving the desired threshold for mapping TEC, would require that we reduce this uncertainty by investing in additional plot data.

5 Discussion

5.1 Summary

5.1.1 Cited vegetation communities and determination species assemblage list

The interpretations adopted by the TEC interpretation panel for this project assigned the results from primary floristic analysis in Keith and Scott (2005) and communities cited in the final determinations as one of the strongest diagnostic attributes for each TEC. The implementation of this interpretation uncovered a number of inconsistencies and contradictions within each TEC determination. These problems were compounded because there are now significantly more data and classification descriptions available, which were not accessible at the time of the original determinations. There remains particular difficulties of interpretation relating to inconsistencies across cited classifications, recent uncited classifications and Keith and Scott (2005).

The Swamp Sclerophyll Forest final determination is an example where it was uncertain as to whether the species assemblage list or the cited vegetation communities assumed precedence or whether both should be accepted in the interpretation. The determination explicitly includes map unit 42 (NPWS 2000) from a study in the lower Hunter and Central Coast. Plots used to define this unit are mostly included within a more recent classification MU131 (Sivertsen et al. 2011) in the same region. However, MU131 is relatively highly dissimilar to any determination assemblage list (in particular Swamp Sclerophyll Forest in which it is cited) and is more similar to group 5 (not TEC) in Keith and Scott (2005) than any TEC group in that study. The panel was unable to exclude plots allocated to map unit 42 (and more recent MU131) as the SWSF TEC based on its weaker relationship to the determination assemblage list because it is explicitly cited.

Similarly, for Swamp Oak Floodplain Forest, the final determination assigns map units 40 and 41 from the same Lower Hunter and Central Coast study (NPWS, 2000). Plots defining these units are largely included within the more recent classification units MU209 and MU210 (Sivertsen et al. 2011). However these units are more closely aligned to Keith and Scott group 17 (not TEC) than group 2 (SOAK TEC). In this instance, the panel assigned all relevant plots as SOAK TEC to overcome the inconsistencies.

We encountered difficulties locating the species assemblage associated with River-flat Eucalypt Forest TEC in many of the coastal valley alluvial environments for which it is described on the Central and North Coasts. This determination cites a number of existing communities from the NPWS (2000) study but also implicitly excludes some alluvial communities from the same study (e.g. map unit 5 Alluvial Tall Moist Forest). North of the Hunter River, there are no cited communities. We relied on the relationships between recent classification units and the determination species assemblage list. However, as the determination species assemblage is primarily drawn from alluvial systems in drier coastal valleys including the Cumberland Plain and Hunter regions we found only weak relationships with alluvial eucalypt forests in coastal regions with higher rainfall. We identified stronger relationships between RFEF and classification units from the Sydney Basin (OEH in prep) describing alluvial forests in the Putty and Howes Valley in the Hunter region.

Our interpretation for Subtropical Coastal Floodplain Forest overcame some of the inconsistencies associated with RFEF because we identified a wider distributional range using our plots and comparative analysis. SCFF has no cited vegetation communities but we were able to refer to Keith and Scott (2005) units aligned to the TEC. Overall we were more reliant on the comparisons with the determination assemblage list. We identified that map unit 198 from a recent classification of the Hunter region (Sivertsen et al. 2011) has a relatively high degree of similarity to the determination assemblage list for SCFF. However, is not closely similar to any Keith and Scott group (the highest similarity is with group 5, not

TEC) and although usually on or near alluvial landforms, it is not a floodplain community. It also occurs across the bioregional boundary between North Coast and Sydney Basin. We have assigned it to SCFF, even though in the strict sense, its occurrence in Sydney Basin bioregion is excluded by the determination.

We overcame some of the ambiguity associated with the definition of TEC assemblages by using large regional systematic floristic datasets, new survey data and a range of comparative analyses. Our interpretations involved agreements to provide greatest certainty against vegetation communities that were implicitly cited Keith and Scott (2005) groups or other cited communities. However, this did not preclude the TEC reference panel from making subjective interpretations on the inclusion or exclusion of particular assemblages as there was no alternative practical means of resolving inconsistencies in determinations.

5.1.2 Distribution and habitat descriptors

The final determinations include a set of environmental descriptors that may assist in interpreting floodplain TECs. The project relied on particular interpretations of environmental descriptors. Without these, and in the absence of explicitly cited communities, it is difficult to put the determination assemblage into context for TEC assessment. However, there is considerable uncertainty as to how the environmental descriptors themselves should be interpreted and the extent to which these criteria had to be satisfied in order to assign the TEC. The TEC Reference Panel addressed this uncertainty by adopting those criteria, which were accompanied by statements that suggested a definitive association: bioregion, alluvial flats and floodplains and elevation. There is much greater uncertainty over descriptors such as ‘drainage lines’ and qualifiers such as ‘associated with’. We relied on general environmental relationships at the vegetation community level to interpret vague descriptors.

Notwithstanding these decisions, the inclusion of floodplain and alluviums as a condition of the panel interpretation of the TEC required the identification of suitable landscapes on the North Coast. There is no reference in the final determination to mapped information defining floodplain and alluvial landscapes. The determination contains insufficient detail to apply a diagnostic rule to a site. The project adopted a precautionary interpretation of the landscape criteria by using the best available published maps, models of water flow accumulation using fine scale digital models and aerial photographic interpretation. We believe that the layers that we generated offer the best available representation of candidate alluvial and floodplain landscapes on state forest, but is likely to result in a relatively broad interpretation of vegetation on and ‘associated with’ floodplains. Less refined floodplain mapping remains on other tenures.

Paragraph 7 of the final determinations for each of the floodplain TECs includes a general statement: ‘the Determinations for these (floodplain) communities collectively encompass the full range of intermediate assemblages in transitional habitats’. However, the panel was unable to resolve the meaning of the statement in any practical sense because of the vagueness of what limits a ‘floodplain’ and what the term ‘transitional habitats’ means. We found general agreement with the elevation thresholds described in the determinations.

5.2 TEC Reference Panel Review and Assessment

Tables 14-18 summarise the interpretation of various features of the final determinations, which the TEC Reference Panel adopted, and includes a resolution of inconsistencies within determinations as applied for this project.

Table 14: Panel consideration of Subtropical Coastal Floodplain TEC.

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
Occurs in NSW North Coast bioregions	Accept bioregional qualifiers	Extended the distribution of SCFF into the Sydney Basin bioregion	Agreed

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
'Associated with clay-loams and sandy loams'. Occurs on 'on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence…'	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Floodplain and alluvial landform elements represented by a alluvial model derived from 1m Lidar DEM, supplemented by stereoscopic digital aerial photograph interpretation; not directly constrained by floodplain, association with floodplain, or soil type, due to difficulty of interpreting these terms in an operational sense, but these descriptors used to determine relationships of EEC with floristic groups We have used 30% of plots in modelled alluvium in a community as a general threshold to define floodplain/alluvial communities in a broad sense, consistent with but more precautionary than the proportions assessed for plots assigned to Keith and Scott's floodplain groups	Noted and agreed as for all floodplain TECs
Floodplains generally occur below 50 m elevation, but may occur on localised river flats up to 250 m	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Elevation threshold used to test floristic communities; the model may predict suitable habitats for EEC occur at higher elevations We did not constrain our mapping to elevation thresholds as no plots exceeded those specified	Noted
Characterised by the list of 102 plant species	Be guided by the species lists presented in the Determination	Compare species assemblage data drawn from source classifications, other existing classifications and new classifications developed by our project with that presented in the determination For Northern Rivers, 3 of 5 communities which most closely match the determination assemblage are also both alluvial and match K&S group 8. We have included these (700-488, 700-489, 1000-1107) as SCFF. Two of the 5 are similar to KS 8 but are mainly non-alluvial. Our assessment excludes these (1000-1106, 700-86) from SCFF. We identify a new community (N-M1) based on our analysis and include it as SCFF For the Hunter-lower North Coast, MU 198 is closest to	Noted and Agreed

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		the SCFF assemblage list and we have included it; all other Hunter communities which are similar to the assemblage list are more similar to SWSF or SOAK and more appropriately placed in those TECs	
Description of frequent, widespread or common species in canopy and other vegetation strata	Assess statements regarding the characteristics of the floristic composition	Use descriptive statements to assist in assessing how classifications described since the determination, including new classifications developed by our project, relate to the EEC Northern Rivers 1000-1106, floristically close to SCFF but not alluvial, has both TEC and non-TEC canopy species as dominant. As noted above, we have excluded it	Noted
Cited vegetation sources for bioregion as a whole include areas mapped as CRA FE 46 and parts of FE 73 **Cited sources for Tweed lowlands F5 and FL of Pressey and Griffith** **Implicit reference to unspecified Keith and Scott group**	Assess references to existing vegetation classification sources in the determination. The panel will note whether the existing classifications are 'included within' are 'part of' or 'component of' the determination Classifications developed using traceable quantitative data will be recognised as primary data upon which to assess floristic, habitat and distributional characteristics. Where data has been sourced and used in alternate regional or local classification studies the results will be considered by the panel to assist in the development of the TEC definitional attributes	There are very limited traceable primary quantitative data Cited map units FE46 and FE73 are derived only from API and not floristic data and are of widely varying accuracy. Plots in this map unit used for floristic analysis but cannot be considered primary data. Conflicts between mapped areas and floristic analyses resolved in favour of the latter where there is evidence of mapping inaccuracy A few FE46 plots in NR1000-1148 and 700-325; these are not closely similar to the assemblage list, are not alluvial and are closer to non-TEC KS groups; we have assessed them as not SCFF. FE73 alluvial plots are in NR1000-1106, 1000-1107 and 700-488; these are discussed in rows above Cited sources for Tweed lowlands of limited relevance to SF occurrences Implicit reference to Keith and Scott group used as a guide but conflicts resolved in favour of more consistent recent data and analyses where available An additional NR group (700-493) is similar to KS 8, mostly alluvial and has	Noted

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		SCFF canopy species; we have included it in SCFF About half of the plots used by K&S to define KS 8 are assigned to NR group 1000-1106, a large and primarily non-alluvial group	
	Other issue: Habitats in which this EEC occurs have been relatively poorly sampled and vegetation in these areas was very poorly described at the time of the determination. Vegetation descriptions have since been improved (e.g. NR classification)		Noted and agreed that where better data exists the interpretation should draw on it to guide the relationships to the species assemblage list

Table 15: Panel consideration of Swamp Sclerophyll Forest TEC.

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
Occurs in 'NSW North Coast, Sydney Basin, South East Corner Bioregions'	Accept bioregional qualifiers	Adopted	Agreed
Is 'associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence'	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Floodplain and alluvial landform elements represented by an alluvial model derived from 1m Lidar DEM, supplemented by stereoscopic digital aerial photograph interpretation We have used 30% of plots in modelled alluvium in a community as a general threshold to define floodplain/alluvial communities in a broad sense, consistent with but more precautionary than the proportions assessed for plots assigned to Keith and Scott's floodplain groups Plots on landscapes unambiguously defined by marine sand deposition were excluded from TEC candidacy for modelling purposes	Noted and Agreed
Occurs on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Our interpretation and mapping not constrained by elevation thresholds	Noted and agreed

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
Characterised by the list of 59 plant species	Be guided by the species lists presented in the determination	We compared species assemblage data drawn from source classifications, other existing classifications and new classifications developed by our project with that presented in the determination For the Hunter region (Sivertsen et al. 2011), communities MU 200, MU 206, MU 197, MU 199 and MU 205 are similar to the assemblage list and to KS 1, the group aligned to SWSF. We have included all of these in SWSF. For Northern Rivers, 700-633 and 700-634 are similar to both the determination list and KS 1 and we have included both as SWSF. 700-629 is similar to both SWSF and SOAK, but we have included it in SWSF because it is dominated by *Melaleuca quinquenervia* For new groups, 49 is both similar to the assemblage list and to KS 1. We have included it as SWSF	
Description of frequent, widespread or common species in canopy and other vegetation strata	Assess statements regarding the characteristics of the floristic composition	Used descriptive statements to assist in assessing how classifications described since the determination, including new classifications developed by our project, relate to the EEC	Agreed
'...includes the *Eucalyptus robusta* (Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002)'; includes CRA FE112 and FE142 'on floodplains'; on Tweed lowlands includes F7, F9 and parts of F8 and FL; in the Hunter district includes MU37, MU42 and MU42a **Implicit reference to unspecified Keith and Scott group**	Assess references to existing vegetation classification sources in the determination. The panel will note whether the existing classifications are 'included within' are 'part of' or 'component of' the determination Classifications developed using traceable quantitative data will be recognised as primary data upon which to assess floristic, habitat and distributional characteristics. Where data has been sourced and used in alternate regional or local classification studies the results will be considered by the panel to assist in the development of the TEC definitional attributes	Traceable data is not be available for Douglas and Anderson or Anderson and Asquith Cited CRA map units are of varying accuracy and do not provide primary quantitative data. Possible conflict between determination 'inclusion' of the mapped area and actual on-ground vegetation Cited sources for Tweed lowlands of limited relevance to SF occurrences Implicit reference to Keith and Scott group used as a guide but conflicts resolved in favour of more consistent recent data and analyses where available MU42 cited in the determination is included in a new classification unit in the Hunter, MU 131, which is similar to the determination assemblage but aligns with KS 5, implicitly excluded from the determination. New MU 131 is a larger group and may include several elements. We have included MU 131 as SWSF to resolve this inconsistency. Plots from unit MU37 cited in the determination are assigned to new MU 200 and 206,	

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		which we have included in SWSF as noted above Northern Rivers 1000-1936 is the most similar community to the determination assemblage but is similar to KS 17, implicitly excluded from the determination. We have included it in SWSF to resolve this inconsistency For mapping purposes we excluded samples that were unambiguously located on mapped marine sand deposits On a regional basis, we exclude floodplain assemblages described at the time of the determination but not cited, on the basis that these are implicitly excluded from the determination	

<u>Table 16</u>: Panel consideration of Swamp Oak Forest on Floodplain TEC.

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
Occurs in '…Sydney Basin, South East Corner Bioregions'	Accept bioregional qualifiers	Adopted	Agreed
Is 'associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains'	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Floodplain and alluvial landform elements represented by an alluvial model derived from 1 m Lidar DEM, supplemented by stereoscopic digital aerial photograph interpretation We have used 30% of plots in modelled alluvium in a community as a general threshold to define floodplain/alluvial communities in a broad sense, consistent with but more precautionary than the proportions assessed for plots assigned to Keith and Scott's floodplain groups .	Agreed as for all floodplain TECs
Generally occurs below 20 m (rarely above 10 m) elevation	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Determination does not define a fixed upper elevation threshold. We do not constrain EEC occurrence by elevation	Agreed
Characterised by the list of 45 plant species	Be guided by the species lists presented in the determination	Compare species assemblage data drawn from source classifications, other existing classifications and new classifications developed by our project with that presented in the determination For Northern Rivers, only 700-621 and 700-638 are similar to both the	

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		assemblage list and KS 2, the group aligned to SOAK; we have included both in SOAK. NR 1000-1936 and 1000-1979 are most similar to the assemblage list but are close to KS 17, implicitly excluded from the determination; however, for consistency with our treatment of the Hunter groups described in the next paragraph, we have included them in SOAK For Hunter, MU 209, MU 210, MU 211 and MU 206 are closest to the assemblage list, but MU 206 is closest to SWSF (in which we have included it) and the others are close to KS 17. However, we have included MU 209, MU 210 and MU 211 in SOAK because LHCCR plots in MU40 and MU41 (explicitly included by the determination) are assigned to new MU 209 and MU 210 (the use of the same prefix but different numbers in these two regional classifications is confusing) For new groups of previously unclassified plots, groups 148 and 43 are most similar to the assemblage list. We have included them as SOAK even though they are similar to KS group 17, implicitly excluded from the determination	
Description of frequent, widespread or common species in canopy and other vegetation strata	Assess statements regarding the characteristics of the floristic composition	Use descriptive statements to assist in assessing how classifications described since the determination, including new classifications developed by our project, relate to the EEC	
On the Tweed lowlands, includes F10 and FL of Pressey and Griffith; in north-eastern NSW includes mapped areas of CRA FE143; in the Hunter Valley includes MU40 and MU41 **Implicit reference to unspecified Keith and Scott group.**	Assess references to existing vegetation classification sources in the determination. The panel will note whether the existing classifications are 'included within' are 'part of' or 'component of' the determination Classifications developed using traceable quantitative data will be recognised as primary data upon which to assess floristic, habitat and distributional characteristics. Where data has been sourced and used in alternate regional or local classification studies the results will be considered by the panel to assist in	Analyse relationships between new samples collected on state forest and samples used to define source classifications Hunter Valley units are the main primary data source but are relevant to only a small part of the study area Cited sources for Tweed lowlands of limited relevance to SF occurrences Implicit reference to Keith and Scott group used as a guide but conflicts resolved in favour of more consistent recent data and analyses where available We have included plots assigned to MU40 and MU41, Hunter groups MU 209 and MU 210 and new groups 43 and 148, but there is an inconsistency with KS group 17 as noted above. This inconsistency needs to be resolved by a panel decision	

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
	the development of the TEC definitional attributes	We compare assemblage data from existing and new classifications for the study area with communities cited in the determination from elsewhere within the range of the EEC	

<u>Table 17</u>: Panel consideration of River-flat Eucalypt Forest TEC.

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
Occurs in '...North Coast, Sydney Basin and South East Corner Bioregions'	Accept bioregional qualifiers	Adopted	Agreed
Occurs on 'on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence…'	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Floodplain and alluvial landform elements represented by a alluvial model derived from 1m Lidar DEM, supplemented by stereoscopic digital aerial photograph interpretation; not constrained by floodplain or association with floodplain, due to difficulty of interpreting these terms in an operational sense We have used 30% of plots in modelled alluvium in a community as a general threshold to define floodplain/alluvial communities in a broad sense, consistent with but more precautionary than the proportions assessed for plots assigned to Keith and Scott's floodplain groups. RFEF in particular has a low proportion of plots in modelled alluvium, but this is because the few K&S plots in our study area assigned to their relevant group 7 are to the west of our available LIDAR coverage or CCA mapping	Agreed as for all northern floodplain TECs
Floodplains generally occur below 50 m elevation, but may occur on localised river flats up to 250 m	Assess habitat descriptors and whether these constrain or define the limits of the TEC which otherwise may have a broader distribution	Elevation threshold used to test floristic communities; the model may predict suitable habitats for EEC occur at higher elevations We did not constrain our mapping to elevation thresholds	Noted
Characterised by the list of 86 plant species	Be guided by the species lists presented in the determination	Compare species assemblage data drawn from source classifications, other existing classifications and new classifications with that presented in the determination Previous analysis of South Coast data found that the determination species list is strongly associated with Cumberland Plain River-flat Forests in western Sydney; this constrains utility of determination list for North Coast analyses and assessment	Agreed

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		We found strong relationships between the RFEF assemblage list and alluvial communities from the Sydney Basin analysis in the Putty and Howes Valley area (Primarily S_GW18) There is no community from the Hunter regional classification which closely matches the assemblage list. The closest match for an alluvial community is MU 198 but is more similar to the assemblage list for SCFF TEC and has been assigned to it by extending the current bioregional definition to include Sydney Basin bioregion For Northern Rivers, there are four alluvial communities (700-488, 700-489, 700-633, 1000-1107) which are a relatively close match for the assemblage, but we have included them in SCFF or SWSF, for which they are a better match Of additional groups we have defined, only group 14 is both a match for the assemblage and similar to KS group 7; others which are similar to the assemblage list are closer to other TECs	
Cited vegetation sources relevant to the study area are areas mapped as FE 47 on the Manning River floodplain and LHCCR MU13, MU14 and MU38 in the Hunter Valley; only the latter 3 have traceable primary data **Implicit reference to Keith and Scott group may provide traceable data**	Assess references to existing vegetation classification sources in the determination. The panel will note whether the existing classifications are 'included within' are 'part of' or 'component of' the determination Classifications developed using traceable quantitative data will be recognised as primary data upon which to assess floristic, habitat and distributional characteristics. Where data has been sourced and used in alternate regional or local classification studies the results will be considered by the panel to assist in the development of the TEC definitional attributes	There are limited traceable primary data in our Northern Study Area and none from areas north of the Manning River. The determination strongly implies that the EEC does not occur north of the Manning River, and this confirmed by analysis Plots in Lower Hunter and Central Coast REMS (NPWS,2000) unit MU13 were assigned to two groups, MU 174 and MU 213, in the Hunter classification. In both cases the plots have since been assessed as not suitable for floristic analysis. MU 213 has relatively week association, MU14 and MU38. All do not occur on SF Cited mapped FE47 is derived only from API and not floristic data. Plots in this map unit used for floristic analysis but cannot be considered primary data There are 20 plots in modelled FE47 referred to in the determination and these are scattered among 19 communities. We do not consider this a reliable means of assessing RFEF On a regional basis, (e.g. LHCCR) we exclude floodplain assemblages (e.g. Alluvial Tall Moist Forest) described at the time of the determination but not cited, on the	Noted and Agreed

Final Determination	TEC Panel Principles	Our Project	TEC Panel Review
		basis that these are implicitly excluded from the determination We compared assemblage data from existing and new classifications for the study area with communities cited in the determination from elsewhere within the range of the EEC, although effects of latitudinal species turnover limit comparisons	

5.3 Final state forest-EEC Occurrence Matrix

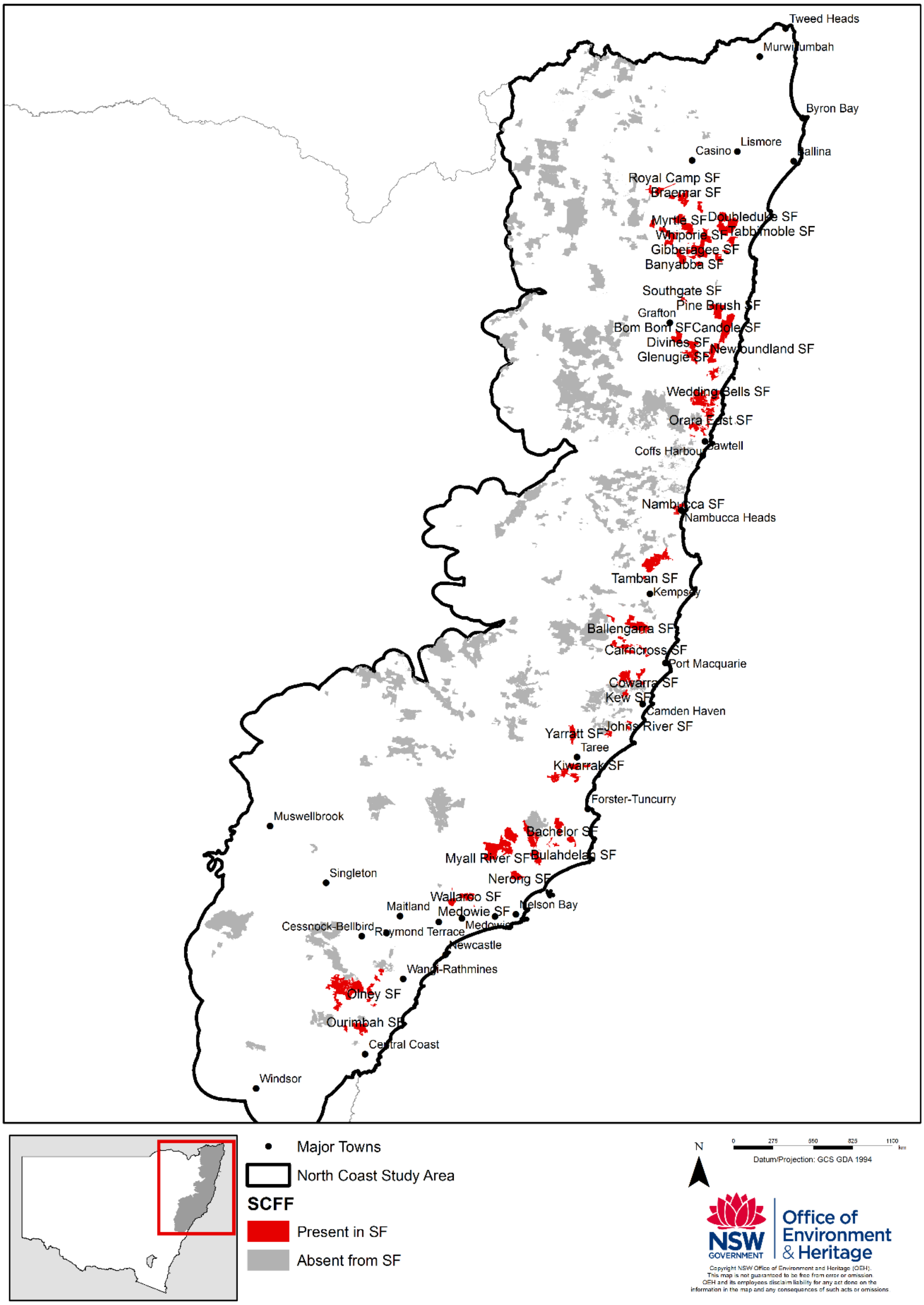
Table 10 indicates the mapped area of each floodplain TEC within state forests of our northern study area. The proportion of each state forest covered by each TEC is also provided. Maps 18-20 and Table 11 show state forests supporting the assessed floodplain TECs.

Table 10: Area and proportion of each TEC and total TEC in each state forest. State forests are listed in decreasing order based on the total amount of all floodplain TECs found within them.

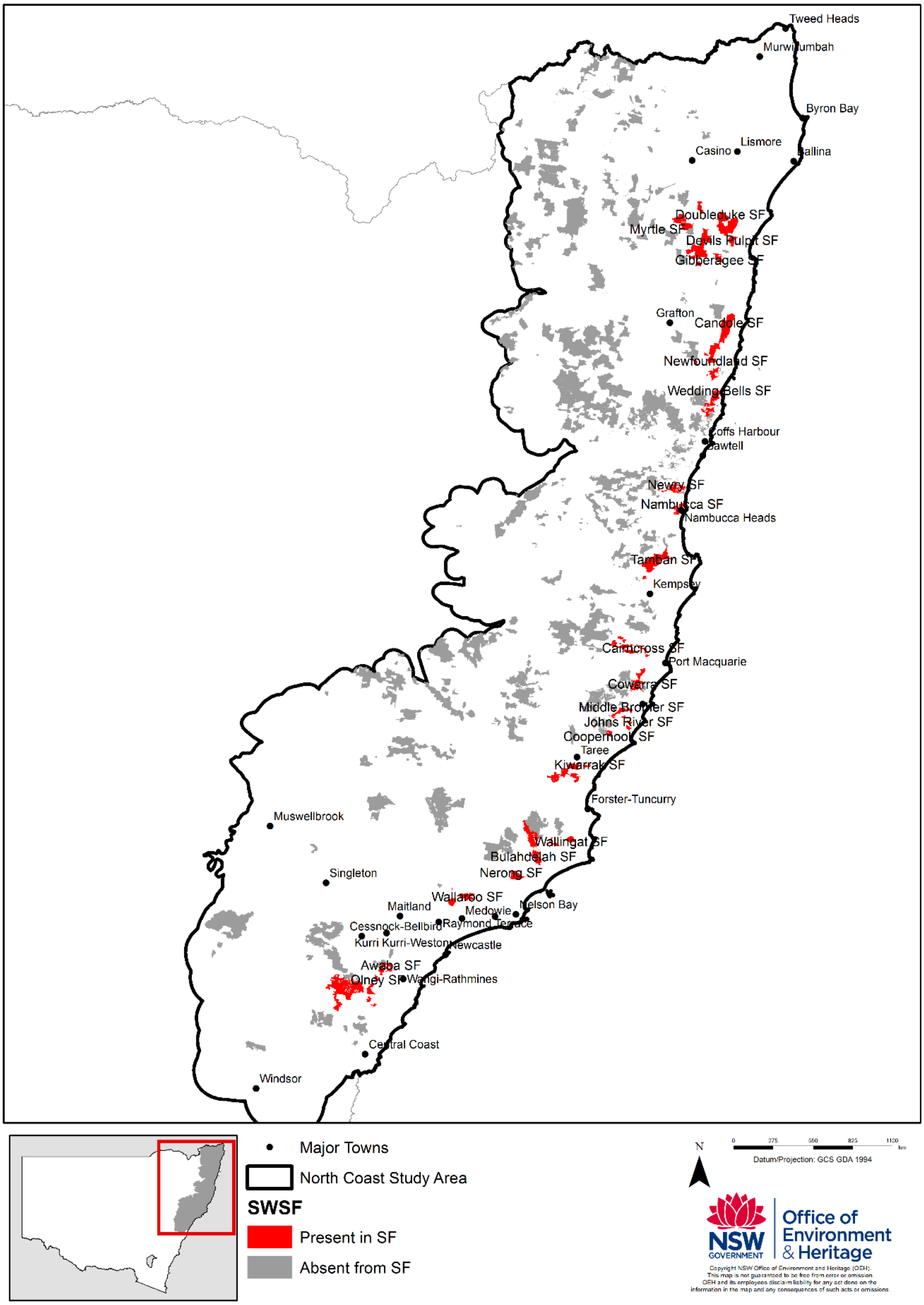
State Forest (SF)	SF Area (Ha)	SCFF Mapped Area (Ha)	% of SF mapped as SCFF	SWSF Mapped Area (Ha)	% of SF mapped as SWSF	SOAK Mapped Area (Ha)	% of SF mapped as SOAK	RFEF Mapped Area (Ha)	% of SF mapped as RFEF	Total Area on SF
Myrtle SF	4,303	1,725.8	40.1%	2.8	0.1%					1729
Gibberagee SF	10,574	1,588.3	15.0%	41.5	0.4%					1630
Doubleduke SF	5,824	945.0	16.2%	67.3	1.2%					1012
Devils Pulpit SF	1,484	441.3	29.7%	313.6	21.1%					755
Camira SF	4,009	717.6	17.9%							718
Tabbimoble SF	2,627	605.8	23.1%	12.8	0.5%					619
Braemar SF	2,002	618.4	30.9%							618
Candole SF	6,574	536.1	8.2%							536
Wallaroo SF	3,487	404.5	11.6%	24.4	0.7%	29.7	0.9%			459
Banyabba SF	2,674	447.3	16.7%							447
Whiporie SF	1,109	419.3	37.8%							419
Pine Brush SF	3,966	411.2	10.4%							411
Bungawalbin SF	1,204	279.9	23.3%	3.8	0.3%					284
Glenugie SF	4,952	259.6	5.2%							260
Divines SF	1,524	221.7	14.5%							222
Putty SF	22,252							198.4	0.89	198
Johns River SF	725	35.8	4.9%	153.0	21.1%	0.9	0.1%			190
Cairncross SF	4,487	148.6	3.3%	36.5	0.8%	2.9	0.1%			188
Royal Camp SF	2,203	160.1	7.3%							160
Newry SF	2,841			36.9	1.3%	121.3	4.3%			158
Nambucca SF	1,510	10.6	0.7%	130.0	8.6%	6.3	0.4%			147
Newfoundland SF	5,939	123.4	2.1%	7.6	0.1%					131
Wedding Bells SF	4,645	116.7	2.5%	13.4	0.3%					130
Mororo SF	379	118.2	31.2%							118
Ellangowan SF	1,179	115.1	9.8%							115
Fullers SF	1,053	100.4	9.5%							100
Tamban SF	7,632	34.1	0.4%	16.8	0.2%	33.4	0.4%			84
Wallingat SF	1,240	11.6	0.9%	69.7	5.6%					81
Bulahdelah SF	7,799	65.7	0.8%	12.8	0.2%					79
Kiwarrak SF	6,535	55.7	0.9%	13.3	0.2%					69
Yarratt SF	2,381	68.7	2.9%							69
Nerong SF	2,173	47.7	2.2%	17.2	0.8%	2.0	0.1%			67
Myall River SF	13,611	63.4	0.5%							63
Olney SF	17,795	7.7	0.0%	51.1	0.3%					59
Awaba SF	1,784			43.2	2.4%					43

State Forest (SF)	SF Area (Ha)	SCFF Mapped Area (Ha)	% of SF mapped as SCFF	SWSF Mapped Area (Ha)	% of SF mapped as SWSF	SOAK Mapped Area (Ha)	% of SF mapped as SOAK	RFEF Mapped Area (Ha)	% of SF mapped as RFEF	Total Area on SF
Carwong SF	603	39.3	6.5%							39
Bom Bom SF	872	38.4	4.4%							38
Cowarra SF	1,687	6.4	0.4%	13.5	0.8%					20
Orara East SF	3,983	19.5	0.5%							19
Coopernook SF	871	7.4	0.9%	11.2	1.3%					19
Bachelor SF	2,642	13.2	0.5%							13
Medowie SF	50	5.9	11.8%			7.1	14.3%			13
Burrawan SF	2,040			6.0	0.3%					6
Ourimbah SF	3,571	5.9	0.2%							6
Southgate SF	628	4.7	0.7%							5
Kew SF	897	2.8	0.3%							3
Middle Brother SF	2,131			0.7	0.0%					1
Conglomerate SF	5,162	0.6	0.0%							1
Broken Bago SF	3,543	0.5	0.0%							0
Ballengarra SF	6,106	0.4	0.0%							0
Candole SF	6,574			0.2	0.0%					0
Totals	205836	11050		1099		204		198		12552

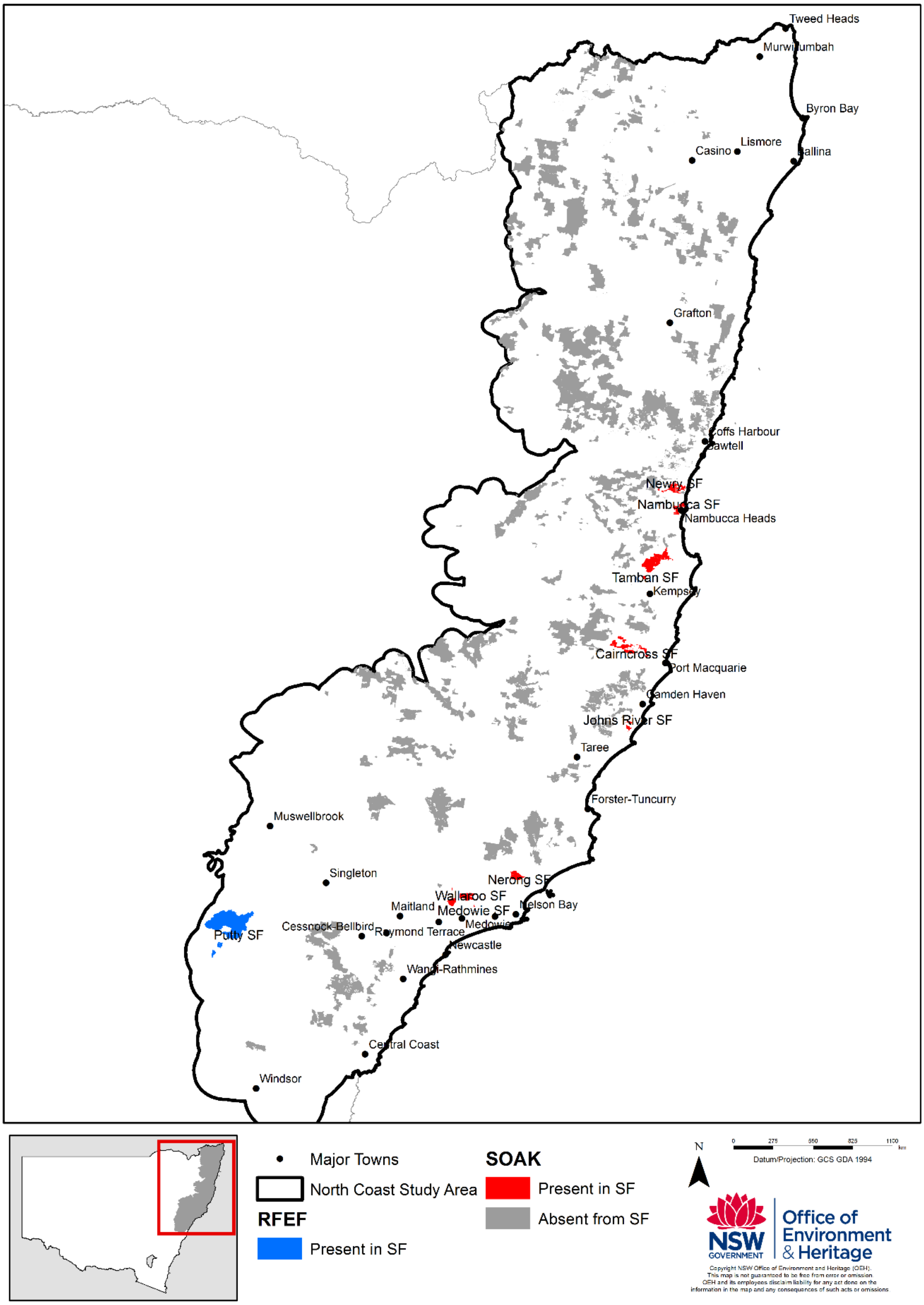
Map 18: **State forests with mapped occurrences of SCFF.**



<u>Map 19</u>: State forests with mapped occurrences of SWSF.



Map 20: **State forests with mapped occurrences of SOAK and RFEF.**



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Appendix A: API Map Classes for Alluvial Environments of the Lower - Mid North Coast.

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
COMPLEX					
Saltmarsh / tidal mudflat complex	*100*		*Sarc.quinqueflora, Sporobolus virginicus +/- Juncus krausii*		
Riparian vegetation complex	*101*		*Riparian vegetation complex*	*Riparian vegetation complex comprising several riparian associated features such as water, gravel, rock, vegetated streamside embankments, terraces and stream beds that are frequently inundated by high energy flood water. Tristaniopsis laurina, Melaleuca, Callistemon are typically common, larger trees may also be present*	
Riparian stream-bed complex	*103*		*Riparian streambed complex*	*Riparian streambed complex which essentially comprises water, gravel, rock, and very sparsely scattered shrubs / trees etc.*	
Freshwater scrub / sedge / wet heath complex	*104*		*Freshwater scrub / sedge / wet heath complex*	*Occurs as a complex pattern of scrub / sedge / wet heath patches (discrete separation not required)*	

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
Rainforest / Palm complex	*105*	*7*	*Palm rainforest*		
Saline rushland/sedgeland complex	*106*		*Juncus krausii / Baumea juncea etc.*	*May include oc emergent trees (C. glauca Melaleuca etc.)*	
FOREST / WOODLAND					
Unidentified	*200*		*Unidentified*	*Unidentified*	
Rainforest (unidentified type)	*201*		*Rainforest (unidentified type)*	*T. conferta*	
Brush Box	*202*	*53*	*Tristaniopsis conferta*	*Rainforest spp, E. grandis, E. saligna, E. microcorys, E. maculata, E. pilularis, S. glomulifera*	
Viney Scrub	*203*		*Viney Scrub*	*Mesic shrubs / vines dom in large canopy openings*	
WaterGum, very tall shrubland low forest	*204*		*Tristaniopsis laurina*	*Scattered emergent trees (CRS>4) rainforest*	
Acacia	*205*		*Acacia*		
Flooded Gum	*206*	*48*	*Eucalyptus grandis*	*Melaleuca, E. microcorys, T. conferta, E. saligna, E. punctata, S. glomulifera, E. pilularis*	
Sydney Blue Gum	*207*	*47*	*Eucalyptus saligna +/- Eucalyptus microcorys*	*Melaleuca, T. conferta, E. grandis, S. glomulifera, E. pilularis etc.*	
Moist Blackbutt	*208*	*36*	*Eucalyptus pilularis*	*E. microcorys, T. conferta, E. grandis, C. intermedia E. saligna, E. punctata, S. glomulifera*	

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
Mixed moist Eucalypts	*209*	*60*	*E. propinqua/punctata Ironbark A. costata E. resinifera E. microcorys*	*Melaleuca, E. robusta Stringybark E. acmenoides E. pilularis E. grandis E. saligna T. conferta S. glomulifera*	*An Intermediate to mesic type of variable composition that occupies a transition zone between the more mesic flooded / blue gum gully types and the less mesic communities such as 210*
Ironbark / Red Mahogany / Tallowwood / Spotted Gum	*210*	*74 84*	*Ironbarks E. microcorys E. resinifera E. maculata*	*A. costata, E. punctata, E. globoidea, E. tereticornis, C. gummifera (E. moluccana), E. acmenoides, US Scattered Melaleuca Dry shrub / grass (+/- rush sedge)*	*A more moist var of RN84 that occupies drainage depressions. E. resinifera , paperbarks and rush sedge (scattered Lomandra Gahnia) may be present . May grade from RN84 (outside model) to types 212 and 209 where more moist.*
Red mahogany / Smoothbarked apple (+/- A. inopina Wallaroo SF)	*212*	*105 68*	*E. resin / E. costata (both usually present but one may be locally absent)*	*Melaleuca (often M. sieberi/nodosaM.lin/ oc quinquinervia) E. globoidea, E. robusta, C. gummifera, E. tereticornis, A. inopina, oc Ironbark / E. maculata from edges. Scattered Gahnia, Lomandra and grasses.*	*Often occurs as a layered woodland to open forest. Key tree spp are Eucalyptus resininifera and Angophora costata with Melaleuca spp frequently occurring as a mid layer. Woodland var usually has a well-developed melaleuca layer under. Typically grades to 209 (less boggy, more mesic) and 215 (becomes even more boggy)*
Sydney Peppermint - Apple (smooth/rough) - Stringybark	*213*	*106 116*	*E. piperita, A. floribunda/costata, Stringybark*	*E. gummifera, E. resinifera, Emicrocorys, E. saligna, S. glomulifera, E. propinqua*	

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
Forest Red Gum	*214*	*92*	*E. tereticornis*	*Melaleuca A. floribunda, A. costata, Ironbark C. gummifera E. resinifera, E. robusta Ironbark E. punctata/propinqua, E. microcorys*	*sometimes hummock soils*
Swamp Mahogany	*215*	*30a*	*E. robusta (A. costata)*	*E. resinifera E. tereticornis C. gummifera Melaleuca*	
Swamp Oak	*216*	*32*	*C. glauca*	*Mangrove, M. ericifolia, Juncus krausii, Sarc.quinqueflora, Sporobolus virginicus*	
Mangrove	*217*	*33*			
Broad-leaved Paperbark	*219*	*31*	*Melaleuca quinquenervia*		
Melaleuca (sieberi / nodosa / linarrifolia / stypheliodes)	*220*	*31*	*M. sieberi / nodosa / linariifolia / styphelioides (tall Callistemon, C. salignus etc.)*		
Dry Blackbutt	*221*	*37*			
Dry Blackbutt on alluvium	*224*	*37*	*E. pilularis*	*E. resinifera C. gummifera E. microcorys E. robusta*	*difference: paperbark lomandra gahnia sometimes grassy*
Bancroft's Red Gum	*225*	*93*	*E. bancroftii*	*A. floribunda Ironbark Stringy M. styph M. lin A. litto*	*grassy gahnia lomandra*
Narrow-leaved Red Gum	*226*	*93*	*Eseeana*	*Ironbark E. resinifera C. gummifera*	*grassy often hummock soils*
Turpentine	*227*	*49*	*S. glomulifera*	*T. conferta E. microcorys E. saligna/grandis rainforest E. pilularis*	
Rough-barked Apple	*228*		*A.floribunda*	*Ironbark E. punctata C. gummifera E. tereticornis*	
Grey Box	*229*	*302*	*E. moluccana*	*A. floribunda C. gummifera*	

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
Rough-barked Apple / Forest Red Gum	*230*	*129 92*	*A. floribunda /E.tereticornis*		
Charn Haven Apple / Red Mahogany	*231*	*60 68*	*A. inopina/E. resinifera*	*M. sieberi A. costata C. gummifera*	*variation of 212*
River Oak	*232*	*211*	*C. cunninghamiana*	*A. floribunda E. grandis/saligna rf T.conferta*	
SHRUBLAND					
Swamp shubland (tall to very tall)	*300*	*224*	*Melaleuca (sieberi / nodosa/ linarrifolia*	*Typically M. squarrosa (fresh water, scattered trees may be present) sometimes M. eric (sub saline to saline)*	
Freshwater sedgeland / rushland	*304*	*231*			
Wet Heath	*305*	*223 231*			
Graminoid Clay Heath	*301*	*224*	*Banksia oblongifolia, Ptilothrix deusta, grasses, shrubs, scattered emergent trees <10% (Melaleuca etc., euc emergents CSR >4)*	*Scattered emergent trees <10% (Melaleuca Euc emergents etc. CSR >4)*	*Transition type often grading from eucalyptus resinifera and Paperbark dominated communities upslope to woodland with a Clay Heath Understorey*
Saline to sub-saline Swamp shubland (tall to very tall)	*302*	*224*	*M. ericifolia*	*C. glauca (as emergents), mangrove*	*sub saline to saline*
ARTIFICIAL / MODIFIED LANDS					
Disturbance associated with road / trail	*400*		*Disturbance associated with road / trail*		
Disturbance associated with transmission line easement	*401*		*Disturbance associated with transmission line easement*		

API VEG TYPE	MNC ALLUVIAL API CODE	RN17 (approx)	CANOPY1 Common Dominant / Co-dominants	CANOPY 2 Common associates (subsidiary and minor) may occasionally be co-dominant	NOTE
Disturbance associated recently logged areas	*402*		*Disturbance associated recently logged areas*		
Cleared / semi-cleared / regeneration areas	*403*		*Cleared / semi-cleared / regeneration areas*		
Disturbance associated with Plantation / woodlot	*404*		*Disturbance associated with Plantation / woodlot*		
OTHER					
Open Water	*900*		*Open Water*		
Non alluvium / alluvium unlikely	*X*		*Non alluvium / alluvium unlikely*		
Below minimum polygon area	*Y*		*Below minimum polygon area*		

Appendix B: Summary of vegetation communities on alluvial and similar landforms

This appendix lists all communities with 30% or more of plots in mapped alluvium. Mapped alluvium is broadly defined, as described in Section 3.2, and includes areas that may be other gently sloping landforms, such as estuarine fringes and dune swales. Vegetation communities described in Northern Rivers classification have a numerical prefix or 'N' prefix. Those described in Hunter-Central Rivers have an 'MU' prefix. The study areas and some vegetation communities overlap and some plots are allocated to both classifications. Plot allocations may vary slightly from original allocations for plots used in these regional classifications and also include plots which have been surveyed since those classifications were developed. Means and dissimilarities are calculated as described in Section 3.5.3 and are based on plots allocated to communities using fuzzy clustering methods described in Section 3.5.1.

Community code	Community Name	Number of plots with membership >=0.5	Percentage of plots in CCA floodplain unit	Percentage of plots in modelled alluvium	RFEF mean	SCFF mean	SOAK mean	SWSF mean	Most similar K&S group	Dissimilarity with most similar K&S group	TEC assessment
1000-1107	Forest Red Gum - Broad-leaved Paperbark - Swamp Box grass/herb open forest in gently undulating areas of the lower Clarence and Richmond River Valleys, South Eastern Queensland bioregion and NSW North Coast bioregion	18	41	72	0.37	0.65	0.23	0.29	KS08	0.75	SCFF
1000-1449	Pink Bloodwood - Red Mahogany - Swamp Box shrub/grass open forest at low altitudes, South Eastern Queensland Bioregion and northern NSW North Coast bioregion	18	2	39	0.3	0.52	0.18	0.35	KS06	0.77	not TEC, closest to toeslope K&S group 6
1000-1490	Fern-leaved Banksia - Dwarf Heath Casuarina - Midgen Berry - Black Bog-rush graminoid heathland on heavy clay soils of the far north coastal hills, South Eastern Queensland bioregion	5		40	0.1	0.23	0.05	0.22	KS34	0.84	
1000-1594	Blackbutt - Turpentine tall moist open forest on sandstone ranges of the southern Clarence-	11	7	36	0.26	0.46	0.15	0.25	KS06	0.8	not TEC, closests to toeslope K&S group 6

Community code	Community Name	Number of plots with membership >=0.5	Percentage of plots in CCA floodplain unit	Percentage of plots in modelled alluvium	RFEF mean	SCFF mean	SOAK mean	SWSF mean	Most similar K&S group	Dissimilarity with most similar K&S group	TEC assessment
	Moreton Basin, South Eastern Queensland bioregion										
1000-1627	Tuckean Wet Sclerophyll Forest (*Lophostemon confertus - Livistona australis - Corymbia intermedia - Eucalyptus siderophloia*)	4		50	0.13	0.31	0.14	0.15	KS03	0.81	
1000-1936	Broad-leaved Paperbark - Bare Twig Rush swamp sclerophyll open forest of coastal swamps, NSW North Coast bioregion and the South Eastern Queensland Bioregion	16		100	0.1	0.32	0.56	0.55	KS17	0.75	SWSF, although close to ks17, not TEC, plots overlap with Hunter MU 206 which we assessed as SWSF
1000-1950	Soft Twig Rush - Swamp Water Fern - Common Reed swamp and marshland on coastal sand and alluvial floodplain, NSW North Coast bioregion	19	4	100	0.06	0.22	0.38	0.49	KS30	0.77	not TEC, closest to wet heath on dune swales
1000-1979	Swamp Oak forested wetland of saline areas of coastal estuaries, NSW North Coast Bioregion, South Eastern Queensland bioregion and Sydney Basin bioregion	22	4	100	0.19	0.35	0.55	0.39	KS17	0.69	SOAK, estuarine fringe, although close to ks17, not TEC, overlaps with Hunter MU 209 which includes REMS mu40 plots
1000-1980	Searush saltmarsh of saline coastal swamps and flats, South Eastern Queensland bioregion and NSW North Coast bioregion	10		100	0.13	0.14	0.45	0.18	KS28	0.7	saltmarsh
1500-1153	Brush Box - Tuckeroo tall to very tall moist open forest/rainforest transition on the coastal plain north of the Richmond River, South Eastern Queensland bioregion	6		67	0.17	0.47	0.29	0.28	KS04	0.78	referred to rainforest TEC assessment
1500-1157	Forest Red Gum tall to very tall moist open forest/rainforest transition with on the coastal	6	22	67	0.28	0.56	0.4	0.36	KS04	0.84	SCFF, not closely similar to K&S 8, but relatively high proportion of assemblage list

Community code	Community Name	Number of plots with membership >=0.5	Percentage of plots in CCA floodplain unit	Percentage of plots in modelled alluvium	RFEF mean	SCFF mean	SOAK mean	SWSF mean	Most similar K&S group	Dissimilarity with most similar K&S group	TEC assessment
	plain north of the Richmond River, South Eastern Queensland bioregion										
700-302	Swamp Box - Red Mahogany - Paperbark transitional swamp forest on floodplain edges, NSW North Coast Bioregion and South Eastern Queensland bioregion	9		78	0.22	0.46	0.15	0.31	KS06	0.8	not TEC, closests to toeslope K&S group 6
700-330	*E. resinifera - Ptilothrix deusta*	21	3	62	0.17	0.28	0.1	0.31	KS05	0.73	
700-332	*E. robusta - Gahnia clarkei - Mel sieberi;* swamp forest	4	12	75	0.22	0.34	0.19	0.41	KS05	0.75	not TEC, K&S 5 sandy flats forest
700-333	*Xanthorrhoea fulva* - Wallum Bottlebrush - Fern-leaved Banksia wet heath in swales on coastal sand masses, South Eastern Queensland bioregion and NSW North Coast bioregion	14		86	0.03	0.14	0.05	0.15	KS37	0.71	
700-334	Swamp Mahogany - Melaleuca sieberi shrub/sedge swamp forest on low lying sandy areas, South Eastern Queensland bioregion and NSW North Coast bioregion	4	33	100	0.1	0.23	0.09	0.38	KS05	0.82	not TEC, K&S 5 sandy flats forest, low det means
700-336	Scribbly Gum Banksia *ericifolia* shrubby forest - northern outlier of Hunter Grp 201	44		98	0.07	0.12	0.02	0.19	KS34	0.79	
700-342	Black She-Oak - Wallum Banksia - Blueberry Ash dry heath on coastal sands, South Eastern Queensland Bioregion and NSW North Coast Bioregion	9		78	0.15	0.29	0.11	0.25	KS23	0.81	
700-343	Prickly-leaved Paperbark - Wallum Banksia dry heath on coastal sands, South Eastern Queensland bioregion and NSW North Coast bioregion	12	6	75	0.05	0.16	0.06	0.16	KS37	0.83	

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700-344	Wallum Banksia - Prickly Moses - *Caustis recurvata* dry heathland on coastal sands, South Eastern Queensland bioregion and NSW North Coast bioregion	15		53	0.06	0.11	0.02	0.1	KS23	0.84	
700-348	Port Jackson Pine shrubby open forest of Holocene dunes, NSW North Coast bioregion	79		43	0.17	0.21	0.09	0.2	KS24	0.67	
700-432	Grey Myrtle - Rough-leaved Elm - Water Gum dry vine rainforest of seasonally dry gullies and hills, NSW North Coast bioregion and South Eastern Queensland bioregion	13	27	38	0.3	0.31	0.18	0.25	KS03	0.81	referred to rainforest TEC assessment
700-445	Maiden's Blush - White Booyong - Yellow Pear Fruit subtropical rainforest with Bangalow Palm understorey of the Coffs Coast, NSW North Coast bioregion	8	40	62	0.04	0.09	0.03	0.08	KS03	0.93	referred to rainforest TEC assessment
700-455	Rough Leaved Elm - Hoop Pine - Tuckeroo - Three-veined Laurel subtropical lowland rainforest of the lower Richmond and Tweed River Valleys, South Eastern Queensland bioregion	3		67	0.06	0.22	0.11	0.06	KS03	0.88	
700-458	Bangalow Palm - Umbrella Cheese Tree - Brown Kurrajong - Broad-leaved Paperbark floodplain rainforest on alluvial soils of the far north-east coast of NSW, South Eastern Queensland bioregion	7		71	0.08	0.24	0.2	0.13	KS03	0.9	
700-459	Small-leaved Lilly Pilly - Broad-leaved Lilly Pilly - Lilly Pilly littoral rainforest mainly on sands, NSW North Coast Bioregion and South Eastern Queensland bioregion	12		75	0.1	0.27	0.13	0.11	KS03	0.83	

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700-460	Bennett's Ash - Three-veined Cryptocarya - Blue Lilly Pilly littoral rainforest in the Richmond - Tweed Walleys, South Eastern Queensland bioregion	6		50	0.06	0.23	0.12	0.05	KS04	0.88	
700-465	Blackbutt - Scribbly Gum - Satinwood - Tassell Rush open forest of sandy waterlogged soils of the far North Coast, South Eastern Queensland bioregion	19	9	74	0.13	0.39	0.19	0.3	KS23	0.79	not TEC, closest to K&S 23 dune forest
700-467	Pink Bloodwood - Brush Box open forest on coastal dunes and sandplains, South Eastern Queensland bioregion and NSW North Coast bioregion	12		50	0.17	0.36	0.17	0.19	KS04	0.79	referred to rainforest TEC assessment
700-470	Coast Banksia woodland and open forest of coastal dunes, NSW North Coast bioregion and South Eastern Queensland bioregion	13		46	0.19	0.44	0.26	0.3	KS04	0.83	referred to rainforest TEC assessment
700-471	Swamp Box - Broad-leaved Paperbark - Pink Bloodwood tall woodland and open forest on metasediment footslopes of the Tweed coastal hills, South Eastern Queensland bioregion	8		88	0.16	0.35	0.22	0.35	KS06	0.85	not TEC, low proportion of assemblage species and mainly footslopes
700-473	Coast Banksia - Tuckeroo closed forest/shrubland of coastal Holocene dunes, NSW North Coast bioregion and South Eastern Queensland bioregion	31		52	0.29	0.47	0.28	0.27	KS04	0.79	referred to rainforest TEC assessment
700-476	Broad-leaved Paperbark - Brush Box - Swamp Box swamp sclerophyll forest on clays of coastal plains and sub-coastal hills, NSW North Coast bioregion and the South Eastern Queensland bioregion	8	6	75	0.24	0.52	0.26	0.4	KS04	0.79	referred to rainforest TEC assessment

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700-477	Swamp Mahogany - Willow Bottlebrush - Broad-leaved Paperbark forested wetland of the Coffs Harbour area, NSW North Coast bioregion	19	4	68	0.22	0.5	0.27	0.46	KS01	0.82	SWSF; related to MU 200
700-478	Broad-leaved Paperbark - Swamp Oak - Forest Red Gum - Cabbage Palm swamp sclerophyll forest of coastal sandplains, NSW North Coast bioregion	9	7	56	0.25	0.48	0.31	0.38	KS04	0.83	referred to rainforest TEC assessment
700-488	Swamp Box - Forest Red Gum - Pink Bloodwood seasonal swamp forest on floodplains and low rises, NSW North Coast Bioregion and the South Eastern Queensland bioregion	32	13	69	0.4	0.7	0.33	0.34	KS08	0.8	SCFF
700-489	*Eucalyptus tereticornis Callistemon salignus Lophostemon suaveolens* with a high cover of Blady Grass	6	27	83	0.48	0.61	0.35	0.48	KS08	0.82	SCFF
700-493	Swamp Box - Forest Red Gum - Broad-leaved Paperbark swamp forest of sandy alluvial backswamps in the lower Clarence and Richmond River Valleys, South Eastern Queensland bioregion and NSW North Coast bioregion	21	21	90	0.24	0.46	0.33	0.36	KS08	0.85	SCFF
700-500	Forest Red Gum - Willow Bottlebrush - Broad-leaved Paperbark tall open forest on alluvial floodplains, South Eastern Queensland bioregion	4		100	0.25	0.49	0.4	0.33	KS04	0.86	not TEC
700-511	Coast Cypress Pine shrubby open forest, NSW North Coast bioregion and South Eastern Queensland bioregion	8		88	0.15	0.34	0.12	0.17	KS23	0.83	

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700-512	Coast Cypress Pine open forest to closed forest with littoral rainforest elements, South Eastern Queensland bioregion	4		50	0.25	0.44	0.16	0.14	KS04	0.83	not floodplain TEC (likely Coastal Cypress Forest TEC)
700-513	Coast Cypress Pine - Salwood - Jam Tarts shrubby open forest, South Eastern Queensland bioregion	10	27	30	0.35	0.52	0.1	0.15	KS08	0.87	not floodplain TEC (likely Coastal Cypress Forest TEC)
700-56	*Callistemon salignus - E. resinifera - E. microcorys* - paperbarks; mainly coastal alluvial but not swamp sclerophyll; possibly OK re - allocate CUBAL003 UNE08057	13	12	69	0.3	0.44	0.17	0.32	KS06	0.8	not TEC, closest to toeslope K&S group 6
700-57	Forest Red Gum - Grey Ironbark - Willow Bottlebrush - paperbark shrubby open forest on poorly drained sites in the Port Macquarie area, NSW North Coast Bioregion	5		40	0.35	0.54	0.21	0.35	KS08	0.83	possible SCFF, but marginally floodplain/alluvial and excluded
700-58	Pink Bloodwood *E. tindaliae E. siderophloia* dry OF common between Grafton and Casino	5	8	60	0.24	0.48	0.16	0.34	KS06	0.82	not TEC, closest to toeslope K&S group 6
700-605	Xanthorrhoea fulva - Olive Tea-tree - Sporadanthus interruptus wallum heath on sandy near-coastal areas, South Eastern Queensland Bioregion and NSW North Coast Bioregion	25		80	0.01	0.06	0.03	0.11	KS38	0.69	
700-606	Heath Banksia moist and wet heath of coastal Pleistocene sandplains, South Eastern Queensland Bioregion	6		100	0.02	0.13	0.13	0.27	KS37	0.79	
700-610	Pale Twig Rush - Broad-leaved Paperbark sedgeland and wet heath of coastal Pleistocene sandplains, South Eastern Queensland Bioregion and NSW North Coast Bioregion	3		100	0	0.11	0.21	0.28	KS30	0.86	

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700-612	Drier sandy Mel quin Euc robusta heathy shrubby forest - southern	5		80	0.15	0.37	0.16	0.3	KS23	0.74	not TEC, closest to K&S 23 dune forest
700-613	Smooth-barked Apple heathy open forest or woodland on coastal sands, NSW North Coast Bioregion	4		100	0.06	0.17	0.07	0.2	KS23	0.79	
700-614	Swamp Mahogany - tea-tree - Tassell Rush forested wetland of waterlogged wallum soils, NSW North Coast Bioregion and South Eastern Queensland Bioregion	18	13	72	0.1	0.33	0.17	0.43	KS10	0.71	not TEC, KS10 on sandplains
700-621	Swamp Oak - Broad-leaved Paperbark - Willow Bottlebrush floodplain forested wetland, NSW North Coast Bioregion and South Eastern Queensland Bioregion	36	24	97	0.27	0.49	0.55	0.45	KS02	0.82	SOAK; related to MU 210
700-623	Swamp Oak - Milky Mangrove - Broad-leaved Paperbark king tide forest and woodland of coastal estuaries, NSW North Coast Bioregion and South Eastern Queensland bioregion	16		94	0.12	0.25	0.33	0.2	KS27	0.86	
700-625	Swamp Oak - Tuckeroo - Cabbage Palm - Bangalow Palm forest on alluvium on the lower Richmond River floodplain, South Eastern Queensland bioregion	3		100	0.28	0.42	0.4	0.33	KS02	0.84	possible SOAK, but referred to rainforest TEC relationships
700-629	Broad-leaved Paperbark swamp sclerophyll forest with rainforest elements on coastal floodplains north of the Richmond River, South Eastern Queensland bioregion	46	2	91	0.14	0.36	0.41	0.4	KS02	0.85	SWSF, close to both SOAK and SWSF, but Melaleuca dominant
700-633	*Melaleuca quinquenervia Imperata cylindrica Lomandra longifolia Viola hederacea*	4		100	0.44	0.57	0.42	0.6	KS01	0.81	SWSF, but few plots and may not be alluvial

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700-634	Broad-leaved Paperbark - Flax-leaved Paperbark - Buff Hazelwood - Tall Saw-sedge Swamp Sclerophyll Forest on alluvial sediments of coastal plains, NSW North Coast bioregion	23	11	100	0.22	0.43	0.46	0.58	KS01	0.78	SWSF
700-636	Broad-leaved Paperbark - Willow Bottlebrush forested wetland of creek channels draining intermittent coastal lakes and lagoons, NSW North Coast bioregion	4		100	0.1	0.49	0.46	0.46	KS02	0.86	SWSF; close to both SOAK and SWSF, but Melaleuca dominant
700-638	Broad-leaved Paperbark - Swamp Oak - Tall Sedge swamp forest on alluvial soils, South Eastern Queensland bioregion and NSW North Coast bioregion	24	8	96	0.22	0.35	0.57	0.43	KS02	0.84	SOAK; also related to MU 206 (SWSF)
700-641	Common Reed grassland on alluvial floodplains, South Eastern Queensland bioregion and NSW North Coast bioregion	13		100	0.06	0.19	0.54	0.47	KS18	0.81	freshwater wetland
700-643	Giant Sedge sedgeland of frequently inundated areas of sandy alluvium of the lower and mid North Coasts, South Eastern Queensland bioregion and NSW North Coast bioregion	17		100	0.03	0.22	0.28	0.29	KS12	0.88	
700-645	Melaleuca quinquenervia Pseudoraphis paradoxa Schoenus brevifolius	9		100	0.16	0.33	0.26	0.49	KS30	0.83	not TEC, closest to wet heath on dune swales
700-647	Prickly Tea-tree wet heathland of wallum swales and drainage depressions, South Eastern Queensland bioregion and NSW North Coast bioregion	6		100	0.09	0.21	0.17	0.38	KS30	0.74	
700-655	Soft Twig-rush - Swamp Water Fern - Prickly Tea-tree shrub/sedgeland on sandstone outwash in the lower Clarence River Valley, South	3		33	0.11	0.16	0.16	0.23	KS30	0.87	

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	Eastern Queensland bioregion and NSW North Coast bioregion										
700-675	Coast Wattle shrubland on coastal foredunes, South Eastern Queensland bioregion and NSW North Coast bioregion	9		44	0.1	0.17	0.13	0.26	KS25	0.78	
700-680	Swamp Oak - Club Rush dune soak shrubland of Holocene dunes, NSW North Coast bioregion and South Eastern Queensland bioregion	6		100	0.14	0.27	0.34	0.29	KS17	0.87	
700-682	Prickly Couch - Sea Rush - Common Couch saltmarsh of saline coastal swamps and flats, South Eastern Queensland bioregion and NSW North Coast bioregion	9		89	0.17	0.18	0.41	0.18	KS17	0.84	saltmarsh
700-684	Saltwater Couch - Samphire saltmarsh of low-lying estuarine areas, South Eastern Queensland bioregion and NSW North Coast bioregion	18	6	100	0.01	0.01	0.21	0.02	KS28	0.5	
700-686	Grey Mangrove - River Mangrove low open or closed forest or shrubland of intertidal flats, NSW North Coast bioregion and the South Eastern Queensland bioregion	27		100	0.01	0.04	0.07	0.03	KS27	0.42	
700-693	Tall Spike Rush freshwater wetland of coastal floodplains and depressions in low hills, NSW North Coast bioregion and South Eastern Queensland bioregion	7		71	0	0	0.06	0	KS13	0.91	
700-694	*Eleocharis equisetina* freshwater wetland of coastal floodplains, NSW North Coast bioregion and South Eastern Queensland bioregion	15		100	0.03	0.02	0.13	0.09	KS13	0.86	

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700-695	*Azolla pinnata* - Water Primrose - *Hygrophila angustifolia* fern/herb wetland on floodplains of the mid Richmond River Valley, South Eastern Queensland Bioregion	3		100	0	0	0.09	0	KS13	0.89	
700-697	*Eleocharis dietrichiana* - Cyperus procerus sedgeland of freshwater wetland lagoons of alluvial floodplains, South Eastern Queensland bioregion	3	25	67	0.27	0.15	0.35	0.18	KS13	0.84	not TEC, K&S 13 Estuarine scrub, low det means
999-706	Paperbark - Red Mahogany Swamp Sclerophyll Forest or shrubland of stagnant alluvial plains, South Eastern Queensland bioregion	4		100	0.08	0.34	0.17	0.29	KS05	0.83	
MU 004	Lilly Pilly/ Sandpaper Fig/ Prickly-leaved Tea Tree warm temperate rainforest of the Central Coast and lower Hunter Valley	12	12	50	0.4	0.4	0.24	0.32	ks3	0.81	referred to rainforest TEC assessment
MU 012	Weeping Lilly Pilly/ Water Gum riparian warm temperate rainforest of the Lower North Coast	80	25	41	0.24	0.24	0.13	0.2	ks3	0.87	
MU 040	Pink Bloodwood/ Thin-leaved Stringybark/ Grey Ironbark shrub/ grass open forest on ranges of the Lower North Coast	5	9	40	0.25	0.5	0.16	0.31			not TEC, relatively close to K&S, marginally alluvial
MU 100	Smooth-barked Apple/ White Stringybark/ Red Mahogany/ *Melaleuca sieberi* shrubby open forest on lowlands of the Lower North Coast	14		43	0.21	0.29	0.1	0.3	ks5	0.71	
MU 106	Smooth-barked Apple/ Swamp Mahogany/ Red Mahogany/ Cabbage Palm open forest on lowlands of the Central Coast	10		40	0.24	0.35	0.14	0.49	ks5	0.82	not TEC, closest to K&S 5/6

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MU 119	Scribbly gum/ Wallum banksia/ Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands	20		90	0.03	0.1	0.02	0.11	ks39	0.74	
MU 126	Coast Tea Tree/ Old Man Banksia coastal shrubland on foredunes of the Central and Lower North Coast	23		43	0.19	0.25	0.11	0.25	ks16	0.72	
MU 127	Old Man Banksia/ Rough-barked Apple/ Bangalay shrubby open forest on coastal sands of the Central Coast	22		59	0.3	0.34	0.13	0.33	ks24	0.74	
MU 128	Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	117		45	0.21	0.25	0.1	0.22	ks24	0.67	
MU 129	Red Bloodwood/ Smooth-barked Apple heathy woodland on coastal sands of the Central and lower North Coast	15		47	0.09	0.17	0.06	0.16	ks24	0.76	
MU 131	Smooth-barked Apple/ Red Mahogany/ Swamp Mahogany/ *Melaleuca sieberi* heathy swamp woodland of coastal lowlands	89		76	0.11	0.2	0.07	0.28	ks5	0.77	SWSF because related to cited REMS MU42, but closest to implicitly excluded K&S 5 and very dissimilar to determination assemblage list
MU 132	Parramatta Red Gum/ Rough-barked Apple/ Swamp Mahogany/ Paperbarks swamp forest on lowlands of the Central Coast	3		67	0.28	0.28	0.27	0.36			
MU 133	Parramatta red gum/ Fern-leaved banksia/ *Melaleuca sieberi* swamp woodland of the Tomaree Peninsula	36		97	0.07	0.11	0.02	0.18	ks34	0.79	

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MU 140	Rough-barked Apple/ Narrow-leaved Ironbark/ Blakely's Red Gum/ Bull Oak/ Coast Banksia woodland on sands of the Warkworth area	16		38	0.24	0.26	0.04	0.05	ks7	0.92	
MU 185	Wallum Banksia / *Monotoca scoparia* heath on coastal sands of the Central Coast and Lower North Coast	35		51	0.02	0.06	0.01	0.05	ks39	0.75	
MU 186	Fern-leaf Banksia/ Prickly-leaved Paperbark/Tantoon/ *Leptocarpus tenax* wet heath on coastal sands of the Central Coast and Lower North Coast	12		83	0.03	0.09	0.02	0.12	ks39	0.81	not TEC, heath on dunes
MU 187	Heath-leaved Banksia/ Olive Tea-tree/ Wallum Boronia wet heath on coastal sands of Lower North Coast	8		100	0.01	0.07	0	0.09	ks37	0.6	not TEC, wet heath
MU 188	Olive Tea-tree/ Crimson Bottlebrush/ *Xanthorrhoea fulva* wet heath on coastal sands of Lower North Coast	10		100	0.01	0.07	0.05	0.14	ks38	0.7	not TEC, wet heath
MU 197	Prickly-leaved Paperbark/ Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast	9		44	0.29	0.45	0.25	0.52	ks5	0.84	SWSF, high det mean, but closest to K&S 5, dissimilarity close to threshold for with K&S group
MU 198	Prickly-leaved paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	65	8	58	0.4	0.51	0.2	0.41	ks5	0.85	SCFF; det mean close to SCFF but community in both Syd Basin and North coast bioregions (thus not strictly SCFF), closest to K&S 5, alluvial but not floodplain, but dissimilarity rel. high

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MU 199	Broad-leaved Paperbark/ Swamp Mahogany/ Swamp Oak/ Saw Sedge swamp forest of the Central Coast and Lower North Coast	32	12	97	0.36	0.46	0.39	0.53	ks1	0.81	SWSF; related to 700-633 and 700-634
MU 200	Swamp Mahogany/ Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	61	4	75	0.33	0.48	0.31	0.58	ks1	0.8	SWSF; related to 700-477
MU 201	Paperbarks/ Woollybutt swamp forest on coastal lowlands of the Central Coast	20		100	0.23	0.23	0.17	0.43	ks5	0.82	not TEC, closest to K&S 5
MU 202	Cabbage Gum/ Forest Red Gum/ Flax-leaved Paperbark Floodplain Forest of the Central Coast	3		100	0.41	0.36	0.38	0.34			
MU 203	Swamp Mahogany/ Broad-leaved Paperbark/ Saw Sedge/ Yellow Masrh Flower swamp forest of coastal lowlands	10		90	0.18	0.31	0.19	0.49	ks5	0.82	not TEC, closest to K&S 5
MU 204	Swamp Mahogany/ Paperbarks/ Harsh Ground Fern swamp forest of the Central Coast	10		30	0.35	0.41	0.36	0.58	ks1	0.85	SWSF, marginally alluvial, but high detmean and fairly close to K&S 1
MU 205	Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast	28		46	0.3	0.42	0.4	0.58	ks1	0.84	SWSF
MU 206	Broad-leaved Paperbark/ Swamp Oak/ Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	65	7	89	0.18	0.4	0.5	0.65	ks1	0.84	SWSF
MU 207	Swamp Mahogany/ Broad-leaved Paperbark/ Swamp Water Fern/ Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast	29	3	79	0.14	0.32	0.24	0.49	ks10	0.75	not TEC, closest to K&S 10

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MU 208	Flax-leaved Paperbark/ Tall Sedge shrubland of the Sydney Basin	10		80	0.41	0.3	0.42	0.46	ks1	0.9	SWSF, marginal, alluvial but relatively low det mean and not very close to K&S 1
MU 209	Swamp Oak/ Sea Rush/ *Baumea juncea* swamp forest on coastal lowlands of the Central Coast and Lower North Coast	65	3	95	0.19	0.26	0.55	0.39	ks17	0.75	SOAK, although close to ks17 and not ks2, includes plots allocated to REMS MU 40
MU 210	Swamp Oak/ Prickly Paperbark/ Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	14	10	100	0.36	0.45	0.65	0.54	ks17	0.84	SOAK, although close to ks17 and not ks2, includes plots allocated to REMS MU 41
MU 211	Swamp Oak swamp forest on coastal lowlands of the Central Coast and Lower North Coast	18		89	0.32	0.4	0.51	0.42	ks17	0.82	SOAK, although close to ks17 and not ks2, and does not include any REMS plots, included for consistency with MU 209 and MU 210
MU 212	Swamp paperbark/ *Baumea juncea* swamp shrubland on coastal lowlands of the Central Coast and Lower North Coast	24	17	96	0.11	0.21	0.6	0.57	ks17	0.81	not TEC, estuarine and sandplains, closest to ks17/18
MU 216	Wallum Bottlebrush/ Leptocarpus tenax/ Baloskion pallens wallum sedge heath of the Lower North Coast	21		95	0.07	0.14	0.11	0.28	ks30	0.75	not TEC, wet heath mainly dune swales
MU 218	Water Couch/ Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter	12		58	0.18	0.09	0.27	0.12			wetland
MU 219	Typha rushland	14		64	0.07	0.07	0.37	0.21			wetland
MU 223	*Lepironia articulata* sedgeland	5		100	0.03	0.21	0.2	0.32			wetland, possibly dune swales

Community code	Community Name	Number of plots with membership >=0.5	Percentage of plots in CCA floodplain unit	Percentage of plots in modelled alluvium	RFEF mean	SCFF mean	SOAK mean	SWSF mean	Most similar K&S group	Dissimilarity with most similar K&S group	TEC assessment
MU 224	Jointed Twig-rush sedgeland	18	8	89	0.04	0.15	0.21	0.52			not TEC, closest to K&S 18
MU 226	*Baloskion stenocoleum*/ Small-fruit Hakea wet heath of the Barrington Tops and Northern Tablelands	6		33	0.07	0.02	0.03	0.07			
MU 228	Saltmarsh/ Estuarine Complex	38		100	0.03	0.03	0.1	0.04	ks28	0.64	saltmarsh
MU 229	Grey Mangrove low closed forest	33		97	0.02	0.02	0.06	0.04	ks27	0.44	
N-M1	*Lophostemon suaveolens-E. tereticornis-Alphitonia excelsa-Acacia concurrens-Imperata cylindrica*	52	13	90	0.39	0.68	0.25	0.35	KS08	0.77	SCFF

Appendix C: Summary of Sydney Basin wetland, floodplain, alluvial or lowland grassy woodland vegetation communities

SB_CodeV17	Community name	Number of plots	Most similar Hunter community	Mean proportion per plot of final determination assemblage characteristic species			
				RFEF	SCFF	SOAK	SWSF
S_FoW01	Coastal Alluvial Bangalay Forest	29	MU 204	0.37	0.4	0.2	0.47
S_FoW02	Coastal Flats Swamp Mahogany Forest	94	MU 200	0.33	0.46	0.33	0.54
S_FoW03	Coastal Freshwater Swamp Forest	35	MU 204	0.34	0.37	0.39	0.56
S_FoW03	Coastal Freshwater Wetland (Cumbungi)	7	MU 204	0.19	0.17	0.53	0.36
S_FoW03	Disturbed variant of Coastal Freshwater Wetlands	3	MU 204	0.15	0.18	0.52	0.38
S_FoW04	Coastal Sand Swamp Mahogany Forest	24	MU 100	0.28	0.41	0.18	0.41
S_FoW06	Cumberland Riverflat Forest	38	M4	0.65	0.41	0.12	0.17
S_FoW07	Cumberland Swamp Oak Riparian Forest	6	M19	0.55	0.35	0.13	0.2
S_FoW08	Estuarine Swamp Oak Forest	62	MU 209	0.19	0.24	0.55	0.31
S_FoW09	Sydney Hinterland Riverflat Forest	63	M4	0.61	0.38	0.12	0.22
S_FoW11	Hunter Range Flats Apple-Red Gum Forest	43	M4	0.53	0.39	0.12	0.27
S_FoW12	Coastal Swamp Oak- Swamp Paperbark Scrub	33	MU 209	0.18	0.31	0.7	0.59
S_FoW13	Sydney Basin River Oak Forest	63	M4	0.5	0.32	0.15	0.19
S_FoW17	Hunter Range Flats Paperbark Thickets	8	M4	0.5	0.41	0.21	0.38
S_FoW20	Coastal Sandstone Riparian Scrub	24	M18	0.12	0.11	0.05	0.15
S_FoW200	Disturbed Lake Flat Apple Red Gum Swamp Forest	6	MU 103	0.52	0.59	0.34	0.46
S_FoW22	Tomago Sand Swamp Woodland	49	MU 133	0.07	0.11	0.02	0.18
S_FoW23	Central Coast Biconvex Paperbark Swamp Forest	24	MU 205	0.31	0.42	0.38	0.57
S_FoW24	Hunter Valley Flats River Red Gum Forest (low diversity)	2	MU 215	0.19	0.14	0.22	0.08

SB_CodeV17	Community name	Number of plots	Most similar Hunter community	Mean proportion per plot of final determination assemblage characteristic species			
				RFEF	SCFF	SOAK	SWSF
S_FoW24	Western Hunter River Red Gum Forest	4	MU 215	0.04	0	0.33	0
S_FoW25	Central Hunter Flats Swamp Oak Forest	8	MU 213	0.48	0.4	0.07	0.12
S_FoW26	Burragorang Riverflat Forest	3	MU 054	0.5	0.38	0.19	0.31
S_FoW29	Central Coast Creekflat Melaleuca nodosa Scrub-Woodland	48	MU 198	0.41	0.52	0.22	0.42
S_FoW29	Central Coast Creekflat Melaleuca nodosa Scrub-Woodland (type 2)	39	MU 198	0.29	0.4	0.09	0.26
S_FoW31	Central Coast Sand Swamp Mahogany-Paperbark Forest	67	MU 206	0.3	0.49	0.43	0.61
S_FoW32	Coastal Sand Wet Cyperoid Scrub	14	MU 216	0.06	0.19	0.18	0.34
S_FoW34	South Coast Flats Swamp Forest	27	M3	0.38	0.45	0.24	0.52
S_FoW37	North Coast Dune Swale Swamp Mahogany Forest	11	MU 207	0.11	0.31	0.22	0.51
S_FoW38	Sydney Hinterland Flats Swamp Mahogany-Paperbark Forest	23	MU 208	0.47	0.41	0.26	0.47
S_FoW39	Coastal Floodplain Paperbark-Eucalypt Swamp Forest	9	MU 208	0.47	0.41	0.26	0.4
S_FoW40	Central Coast Creekflat Mesic Swamp Forest	19	MU 200	0.34	0.46	0.29	0.5
S_FoW40	Coastal Riverflat Red Gum-Paperbark Forest	32	MU 200	0.47	0.49	0.2	0.35
S_FoW41	Hunter Coast Creekline Wet Scrubby Woodland	18	MU 197	0.19	0.33	0.21	0.38
S_FoW42	Coastal Melaleuca Decora Swamp Forest	15	M19	0.45	0.4	0.19	0.3
S_FoW43	Sydney Hinterland Riverflat Forest (2)	53	M19	0.46	0.36	0.13	0.31
S_FoW47	Lake Macquarie Flats Apple-Red Gum Forest	4	MU 9999	0.45	0.46	0.19	0.44
S_FoW48	Lower North Coast Dune Swale Swamp Forest	18	MU 126	0.13	0.26	0.15	0.31
S_FoW49	Coastal Flats Swamp Mahogany-Coral Fern Forest	3	MU 207	0.14	0.29	0.26	0.52
S_FoW50	Central Coast Flats Woollybutt Swamp Forest	20	MU 201	0.22	0.2	0.16	0.43
S_FoW51	Coastal Creekflat Paperbark Swamp Forest	14	MU 208	0.27	0.21	0.31	0.46

SB_CodeV17	Community name	Number of plots	Most similar Hunter community	Mean proportion per plot of final determination assemblage characteristic species			
				RFEF	SCFF	SOAK	SWSF
S_FoW52	Coastal Freshwater Swamp Paperbark Scrub	22	MU 212	0.2	0.26	0.56	0.61
S_FoW53	Coastal Floodplain Swamp Oak Forest	60	MU 210	0.35	0.4	0.52	0.43
S_FoW54	Coastal Alluvial Swamp Paperbark	3	MU 212	0.11	0.32	0.38	0.56
S_FoW56	Central Coast Creekline Paperbark Swamp Woodland	82	MU 131	0.11	0.21	0.08	0.29
S_FoW57	Hunter Coast Creekflat Mahogany Swamp Forest	46	MU 200	0.28	0.4	0.19	0.5
S_FoW8a	Estuarine Saltmarsh-Mangrove-Swamp Oak Complex	15	MU 229	0.12	0.12	0.3	0.16
S_FrW01	Coastal Upland Damp Heath Swamp	5	MU 189	0.04	0.05	0.02	0.08
S_FrW02	Coastal Upland Wet Heath Swamp	10	MU 189	0.03	0.04	0	0.09
S_FrW06	Estuarine Reedland (phragmites)	11	MU 209	0.15	0.22	0.58	0.48
S_FrW08	Blue Mountains Sandstone Damp Heath Swamp	6	MU 189	0.03	0.04	0.01	0.1
S_FrW12	*Chorizandra* sedgeland	2	MU 218	0	0.04	0.19	0.29
S_FrW13	Coastal Sand Swamp Scrub	7	MU 207	0.15	0.22	0.17	0.31
S_FrW19	Coastal Lagoon Fringing Scrub	3	UN	0.04	0.14	0.25	0.33
S_FrW22	Coastal Sand *Lepironia* Sedgeland	4	MU 223	0.04	0.27	0.24	0.4
S_FrW28	Floodplain Wetland var 4	2	MU 204	0.23	0.18	0.19	0.56
S_FrW29	Coastal Sandstone Creekline Swamp	8	M9	0.05	0.06	0.07	0.2
S_FrW30	Central Coast Creekflat Wet Heath	24	MU 131	0.07	0.13	0.02	0.2
S_FrW31	Wyong *Melaleuca thymifolia* Wetland Scrub/Woodland	8	MU 131	0.14	0.19	0.14	0.31
S_FrW32	Coastal Dune Narrowleaf Cumbungi Rushland	4	M9	0.11	0.02	0.21	0.06
S_FrW33	Coastal Lagoon Cladium Sedgeland	2	M9	0.28	0.15	0.48	0.62
S_FrW35	Coastal Sand Swamp Paperbark-Sedgeland	16	MU 206	0.09	0.28	0.49	0.6
S_FrW36	North Coast Sand Bottlebrush Swamp Scrub	6	MU 216	0.07	0.25	0.13	0.4

SB_CodeV17	Community name	Number of plots	Most similar Hunter community	Mean proportion per plot of final determination assemblage characteristic species			
				RFEF	SCFF	SOAK	SWSF
S_FrW37	sand swamp paperbark	3	MU 206	0.1	0.26	0.18	0.51
S_FrW40	Sydney Basin Freshwater Tall Sedgeland	6	MU 208	0.2	0.2	0.4	0.41
S_FrW46	Coastal Floodplain Wetland (Juncus)	2	MU 218	0.17	0.05	0.22	0.17
S_GW02	Cumberland Shale Hills Woodland	2	M17	0.34	0.31	0.02	0.02
S_GW03	Cumberland Shale Plains Woodland	73	M17	0.52	0.44	0.03	0.09
S_GW03	Cumberland Shale Plains Woodland (Variant check grassines and diversity)	13	M17	0.52	0.43	0.04	0.07
S_GW04	Cumberland Shale-Sandstone Ironbark Fores	42	M12	0.35	0.34	0.04	0.16
S_GW18	Hunter Range Flats Apple-Stringybark-Gum Forest	17	MU 054	0.52	0.3	0.09	0.22
S_GW22	Central Hunter Ironbark-Box-Spotted Gum Forest	62	M11	0.3	0.27	0.02	0.03
S_GW22	Central Hunter Ironbark-Box-Spotted Gum Forest (Var 2)	42	M11	0.38	0.32	0.01	0.05
S_GW23	Quorrobolong Sand Flats Forest	2	MU 073	0.39	0.43	0.05	0.14
S_GW24	Lower Hunter Creekflat Forest	11	M19	0.5	0.43	0.14	0.26
S_GW25	Hunter Lowlands Ironbark-Gum Grassy Forest	84	MU 072	0.39	0.41	0.07	0.15
S_GW25	Hunter Lowlands Ironbark-Gum Grassy Forest (low spp)	2	MU 072	0.44	0.35	0.09	0.2
S_GW32	Western Hunter Grassy Box Woodland	4	M15	0.35	0.29	0.06	0.05
S_GW34	Hunter Lowland Apple-Redgum Grassy Forest	21	M6	0.44	0.38	0.06	0.09
S_GW36	North Rothbury Narrow-leafed Ironbark Woodland (more investigation required)	54	M6	0.37	0.35	0.02	0.08
S_GW42	Mudgee Valleys Box-Ironbark Woodland	2	M6	0.35	0.29	0.08	0.02
S_GW53	Manning Valley Lowlands Red Gum Grassy Forest	31	M19	0.51	0.58	0.12	0.28
S_SaW01	Hunter Valley Weeping Myall Woodland (disturbed)	3	M9	0.06	0.02	0	0
S_SW04	Estuarine Samphire Herbfield-Mangrove Complex	4	MU 228	0.06	0.06	0.06	0.06

SB_CodeV17	Community name	Number of plots	Most similar Hunter community	Mean proportion per plot of final determination assemblage characteristic species			
				RFEF	SCFF	SOAK	SWSF
S_SW06	Estuarine Saltmarsh var Couch	3	MU 228	0.1	0.1	0.4	0.2

Appendix D: Subtropical coastal floodplain forest (SCFF) reference sites located in state forest.

State Forest (SF)	Site No	Latitude	Longitude	NR comm	NR memb	Hunter comm	Hunter memb	NC SB	NC sSBm
Banyabba SF	WHP02J1L	-29.3483420	152.9835820	M1	0.85	UN	0.00		0.00
Banyabba SF	WHP03J4L	-29.3483970	152.9920500	M1	0.85	UN	0.00		0.00
Banyabba SF	WHP04J2L	-29.3631530	152.9919740	M1	0.97	UN	0.00		0.00
Braemar SF	ELG02A0F	-29.0245430	153.0214230	700-488	0.52	UN	0.00		0.00
Braemar SF	RAP02A0F	-29.0319710	152.9753270	M1	0.54	UN	0.00		0.00
Braemar SF	RAP03A5S	-29.0319720	152.9837040	M1	0.79	UN	0.00		0.00
Braemar SF	RPP01J0F	-29.0246980	153.0003970	M1	0.72	UN	0.00		0.00
Bungawalbin SF	ELL16J0F	-29.0981460	153.0925750	M1	0.65	UN	0.00		0.00
Bungawalbin SF	ELL17J0F	-29.0908010	153.0758210	M1	0.65	UN	0.00		0.00
Cairncross SF	TLP04A0F	-31.3692160	152.8106380	M1	0.28	MU 198	0.92	S_FoW29	0.40
Camira SF	CLE08A5V	-29.2305650	152.9249730	700-488	0.84	UN	0.00		0.00
Camira SF	CLE09J0F	-29.2379350	152.9585110	M1	0.91	UN	0.00		0.00
Candole SF	NEF1075	-29.6832520	153.2377620	1000-1107	0.97	UN	0.00		0.00
Candole SF	NEF7003	-29.7157420	153.2378390	1000-1107	0.92	UN	0.00		0.00
Candole SF	PLL03A0F	-29.7496000	153.2317660	M1	0.66	UN	0.00		0.00

State Forest (SF)	Site No	Latitude	Longitude	NR comm	NR memb	Hunter comm	Hunter memb	NC SB	NC sSBm
Candole SF	TCB01A0F	-29.7461810	153.2358860	M1	0.61	UN	0.00		0.00
Candole SF	TCB03A0F	-29.6918350	153.2398990	M1	0.56	UN	0.00		0.00
Candole SF	TCB07A1V	-29.6918550	153.2481840	700-493	0.58	UN	0.00		0.00
Candole SF	TCB08F2L	-29.7135050	153.2234950	M1	0.72	UN	0.00		0.00
Devils Pulpit SF	BAN15A0F	-29.2745080	153.2437590	700-493	0.96	UN	0.00		0.00
Devils Pulpit SF	BAN19A0F	-29.2656230	153.2505190	700-493	0.73	UN	0.00		0.00
Devils Pulpit SF	WOO31Q0F	-29.2656140	153.2556610	700-493	0.99	UN	0.00		0.00
Doubleduke SF	BAN18A0F	-29.1641030	153.2502750	700-493	0.50	UN	0.00		0.00
Doubleduke SF	GIB16A0F	-29.1936720	153.1764830	700-477	0.75	UN	0.00		0.00
Doubleduke SF	NEF7011	-29.1905410	153.1944430	1000-1107	0.78	UN	0.00		0.00
Doubleduke SF	TAB13J0F	-29.1788140	153.2603610	M1	0.80	UN	0.00		0.00
Gibberagee SF	BAN01A0F	-29.2820100	153.0589140	M1	0.92	UN	0.00		0.00
Gibberagee SF	BAN02J0F	-29.2747160	153.1262360	M1	0.79	UN	0.00		0.00
Gibberagee SF	BAN03J0F	-29.3113040	153.0423580	M1	0.91	UN	0.00		0.00
Gibberagee SF	BAN04J0F	-29.3188590	153.0424040	M1	0.85	UN	0.00		0.00
Gibberagee SF	BAN07J0F	-29.3041530	153.0507810	M1	0.73	UN	0.00		0.00
Gibberagee SF	BNY04J0F	-29.3114650	153.0675810	700-488	0.76	UN	0.00		0.00

State Forest (SF)	Site No	Latitude	Longitude	NR comm	NR memb	Hunter comm	Hunter memb	NC SB	NC sSBm
Gibberagee SF	BNY05J0F	-29.2499210	153.1371920	M1	0.98	UN	0.00		0.00
Gibberagee SF	GIB17A0F	-29.2477450	153.0965120	M1	0.53	UN	0.00		0.00
Gibberagee SF	GIB21A0F	-29.2158220	153.1178440	M1	0.65	UN	0.00		0.00
Gibberagee SF	GIB22A0F	-29.2378850	153.1011510	M1	0.96	UN	0.00		0.00
Gibberagee SF	NCPP0127	-29.2844180	153.0311580	700-493	0.58	UN	0.00		0.00
Gibberagee SF	NEF1112	-29.2899200	153.1081390	1000-1107	0.81	UN	0.00		0.00
Gibberagee SF	UNE05030	-29.2357750	153.0967710	700-493	1.00	UN	0.00		0.00
Glenugie SF	PLL02J0F	-29.8163140	153.0548550	M1	0.63	UN	0.00		0.00
Glenugie SF	PLL05J0F	-29.8072770	153.0626680	M1	0.58	UN	0.00		0.00
Glenugie SF	TERG2	-29.8380840	152.9959560	M1	0.89	UN	0.00		0.00
Keybarbin SF	NCPP0189	-29.0819240	152.6533360	700-488	0.85	UN	0.00		0.00
Kiwarrak SF	CDL02D0F	-31.9563380	152.5191500	700-56	0.76	MU 198	0.58	S_FoW29	0.32
Myall River SF	18742G4	-32.4308890	152.0035520	UN	0.00	MU 198	0.59	S_FoW40	0.31
Myall River SF	BLH04C5F	-32.4415820	152.0051880	700-56	0.13	MU 198	0.54	S_FoW40	0.91
Myrtle SF	CLE02A0F	-29.1790940	152.9920650	700-488	0.64	UN	0.00		0.00
Myrtle SF	CLE03A0F	-29.1643780	152.9669190	M1	0.51	UN	0.00		0.00
Myrtle SF	CLE04A0F	-29.1790940	153.0004430	700-488	0.90	UN	0.00		0.00

State Forest (SF)	Site No	Latitude	Longitude	NR comm	NR memb	Hunter comm	Hunter memb	NC SB	NC sSBm
Myrtle SF	CLE05A0F	-29.1864500	152.9920650	M1	0.68	UN	0.00		0.00
Myrtle SF	CLE06A0F	-29.1575410	152.9983370	M1	0.52	UN	0.00		0.00
Myrtle SF	CLE10J0F	-29.1570170	152.9501650	M1	0.73	UN	0.00		0.00
Myrtle SF	CLE13J0F	-29.1552840	152.9957580	M1	0.67	UN	0.00		0.00
Myrtle SF	CLE14J0F	-29.2011620	153.0004430	M1	0.52	UN	0.00		0.00
Myrtle SF	CLF01J0F	-29.1350020	152.9835360	M1	0.61	UN	0.00		0.00
Myrtle SF	CLF03J0F	-29.1571420	152.9757390	M1	0.52	UN	0.00		0.00
Myrtle SF	GIB32A0F	-29.1790940	153.0088200	M1	0.76	UN	0.00		0.00
Myrtle SF	GIB33A0F	-29.2011550	153.0423580	M1	0.94	UN	0.00		0.00
Myrtle SF	GIB35A0F	-29.1938000	153.0423580	M1	0.97	UN	0.00		0.00
Myrtle SF	GIB37A0F	-29.2011580	153.0339810	M1	0.94	UN	0.00		0.00
Myrtle SF	GIB38A0F	-29.1936350	153.0471950	700-493	0.97	UN	0.00		0.00
Myrtle SF	TSRG4	-29.1642440	152.9729000	700-488	0.59	UN	0.00		0.00
Myrtle SF	UNE08037	-29.1593140	152.9689330	M1	0.51	UN	0.00		0.00
Nerong SF	VMP2CT62	-32.5430460	152.1584930	UN	0.00	MU 198	0.69	S_FoW29	0.31
Pine Brush SF	NEF1079	-29.6101950	153.2107390	1000-1107	0.57	UN	0.00		0.00
Pine Brush SF	TCB11J2D	-29.6558740	153.1737820	M1	0.50	UN	0.00		0.00

State Forest (SF)	Site No	Latitude	Longitude	NR comm	NR memb	Hunter comm	Hunter memb	NC SB	NC sSBm
Pine Brush SF	TYN02J0F	-29.5980500	153.1735690	M1	0.57	UN	0.00		0.00
Royal Camp SF	NCPP0161	-28.9761410	152.9600070	1000-1107	0.80	UN	0.00		0.00
Royal Camp SF	RPP07J0F	-29.0245150	152.8665470	700-488	0.88	UN	0.00		0.00
Wallaroo SF	KRH51A0D	-32.6735660	151.8241730	700-489	0.83	MU 198	0.47	S_FoW29	0.23
Wallaroo SF	KRH79A3F	-32.6687040	151.8270110	700-40	0.32	MU 198	0.91	S_FoW29	0.97
Wedding Bells SF	WLG05F0F	-30.0598640	153.1769710	M1	0.64	UN	0.00		0.00
Wedding Bells SF	WLG09A2V	-30.0440680	153.1795810	M1	0.71	UN	0.00		0.00
Whiporie SF	GIB34A0F	-29.2379370	153.0339970	700-493	0.68	UN	0.00		0.00
Whiporie SF	GIB39A0F	-29.2364930	153.0369260	M1	0.70	UN	0.00		0.00
Whiporie SF	GIB42J0F	-29.2158640	153.0507510	M1	0.63	UN	0.00		0.00
Whiporie SF	UNE05031	-29.2349010	153.0411990	700-493	0.57	UN	0.00		0.00
Yarratt SF	EAD10T5	-31.8253940	152.4343410	UN	0.00	MU 198	0.60	S_FoW29	0.38

Appendix E: Swamp Sclerophyll Forest (SWSF) reference sites located in state forest.

State Forest (SF)	SiteNo	Latitude	Longitude	NR comm	NR memb	Hun comm	Hun memb	NC_SB	NC_SBm
Bachelor SF	WTN01A7F	-32.298305	152.380096	700-477	0.99	M3	0.24	M20	0.33
Bulahdelah SF	BLH07C4F	-32.409079	152.237747	700-477	0.59	MU 200	0.48	S_FoW40	0.49
Cairncross SF	PTM01P0V	-31.394092	152.823959	700-634	0.25	MU 199	0.75	S_FoW02	0.56
Coopernook SF	NEF6023	-31.781785	152.622437	700-477	0.81	MU 200	0.17	M20	0.76
Cowarra SF	GHD03J2V	-31.539905	152.793472	700-56	0.51	MU 200	0.56	M20	0.74
Johns River SF	LRN01Q0D	-31.733310	152.723343	700-634	0.91	MU 206	0.98	S_FrW35	0.67
Johns River SF	LRN02Q0V	-31.734440	152.712189	700-634	0.93	MU 199	0.62	S_FoW31	0.55
Johns River SF	LRN03Q0D	-31.732227	152.714951	1000-1950	0.99	MU 206	0.84	S_FrW35	0.76
Johns River SF	LRN06Q0D	-31.736746	152.722778	1000-1950	0.76	MU 206	0.93	S_FrW35	0.98
Johns River SF	LRN07Q0V	-31.734464	152.714890	700-634	0.91	MU 199	0.91	S_FoW31	0.73
Nambucca SF	MCK02A7V	-30.659487	152.966614	700-634	0.87	UN	0.00		0.00
Newry SF	NEF5060	-30.517317	152.960434	700-634	0.98	UN	0.00		0.00
Wallaroo SF	KRHD3C4F	-32.641686	151.913254	700-330	0.94	MU 131	0.98	S_FoW56	0.99
Wallingat SF	EA_CT69	-32.345387	152.427261	700-477	0.98	MU 200	0.72	M20	0.33
Wallingat SF	WTN04A1F	-32.332804	152.420273	700-477	0.95	MU 046	0.23	S_WSF45	0.30
Wallingat SF	WTN05A5F	-32.351185	152.429352	700-477	0.99	MU 200	0.48	S_FoW01	0.16

Appendix F: Swamp Oak Forest TEC (SOAK) reference sites located in state forest

State forest	SiteNo	Latitude	Longitude	NRcomm	NRmemb	Huncomm	Hunmemb
Nambucca SF	LNE07046	-30.617713	153.004395	1000-1979	0.98	UN	0.00
Newry SF	MSB03Q0V	-30.526980	152.961517	700-621	0.81	UN	0.00
Newry SF	MSB04Q0V	-30.515077	152.958420	700-621	0.80	UN	0.00
Wallaroo SF	CLR47A1F	-32.616916	151.926773	1000-1979	0.85	MU 228	0.69

Appendix G: River Flat Eucalypt Forest (RFEF) reference sites located in state forest

State Forest (SF)	SiteNo	Latitude	Longitude	NRcomm	NRmemb	Huncomm	Hunmemb	NC_SB	NC_SBm
Putty SF	PTY17N2V	-32.82371	150.728195	UN	0.0000000	M4	0.49	S_GW18	0.94

Appendix H: Allocation of validation plots to communities and TEC

Plot number	Northern Rivers community	NR membership	Hunter community	Hunter membership	Plot TEC	Map TEC
BLH09A6F	M6	0.57	MU 198	0.3	SCFF	SCFF
BNY06J7F	M15	0.93	MU 030	0.19	ambiguous	SCFF
BNY07A7F	1000-1107	0.23	M9	0.12	SCFFposs	SCFF
BNY08J7F	700-325	0.37	MU 101	0.08	not TEC	not TEC
BNY09J7F	700-325	0.99	MU 131	0.26	SWSFposs	not TEC
BNY10J7F	700-399	0.16	M4	0.13	not TEC	not TEC
BNY11J7F	M15	0.73	M9	0.21	ambiguous	SCFF
CLF06J7F	700-493	0.98	MU 199	0.34	SCFF	SCFF
CLF07A7F	1000-1449	0.47	MU 061	0.11	not TEC	SCFF
CLF08J8L	M15	0.6	MU 198	0.3	SCFFposs	SCFF
CLF09J7F	700-488	0.32	M16	0.11	SCFFposs	SCFF
CLR49A1F	700-330	0.47	M1	0.27	not TEC	SCFF
CLR50A5F	M6	0.87	MU 198	0.99	SCFF	SCFF
CLR51A1F	M6	0.37	MU 072	0.19	SCFFposs	not TEC
CLY10P4L	1500-929	0.48	MU 051	0.75	not TEC	not TEC
CLY12P4L	1500-122	0.52	MU 038	0.27	not TEC	not TEC
CLY13P3L	M15	0.25	M10	0.25	ambiguous	SOAK
CLY14P3F	1500-929	0.37	MU 051	0.57	not TEC	not TEC
CLY15P7F	700-432	0.07	M4	0.14	not TEC	not TEC
CND01A1F	M6	0.54	MU 032	0.22	SCFF	SCFF
CPR01A1F	700-330	0.75	MU 131	0.95	SWSF	SCFF
CPR02A2F	700-330	0.44	MU 131	0.95	SWSF	SCFF
ELG06J4L	M15	0.71	MU 030	0.25	ambiguous	not TEC
ELG07J7F	M15	0.93	M6	0.2	ambiguous	not TEC
ELG09J7F	M15	0.93	M7	0.2	ambiguous	not TEC
ELG10A7F	700-488	0.85	M9	0.12	SCFF	SCFF
ENG20C3L	1500-930	0.94	MU 051	0.39	not TEC	not TEC
ENG21C6L	700-432	0.23	MU 051	0.22	not TEC	not TEC
ENG22P7L	M6	0.39	M7	0.16	SCFFposs	not TEC
GBB13J7F	M4	0.09	M16	0.12	not TEC	SWSF
GBB14A7F	700-614	0.47	MU 207	0.65	not TEC	SCFF
GBB15A7F	700-488	0.29	M4	0.21	SCFFposs	SCFF
GBB16J7F	M15	0.5	M9	0.19	ambiguous	not TEC
GBB17J7F	M15	0.96	M10	0.28	ambiguous	not TEC
GBB18A7F	700-493	0.15	MU 199	0.4	SWSFposs	SCFF

Plot number	Northern Rivers community	NR membership	Hunter community	Hunter membership	Plot TEC	Map TEC
GBB19J7F	700-305	0.7	M8	0.12	not TEC	SCFF
GBB20A7F	M15	0.82	M9	0.14	ambiguous	not TEC
GBB21A7F	M6	0.2	MU 206	0.16	SCFFposs	SCFF
GBB22A7F	700-493	0.98	M16	0.15	SCFF	SCFF
GBB23J7F	1000-1107	0.86	M7	0.2	SCFF	SCFF
KMP01P2L	700-488	0.28	M16	0.13	SCFFposs	SCFF
KMP02P7L	1500-122	0.31	M7	0.18	not TEC	SCFF
KRHD4A3V	M6	0.68	MU 200	0.68	SCFF	SCFF
KRHD5A2F	M6	0.83	MU 198	0.51	SCFF	SCFF
KRHD6A1F	M6	0.75	MU 198	0.87	SCFF	SCFF
MCK55C7G	700-471	0.27	MU 106	0.33	not TEC	SWSF
MCK56C1F	1500-929	0.43	MU 051	0.43	not TEC	not TEC
MCK56C7F	M6	0.57	MU 206	0.19	SCFF	SWSF
MNE15C7F	1500-964	0.15	MU 051	0.32	not TEC	not TEC
MNE16A7F	1500-929	0.41	MU 032	0.34	not TEC	not TEC
MSB12A7F	700-629	0.15	MU 204	0.21	SWSFposs	SOAK
MSB13C7F	700-634	0.92	MU 206	0.72	SWSF	SWSF
MSB14A7F	700-621	0.86	MU 209	0.38	SOAK	SOAK
MSB15C7F	1000-1586	0.69	MU 009	0.4	not TEC	not TEC
MSB16C7G	700-445	0.33	M16	0.09	not TEC	not TEC
MSB17C7F	700-445	0.33	MU 009	0.24	not TEC	not TEC
MSB18C3L	700-445	0.91	MU 009	0.27	not TEC	not TEC
PLL08J7F	M15	0.53	M10	0.2	ambiguous	not TEC
PLL09J7F	1000-1104	0.48	M10	0.6	ambiguous	SCFF
PLL10J7L	700-67	0.31	M6	0.24	not TEC	not TEC
PLL11J7F	M15	0.88	M10	0.16	ambiguous	not TEC
RPP09J1L	M15	0.63	M7	0.15	ambiguous	SCFF
RPP10J7F	M15	0.93	M7	0.17	ambiguous	SCFF
RPP11J7F	M15	0.85	M12	0.19	ambiguous	not TEC
RPP12J7F	M15	0.94	M10	0.31	ambiguous	not TEC
RPP13J3F	M15	0.79	M10	0.17	ambiguous	not TEC
RPP14J7F	M15	0.71	M10	0.47	ambiguous	SCFF
RRK10J7F	700-325	0.79	MU 131	0.4	SWSFposs	not TEC
RRK11A7F	1000-1107	0.25	M10	0.3	SCFFposs	SCFF
RRK12A7F	700-302	0.4	MU 106	0.24	not TEC	not TEC
RRK13C7F	999-705	0.55	MU 101	0.24	not TEC	not TEC
RRK14A2L	1000-1449	0.27	M8	0.41	not TEC	not TEC
TAR01A7V	1500-929	0.42	MU 051	0.64	not TEC	not TEC
TBM01J7F	700-326	0.43	MU 131	0.59	SWSF	SCFF

Plot number	Northern Rivers community	NR membe rship	Hunter community	Hunter membe rship	Plot TEC	Map TEC
TYN07A7L	M15	0.9	M9	0.16	ambiguous	not TEC
TYN08J1L	M15	0.91	M10	0.21	ambiguous	not TEC
TYN09J1L	M15	0.47	M7	0.2	ambiguous	not TEC
TYN10J1L	1500-122	0.18	MU 030	0.17	not TEC	not TEC
TYN11J7F	1000-1106	0.32	M7	0.16	not TEC	not TEC
TYN12J4L	M6	0.21	M7	0.13	SCFFposs	not TEC
WCH03A8F	700-56	0.12	MU 032	0.56	not TEC	not TEC
WCH04A8F	700-477	0.85	MU 200	0.71	SCFF/SWSF	SWSF
WHP05J7F	M15	0.55	M7	0.22	ambiguous	not TEC
WHP06J3L	M6	0.47	M7	0.23	SCFFposs	not TEC
WLG02J7G	700-274	0.29	M16	0.11	not TEC	not TEC
WLG03T7L	M6	0.84	M7	0.17	SCFF	SCFF
WLG04A8F	M6	0.92	M7	0.24	SCFF	not TEC
WNG06A2V	M6	0.8	MU 198	0.25	SCFF	SCFF
WNG07A3F	M6	0.91	M7	0.2	SCFF	SCFF
WNG08A5F	M6	0.97	MU 198	0.35	SCFF	SCFF
WNG09A7F	M6	0.89	M7	0.18	SCFF	SCFF
WNG10A1F	M6	0.88	MU 198	0.68	SCFF	SCFF
WNG11A7V	M6	0.27	M7	0.17	SCFFposs	SCFF
WNH01A7F	700-634	0.68	MU 206	0.71	SWSF	SCFF

Appendix I: Keys for field identification of Subtropical Coastal Floodplain Forest TEC of the NSW North Coast Bioregion, in the area north of Kempsey

This key assumes the vegetation to be assessed is in an area north of Kempsey and at or below 150 metres elevation. There is a separate key for areas south of Kempsey. Two keys are provided because the floristic composition of our interpretation of SCFF varies latitudinally. The maximum elevation of any plot which we allocated to SCFF is 134 metres and most plots are below 100 metres. Assessment should be done in 20 metre x 20 metre plots or areas of similar size. The more plots assessed, the more reliable the result. Likelihoods given below are mean proportions based on a single plot and have been rounded to the nearest 5%. This key and the likelihoods provided are based on distinguishing SCFF from vegetation not currently listed as any TEC. Vegetation identified as SCFF by this key may also, or alternatively depending on degree of floristic overlap, belong to other floodplain TECs.

To use this key, count the number of species present which are in the list of positive diagnostic species (Table 1, first column) to use as the row and the number present which are in the list of negative diagnostic species (Table 1, second column) to use as the column. Read the cell in Table 2 corresponding to the row and column counts to obtain an estimate of the likelihood that the vegetation is Subtropical Coastal Floodplain Forest TEC. Likelihoods for the case where no positive diagnostic species are present use the upper 95% confidence limit. In other cases, mean likelihoods are given and have an uncertainty of approximately +/- 5%.

Table 1: Diagnostic species.

Positive diagnostic	Negative diagnostic
Lophostemon suaveolens	*Hardenbergia violacea*
Parsonsia straminea	*Eucalyptus pilularis*
Melaleuca alternifolia	*Lepidosperma laterale*
Eucalyptus tereticornis	*Allocasuarina torulosa*
Centella asiatica	*Billardiera scandens* s.l.
Hydrocotyle tripartita	*Eucalyptus microcorys*
Alphitonia excelsa	*Syncarpia glomulifera*
Ottochloa gracillima	*Pteridium esculentum*
Casuarina glauca	*Dianella caerulea*
Acacia aulacocarpa* or *A. disparrima	*Acacia ulicifolia*

Table 2: Estimates of likelihood that vegetation is Subtropical Coastal Floodplain Forest.

		Number of negative species					
		0	<=1	<=2	<=3	<=4	<=5
Number of positive species	0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	>=1	0.45	0.4	0.3	0.25	0.2	0.2
	>=2	0.55	0.55	0.45	0.4	0.35	0.35
	>=3	0.75	0.7	0.65	0.6	0.55	0.55
	>=4	0.9	0.9	0.85	0.85	0.8	0.8
	>=5	0.95	0.95	0.95	0.95	0.95	0.95

Appendix J: Field key for identification of Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion, in the area south of Kempsey

This key assumes the vegetation to be assessed is in an area south of Kempsey and at or below 150 metres elevation. There is a separate key for areas north of Kempsey. Two keys are provided because the floristic composition of our interpretation of SCFF varies latitudinally. The maximum elevation of any plot which we allocated to SCFF is 134 metres and most plots are below 100 metres. Assessment should be done in 20 metre x 20 metre plots or areas of similar size. The more plots assessed, the more reliable the result. Likelihoods given below are mean proportions based on a single plot and have been rounded to the nearest 5%. This key and the likelihoods provided are based on distinguishing SCFF from vegetation not currently listed as any TEC. Vegetation identified as SCFF by this key may also, or alternatively depending on degree of floristic overlap, belong to other floodplain TECs.

To use this key, count the number of species present which are in the list of positive diagnostic species (Table 1, first column) to use as the row and the number present which are in the list of negative diagnostic species (Table 1, second column) to use as the column. Read the cell in Table 2 corresponding to the row and column counts to obtain an estimate of the likelihood that the vegetation is Subtropical Coastal Floodplain Forest TEC. Likelihoods for the case where no positive diagnostic species are present use the upper 95% confidence limit. In other cases, mean likelihoods are given and have an uncertainty of approximately +/- 5%.

Table 1: Diagnostic species.

Positive diagnostic	Negative diagnostic
Melaleuca nodosa	*Pomax umbellata*
Parsonsia straminea	*Persoonia linearis*
Gahnia clarkei	*Aristida vagans*
Eucalyptus resinifera	*Corymbia gummifera*
Dichondra repens	*Dillwynia retorta*
Melaleuca sieberi	*Acacia ulicifolia*
Hydrocotyle sibthorpioides	*Phyllanthus hirtellus*
Polymeria calycina	*Pteridium esculentum*
Pratia purpurascens	*Eucalyptus pilularis*
Lagenifera stipitata	*Syncarpia glomulifera*

Table 2: Estimates of likelihood that vegetation is Subtropical Coastal Floodplain Forest.

		Number of negative species					
		0	<=1	<=2	<=3	<=4	<=5
Number of positive species	0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	>=1	0.15	0.05	0.05	0.05	0.05	0.05
	>=2	0.2	0.1	0.1	0.05	0.05	0.05
	>=3	0.4	0.25	0.15	0.15	0.1	0.1
	>=4	0.6	0.45	0.35	0.25	0.25	0.25
	>=5	0.9	0.8	0.7	0.55	0.55	0.55