The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities

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Abstract: Twenty-two vascular plant communities occurring on, and adjacent to the Cumberland Plain and Hornsby Plateau, are defined using a multi-variate analysis of quantitative field survey data. Communities are described using structural features, habitat characteristics and diagnostic species. Diagnostic species are identified using a statistical fidelity measure. The pre–European spatial distribution of communities is estimated using a decision tree approach to derive relationships between community distribution and geological, climatic and topographical variables. Contemporary vegetation cover is estimated from 1:16 000 scale aerial photography (1997/98) and sorted into six categories based on cover of *Eucalyptus* species. These categories are only approximately related to vegetation condition: high *Eucalyptus* cover classes are most likely to contain high levels of floristic diversity, but areas with scattered cover or no cover at all may have either high or low diversity.

Map accuracy is assessed using independent field samples and is primarily limited by the accuracy of 1:100 000 geological maps. Patterns in overstorey composition were mapped at 1:16 000 scale but were less useful in delineating community boundaries than was hoped because few species are confined to a single community. The extent to which observer bias may influence estimates of the present extent of remnant vegetation is investigated by comparing the interpretations of two observers for a subset of the study area.

The community classification is interpreted in light of previous publications and the Endangered Ecological Communities listed under the NSW *Threatened Species Conservation (TSC) Act* (1995). Four communities listed under the *TSC Act* (1995) are represented by more than one unit in the new classification: *Cumberland Plains Woodland* (represented by Shale Plains Woodland, Shale Hills Woodland); *Sydney Coastal River Flat Forest* (Riparian Woodland, Riparian Forest, Alluvial Woodland); *Shale/Sandstone Transition Forest* (Shale/Sandstone Transition Forest low sandstone influence, high sandstone influence); and *Sydney Turpentine-Ironbark Forest* (Turpentine-Ironbark Forest, Turpentine-Ironbark Margin Forest). A further seven listed communities are described in this paper (*Cooks River/Castlereagh Ironbark Forest*, *Shale/Gravel Transition Forest*, *Castlereagh Swamp Woodland*, *Agnes Banks Woodland*, *Western Sydney Dry Rainforest*, *Moist Shale Woodland*, and *Blue Gum High Forest*).

As a result of clearing, native vegetation cover on the Cumberland Plain has been reduced to only 13.1% (± 1.7) of the pre-European extent. Despite high levels of fragmentation, the presence of exotic species and a history of extensive grazing, high numbers of native species were recorded in remnants of all sizes. A large proportion of species was recorded once only (22%), while nearly half of all species were recorded 5 times or less. This suggests that there is a high likelihood that further clearing will lead to a loss of floristic diversity. Two exotic species (*Olea europea* subsp. *africana* and *Myrsiphyllum asparagoides*) are identified as a major threat to the conservation of native flora due to their widespread distribution and ability to out-compete native species. Control of these species should be a high priority in conservation management.

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Introduction

The composition of vascular plant communities is highly complex and variable because the abundance of individual species varies independently and continuously throughout the landscape (Austin 1985). The classification and mapping of species assemblages has proven to be a useful method for describing and interpreting these patterns (Mucina 1997). Classification units (communities) provide an obvious focus for efforts to conserve the diversity of biological assemblages. Under the NSW *Threatened Species Conservation (TSC) Act* (1995) an assemblage of species at risk of extinction may be listed as an Endangered Ecological Community (EEC). However, because communities are abstract by nature and inconsistently delineated, the compilation of precise descriptions for legal purposes is problematic.

Descriptions of EECs listed under the *TSC Act* are compiled from a range of sources and typically contain notes on the distribution, structure and habitat occupied by the community and a list of characteristic species. Because there is limited scope for the inclusion of contextual information (such as the relationship between the listed EEC and other communities in the area, and the relative abundance,

frequency and fidelity of characteristic species) EEC descriptions may not be optimal for delineating communities in the field in all circumstances. Supporting contextual data in the form of regional vegetation maps and descriptions can assist in the interpretation of EEC determinations.

Most of the native vegetation communities of the Cumberland Plain and neighbouring Wianamatta Shale are listed under the *TSC Act*. Due to the rate of urban development to the west of Sydney there is a large potential for development proposals to significantly impact on listed communities. Hence there is a need for quantitative data to assist the identification of communities and the assessment of the conservation value of remnants. Quantitative community descriptions would provide a means for differentiating between communities, particularly those not recognised in previous vegetation surveys. An estimate of the extent of native vegetation remaining is also required for the assessment of conservation significance and conservation planning.

This paper describes a new survey of vegetation communities occurring on the Cumberland Plain and isolated and less extensive Wianamatta Shale soils on the adjacent plateaus. The survey incorporated: (i) systematic, stratified field sampling to record floristic structure and composition; (ii) a classification procedure based on hierarchical, agglomerative clustering analysis; (iii) spatial modelling of community distributions using geological, climatic and topographic variables on a 25 m grid; and (iv) the interpretation of patterns in canopy composition and remnant condition in aerial photographs. The use of these techniques in combination has recently been demonstrated in the South East Forests of NSW (Keith & Bedward 1999). The approach was applied on the Cumberland Plain with the following aims:

- revise the existing classification to take account of recently described communities and other communities warranting recognition;
- provide quantitative data for characteristic species in each community (frequency of occurrence and relative abundance);
- identify species showing high fidelity to each community as a basis for diagnosing community type in the field;
- estimate the present cover of native vegetation;
- derive a spatial model as a basis for predicting the vegetation type and conservation value of all remaining remnants.

Study area

Location and landform

The study area (Figure 1) was located in western Sydney (33°30–34°30 S, 150°30–151°30 E) and was formally defined as the extent of soils derived from three main geological units: Wianamatta group shales, Tertiary alluvium and Holocene alluvium (in areas draining Wianamatta group shales); (Walker 1960, Chapman & Murphy 1989, Bannerman & Hazelton 1990). This area includes the Cumberland Plain, a large central section of the Hornsby Plateau and the north-west margin of the Woronora Plateau (Bannerman & Hazelton 1990). West of Parramatta, the Cumberland Plain forms an elongated ellipse stretching from Sackville in the north to Thirlmere in the south, with the western boundary marked by the monocline of the Blue Mountains to the west of Penrith. East of Parramatta the Plain is truncated by the Hornsby Plateau in the north and the Woronora Plateau to the south, and finally terminates near the city centre.

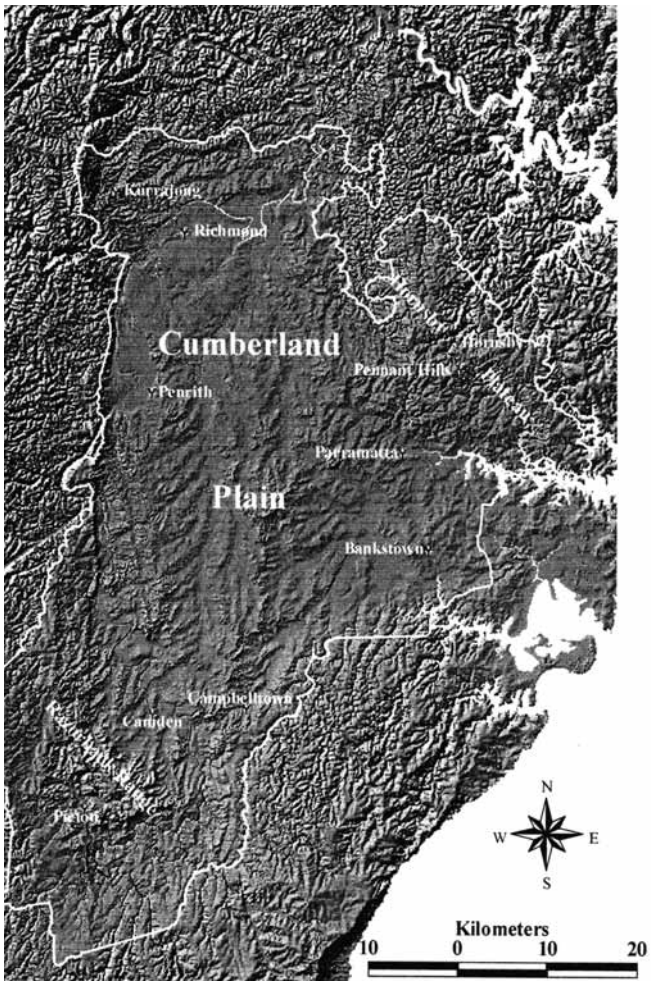

Fig. 1. The location of the study area, showing the physiographic contrast between the Cumberland Plain and the surrounding plateaus of the Sydney Basin.

The Cumberland Plain comprises gently undulating plains and low hills, rising gradually from the flat, low lying areas just above sea level in the north to an altitude of around 350 m on the rolling hills of the Razorback Range in the south. Two low ridgelines project northward from this elevated southern region as far as Mount Druitt and Orchard Hills respectively. The eastern ridge forms a watershed between the drainage channels flowing north to the Hawkesbury River and those draining east into the Georges River. Separating the two ridges is the upper catchment of South Creek, which forms the major drainage channel of the Plain. Rising gradually to the north-west of the Plain, the broadly dissected Hornsby Plateau lies between 100 to 200 m above the northern half of

the Plain. On the Hornsby Plateau, Wianamatta Shale soils are located predominantly along three broad ridgelines running approximately north-west from North Sydney to Hornsby and from Ryde to Castle Hill, and north from Castle Hill to Arcadia. Communities occurring on shale caps on the Blue Mountains and Bell Ranges (west of the study area) were not described in this study.

Geology and soils

The geology and soil landscapes of the study area have been described by Chapman and Murphy (1989), Hazelton et al. (1990) and Bannerman and Hazelton (1990); from which the following description was drawn. The oldest geological units outcropping within the study area are of sedimentary origin and were laid down during the middle Triassic period. Of these, the Wianamatta group is the dominant feature and occurs throughout the Cumberland Plain and on plateau tops and ridges on the Blue Mountains and Hornsby plateaus. It comprises claystone, siltstone, laminite and fine to medium-grained lithic sandstone weathering to low fertility soils ranging in texture from loam to heavy clay. The Wianamatta group conformably overlies the discontinuous Mittagong Formation and Hawkesbury Sandstone. The former comprises inter-bedded and laminated, fine to medium-grained quartz sandstone and siltstone, and constitutes passage beds between the Wianamatta Group and the Hawkesbury Sandstone. Hawkesbury Sandstone weathers to form sandy–loam soils of very low fertility. The Mittagong Formation and Hawkesbury Sandstone outcrop on the margins of the study area especially along watercourses where the overlying shale has eroded during the development of a streambed.

On the Cumberland Plain, the Wianamatta group is overlain by unconsolidated sediments deposited in two geological periods. The deposition and reworking of silty-clayey sands and gravels along watercourses has been ongoing throughout the Quaternary period. These constitute some of the most fertile soils of the Plain and are particularly extensive on the floodplains of the Hawkesbury–Nepean River in the north of the study area. Sediments dating from the Tertiary Period occur in two main localities: to the south of Richmond in the north-west part of the study area and south of Liverpool in the south-east. These comprise sand, clay, gravel and volcanic breccia of both colluvial and alluvial origin and give rise to soils of low fertility. In the vicinity of Agnes Banks tertiary sediments are overlain by low parallel dunes of quartz sand eroded from the upper catchment of the Hawkesbury–Nepean and deposited by wind during the quaternary period. These sandy soils are of very low fertility.

Vegetation and land use

The physiographic division between the Plain and the surrounding plateaus is paralleled by a stark contrast in the composition of native plant communities. The sandstone plateaus support heath, woodland and forest communities characterised by a diverse, sclerophyllous shrub layer and share few species in common with the grassy woodlands of the Cumberland Plain. Variation in the composition of plant communities on the Cumberland Plain was described by Pigeon (1941), who differentiated the *Eucalyptus moluccana – Eucalyptus tereticornis* and the *Eucalyptus saligna – Eucalyptus pilularis* associations along a gradient of increasing rainfall and also noted the occurrence of ecotones between shale and sandstone soils. Building on this work, Phillips (1947) described associations specific to alluvial soils of recent and Tertiary origin. Benson (1992) further elucidated the relationships between vegetation communities and underlying geology and compiled detailed descriptions of the composition and extent (both contemporary and pre-European) of native vegetation of the Penrith 1:100 000 map sheet. Numerous published and unpublished reports describe native vegetation remnants for localities within the Cumberland Plain, including Agnes Banks (Benson 1981) and Bents Basin (Benson et al. 1990). In the most recent comprehensive survey, NPWS (1997) compiled an inventory and description of native vegetation remnants of conservation significance for each local government area in western Sydney. This paper revises an unpublished survey report (NPWS 2000).

As a result of its topographic and geological characteristics, the Cumberland Plain has a much higher capability to support agricultural and urban land use activity than the surrounding plateaus (Bannerman & Hazelton 1990). Agricultural development was under way as early as 1792, by which time some 613 ha of land were under cultivation in the Parramatta–Toongabbie area (Phillip 1978). By 1810, the combined area under cultivation in Parramatta and Hawkesbury had grown to almost 29 000 ha (Bligh & Macquarie 1979), approximately 42% of the present area dedicated to agricultural production (University of Western Sydney 2000). By the mid- nineteenth century the majority of the Cumberland Plain was either under cultivation or subject to grazing. Urban expansion into western Sydney has been ongoing since European settlement, and has accelerated in the second half of the twentieth century (Benson & Howell 1990). In the year 2000, the suburbs of western Sydney held an estimated 20% of the population of NSW and were the predicted centre for 30% of the states future population growth (University of Western Sydney 2000). It is estimated that less than 5% of the pre-European vegetation coverage of the Cumberland Plain remains uncleared (NPWS 1997). In contrast, the vegetation of the surrounding sandstone plateaus is represented in large National Parks including Ku-ring-gai Chase, Blue Mountains and Royal National Parks.

Climate

Topography and distance from the coast are the primary determinants of weather patterns in the study area (Bureau of Meteorology 1979). Average annual rainfall is highest on the coast and decreases steadily inland as a result of moist air streams flowing predominantly from the east (Table 1). West of Parramatta, the majority of the Cumberland Plain receives

less than 800 mm annually. Annual rainfall increases with elevation to approximately 900 mm on the margins of the Plain, and reaches a maximum of 1444 mm at Pymble on the Hornsby Plateau. Seasonal variation in rainfall is highest on the coast with wetter periods occurring in February–March (under the influence of easterly air streams) and June (southerly air streams). Further inland, rainfall is more evenly distributed, although the whole region experiences a relatively dry period in spring.

Table 1. Rainfall, temperature and frost statistics for selected weather stations on the Cumberland Plain and Hornsby Plateau.

B: Bankstown (eastern Plain); **P:** Parramatta (central Plain); **Pic**: Picton (southern Plain); **R:** Richmond (northern Plain); **PH:** Pennant Hills (Hornsby Plateau)

	B	P	Pic	R	PH
Annual Rainfall (mm)	921	922	804	806	1102
Av. min. Temp. July (°C)	3.1	4.6	1.8	3.6	4.6
Av. max.Temp. Jan. (°C)	27.7	28.1	29.5	29.4	27.6
No. days where Temp. >38°C (average/year)	–	–	6.1	9.6	–
Number of severe frost days (average/year)	46	38	133	84	85
Latest recorded severe frost in any year	31 Au	3 Sep	9 Oct	26 Sep	18 Sep

Average maximum temperatures in the hottest month (January) are lowest on the coast due to the frequency of on-shore winds (Table 1). Maximum temperatures increase westward as the influence of these winds dissipates, reaching a maximum on the central Cumberland Plain before decreasing with increasing elevation toward the margins of the Plain. Average minima for the coldest month (July) are highest on the coast and decrease steadily inland away from the moderating influence of the ocean. Temperature extremes occur more frequently with increasing distance from the coast. Frosts also occur more frequently away from the coast and at higher elevations, although the incidence and severity vary considerably over a small scale as a function of topographic, vegetation and soil related factors. Indicative climatic data for selected weather stations on the Cumberland Plain and Hornsby Plateau (Table 1) were sourced from the Bureau of Meteorology (1979).

Methods

The methods used in this study followed the approach used by Keith and Bedward (1999) and comprise the following components: (i) field sampling; (ii) cluster analysis and community classification; (iii) community description; (iv) describing environmental relationships and deriving a spatial model; (v) accuracy assessment; (vi) mapping of woody vegetation; and (vii) map compilation (Figure 2).

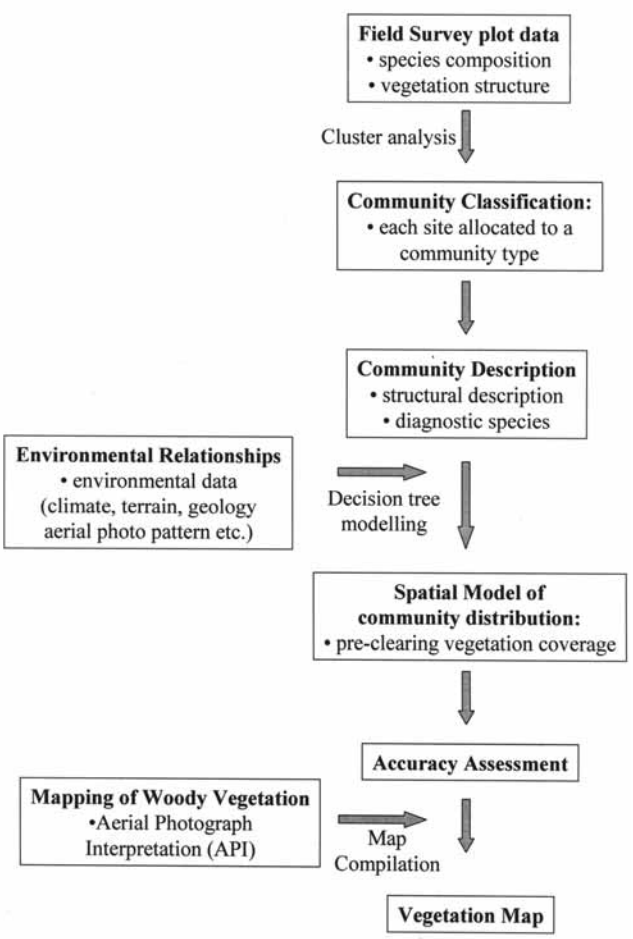

Fig. 2. A summary of the major components of the survey: the sequence in which components were completed is indicated by the arrows.

Field sampling

Survey sites were stratified using factorial combinations of substrate, temperature and rainfall across the study area. Five geological substrates were included: Wianamatta Shale, Holocene alluvium (draining shale soils), Tertiary alluvium, estuarine sediments and aeolian deposits (*sensu* Bannerman & Hazelton 1990). Variation in temperature was characterised using the maximum temperature in the hottest month (January) and simplified into three zones representing ranges 26.1–27.0°C, 27.1–28.0°C, and 28.1–29.0°C. Annual rainfall was divided into four zones representing ranges 701–800 mm; 801–900 mm; 901–1000 mm; and 1001–1100 mm. Some combinations were not represented in the study area and others were poorly sampled due to the small area of remnant vegetation present in those strata.

Field sampling was carried out between October 1998 and September 2000. The vegetation at each survey site was described within a quadrat of area 0.04 ha. Quadrats were marked out using tape measures in an area representative of the surrounding vegetation and as far as possible away from areas of weed infestation or soil disturbance (sites were only located in remnants dominated by native species and highly disturbed or weed infested areas were not sampled). Where

possible, several quadrats were used to sample local variation in slope, aspect and landform (e.g. gullies and ridges). Quadrats were square in shape except where a rectangular configuration was required to ensure homogeneity of terrain and soils across the plot.

All vascular plant species rooted within the quadrat were recorded and assigned a cover/abundance score using a modified Braun-Blanquet scale (Poore 1955) as follows:

1 = rare, few individuals present, cover < 5%;
2 = uncommon & cover < 5%;
3 = common & cover < 5%;
4 = (very abundant & cover < 5%) or (5% ≤ cover < 20%);
5 = (20% ≤ cover <50%);
6 = (50% ≤ cover <75%);
7 = (75% ≤ cover < 100%).

The height range and projected foliage cover were estimated for each of four structural strata (tree, small tree, shrub and forb), where recognisable at the site. A compass and clinometer were used to measure the slope and aspect at the centre of the quadrat, as well as horizon elevations at azimuths of 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°. The location and elevation of the site were determined in the field using 1:25 000 topographic maps and/or a geographic positioning system. The soil type was determined by hand-texturing. Evidence of rock out-cropping, erosion, weed invasion, logging, soil disturbance or recent fire was noted.

Plant species that could not be identified in the field were collected for later identification. Where necessary, collections were compared to specimens held at the National Herbarium of NSW to confirm their identity. Specimens that could not be identified to species level were not included in the analysis. Nomenclature was standardised to follow Harden (1990–1993). In many cases species recognised at the subspecies level were identified only to the species level. Published species lists (Benson et al. 1996, James et al. 1999) were consulted to determine the number of subspecies recorded for the study area. If only one subspecies had been recorded then the subspecific epithet was adopted. If two or more subspecies had been recorded then subspecies were pooled for analysis. The species name used in the community descriptions indicates the taxonomic level used in the analyses. Exotic species were recorded but excluded from classification analysis.

Cluster analysis and community classification

Data analysis was performed on the raw cover/abundance scores using the PATN package (Belbin 1991). Dissimilarity among survey sites was computed using a symmetric form of the Kulczynski coefficient (Faith 1991). Hierarchical agglomerative clustering was performed using a flexible unweighted pair group arithmetic averaging strategy with no adjacency constraint and a BETA value of -0.1. Homogeneity analysis (Bedward et al. 1992) was used to determine the point in the hierarchy at which a decline is observed in the rate of increase in within-group homogeneity yielded by further group subdivision. Visual inspection of the hierarchical dendrogram confirmed the integrity (*sensu* Belbin 1991) of the groups defined at this point, thus amalgamation was not considered. Groups containing clusters of high integrity were identified for possible subdivision. In addition, the preliminary groupings were compared to a previously derived floristic classification for the survey area to identify sub-groups corresponding to previously recognised communities (Benson 1992). Subdivision was carried out by systematically increasing the number of groups across the whole dendrogram. This process was continued only while an increase in the group number lead to the separation of sub-groups of high integrity, and ceased when groups of high integrity became split. When the definition of groups was completed, the analysis was repeated using the Bray-Curtis coefficient of dissimilarity (Clarke 1993) to examine the consistency of the grouping. The classification of each site was compared to that of the five nearest neighbours to check for potential misclassifications. Sites that could not be reliably assigned to a group were omitted.

Community descriptions and field identification

The floristic assemblages derived by cluster analysis were compared to community descriptions contained in recent publications on the vegetation of the survey area (Benson & Howell 1990, Benson 1992, NPWS 1997), as well as descriptions of EECs. Where an assemblage was judged to represent a previously described community, the assemblage was given the name in common use for that community. If an assemblage was judged not to have been previously described then a name was constructed using elements of the vegetation structure, topographical and geological preferences of the assemblage (e.g. Shale Hills Woodland).

Structural descriptions were compiled from the survey site data. The maximum height and projected foliage cover for each stratum were averaged across all sample sites representative of the community. The frequency with which each stratum was encountered in the community was also calculated. Summary statistics (mean, standard deviation and range) for the sample sites were calculated for elevation, slope, annual rainfall, ruggedness (900 m neighbourhood), solar radiation (January) and maximum temperature (January). The frequency with which sample sites were located on different substrates was also calculated.

Lists of diagnostic species were derived for each vegetation community to assist in the identification of communities in the field. Diagnostic species were those with a higher probability of occurring in the target community than expected based on their frequency of occurrence in the data set. For each community, an estimate was made of the minimum number of diagnostic species expected in any sample of the community (95% confidence interval). Using this estimate, map users may confirm (with 95% confidence) the identity of a vegetation community of unknown identity by enumerating the number of diagnostic species occurring in a field sample.

The identification of diagnostic species was based on an adaptation of the method proposed by Bruelheide (2000). A probability threshold was determined by an iterative process in which the underlying distribution was varied to maximise the number of diagnostic species represented in an independent set of samples of known classification. This process identified the hypogeometric distribution with a probability of 0.001 as the optimal threshold. Therefore, species were identified as positive diagnostic if their frequency of occurrence in the target community was higher than their frequency across the whole data set, and less than 0.1% likely to have occurred by chance alone. Species with target community frequency ≥ 0.4 (and not identified as positive diagnostic) were identified as constant species (characteristic of the target class as well as other classes). In order to minimise the inclusion of unreliable species, those with target class frequency < 0.2 and class frequency coefficient of variation > 0.05 were classed uninformative.

The same approach was used to identify exotic species showing an association with particular community types (positive diagnostic species) or frequently occurring across a range of community types (constant species). Patterns in weed invasion and native species diversity within remnants were investigated by correlating counts of exotic/native species in survey sites with remnant size and configuration (perimeter/area ratio) and the position of the survey within the remnant (distance to the remnant edge).

Table 2. Spatial data layers used in modelling the distribution of vegetation communities

Variable	Description
Parent geology	Geological formation responsible for surface soil features
Soil landscape	Integratedsoil/topography classes (Bannerman & Hazelton 1990)
Distance to sandstone (1)	Shortest distance to soils derived from sandstone, Mittagong Formation excluded (metres)
Distance to sandstone (2)	Shortest distance to soils derived from sandstone, Mittagong Formation included (metres)
Distance to coast	Shortest distance the nearest point of the coastline (metres)
Distance to stream	Shortest distance to stream of any size (metres)
Distance to stream (456)	Shortest distance to stream of size order 4 or larger (metres)
Easting	Australian Map Grid Easting, Zone 56
Northing	Australian Map Grid Northing, Zone 56
Elevation	Elevation above sea level (metres)
Aspect	Deviation from grid north of the horizontal component of the slope vector
Slope	Inclination from horizontal (degrees)
Topographic position	A measure of the position of each grid cell on a continuum between ridge (value = 100) and gully (value = 0) (after Skidmore 1990)
Annual rainfall	Annual Rainfall (mm)
Wetness	Continuous index representing the volume of water draining to a given location (after Moore et al. 1993)
Ruggedness (900 m)	Standard deviation of elevation of cells within a neighbourhood of 900 by 900 metres
Ruggedness (700 m)	Standard deviation of elevation of cells within a neighbourhood of 700 by 700 metres
Ruggedness (500 m)	Standard deviation of elevation of cells within a neighbourhood of 500 by 500 metres
Ruggedness (300 m)	Standard deviation of elevation of cells within a neighbourhood of 300 by 300 metres
Ruggedness (100 m)	Standard deviation of elevation of cells within a neighbourhood of 100 by 100 metres
Terrain (900 m)	Difference in elevation between an individual cell and the mean elevation of cells in the surrounding neighbourhood of 900 by 900 metres
Terrain (700 m)	Difference in elevation between an individual cell and the mean elevation of cells in the surrounding neighbourhood of 700 by 700 metres
Terrain (500 m)	Difference in elevation between an individual cell and the mean elevation of cells in the surrounding neighbourhood of 500 by 500 metres
Terrain (300 m)	Difference in elevation between an individual cell and the mean elevation of cells in the surrounding neighbourhood of 300 by 300 metres
Terrain (100 m)	Difference in elevation between an individual cell and the mean elevation of cells in the surrounding neighbourhood of 100 by 100 metres
Minimum temp. (July)	Minimum temperature for the coldest month of the year (July) (^oC)
Maximum temp. (January)	Maximum temperature for the hottest month of the year (January) (^oC)
Solar radiation (July)	Solar Radiation received in the coldest month (July) corrected for terrain and rainfall (Megajoules.metres^{-2}.Day^{-1})
Solar radiation (January)	Solar Radiation received in the hottest month (January) corrected for terrain and rainfall (Megajoules.metres^{-2}.Day^{-1})

Environmental relationships

A range of spatial data layers was used to explore relationships between vegetation composition and the environment as a basis for spatial modelling (Table 2). These data were derived and/or manipulated in a digital format using a Geographic Information System (GIS). Parent geology was obtained from published geology and soil landscape maps (Walker 1960, Chapman & Murphy 1989, Bannerman & Hazelton 1990, Hazelton et al. 1990) and used to derive variables representing gradients in soil

characteristics. The location and size of drainage channels (stream order) was estimated by computing flow direction and accumulation from a 5 m grid digital elevation model. Terrain variables ('ruggedness' and 'terrain') were derived from a 25 m grid digital elevation model (Table 2). Climatic variables (rainfall, temperature and solar radiation) were derived from the digital elevation model using ESOCLIM (Hutchinson 1989).

Correlations between floristic composition and environmental variables were explored using hybrid multi-dimensional scaling and principal axis correlation (Belbin 1991). Ordination was performed on a dissimilarity matrix calculated using the symmetric form of the Kulczynski coefficient. Solutions were calculated in 5 and 6 dimensions from 10 random starting configurations and a maximum of 50 iterations. The procedure was terminated if successive iterations produced an improvement in stress of less than 0.005. The choice of solution dimension was designed to minimise stress in the resulting solution and maximise the chances of revealing complex, fine scale correlations in the data, while maintaining computing time at an acceptable level. Ratio regression was applied below ratio/ordinal cut values of 0.9, 0.2 and 0. By reducing the ratio/ordinal cut it was hoped that the solution stress could be further reduced (a non-metric solution was not expected to deteriorate rank correlation in the fitted vectors). The importance of the two ordinal variables (geology and its derivative soil landscapes) could be assumed *a priori* (Benson 1992), thus no attempt was made to correlate them. Principal axis correlation was performed using environmental data derived from the digital data layers in preference to using field data. Variables were ranked in order of correlation and used preferentially in subsequent modelling of community distributions.

Spatial modelling of communities

Spatial interpolation of ecological communities was carried out using a hybrid decision tree/expert system technique developed by Keith and Bedward (1999). This technique utilises purpose-built software (ALBERO) to develop decision rules that quantify the environmental envelope(s) occupied by each community. At each node in the decision tree ALBERO provides a list of variables which could be used to discriminate communities. The variables are selected on the basis of Chi-squared statistics. The level of significance for the test ($p < 0.05$ in this case) and the variable upon which the split is performed are chosen by the user. This technique was used in modelling 79 floristic assemblages in the South East Forests Region of NSW (see Keith & Bedward 1999 for further details).

Decision tree models have the disadvantage of sample numbers diminishing with each successive split in the tree. As a result, split thresholds may be influenced by the position in the tree at which the split is made. Furthermore, diminishing sample numbers can render modelling impossible in areas with inadequate sampling. Several strategies were used to minimise the effects of this limitation. Variables highly correlated with floristic patterns were used preferentially in building the decision tree. Other variables were used sparingly, and only where there was an ecologically intuitive reason for doing so (i.e. splits were not determined on statistical significance alone). Variables describing small-scale gradients were fitted before variables describing gradients across the whole study area. This allowed the exploration of complex patterns using the maximum number of samples. Once this had been achieved the decision tree could be rebuilt commencing with large-scale variables, a conceptually easier task, and where appropriate, the splitting of small-scale variables further along the tree could then be forced to comply with decisions derived using larger sample sizes. Often when a split was made using a large-scale variable, further splits on the same variable were pursued in consecutive nodes. In general, variables yielding splits that isolated small numbers of communities were pursued in preference to variables that split communities evenly. Terminal nodes were assigned to the community represented by the most samples.

A purpose-built mapping program (ALBERO Mapper) was used to compile a 25 m grid coverage from the decision rules and GIS data layers. The development of the coverage was iterative. For each rule set the modelled distribution of each community was assessed through comparisons with the distribution of the sample sites and descriptions of distributions contained in field notes and published reports. Where discrepancies were apparent the decision rules were de-constructed and reapplied as sub-rules to identify the section of the tree responsible. The decision rules were changed if inconsistencies in the construction of the decision tree were identified (e.g. in the way a community was modelled in different branches of the tree). Due to the highly fragmented nature of much of the survey area, parts of the environmental domain could not be sampled. Decision rules were modified to extend the range of some communities based on the interpretation of historical records (Benson 1992, Benson & Howell 1990). The final coverage was smoothed using a majority filter operating over a radius of 50 m.

Accuracy assessment

The accuracy of the community distribution model was assessed using a sample of 80 sites withheld from the modelling process to form a set of independent observations with which the accuracy of model predictions could be tested. Approximately 10% of sites representing each vegetation class were selected randomly for accuracy assessment, with the exception of communities 5, 8 and 34 for which too few samples were available. Accuracy was conceived as a function of the spatial proximity between independent sites of known classification and predicted occurrence of the same class. Therefore, the degree to which model predictions conformed to independent observations was calculated within concentric, circular neighbourhoods of radii increasing from zero to 1000 m in 100 m intervals. Two measures of accuracy were calculated for each neighbourhood size: (i) the

percentage of sites for which the site class was predicted to occur within the neighbourhood; and (ii) the proportion of the neighbourhood for which the site class was predicted to occur. The first measure estimates the likelihood of finding an example of the predicted vegetation type within an increasing neighbourhood size around the point for which the prediction is made. The second measure estimates how common the predicted vegetation type is within the site neighbourhood. This measure is subject to the limitation that a uniform distribution of a vegetation class can not be implied beyond a neighbourhood range of approximately 100 m from a site, therefore there is no expectation that the community may occur beyond this range. Therefore, the second measure was calculated for a 100 m neighbourhood radius only.

The extent to which field survey sites sampled environmental gradients was assessed by estimating environmental redundancy (Faith 1996) for cells in a 25 m grid covering the study area. A p-median calculation was used as an estimate of the environmental diversity represented by sites in multi-dimensional space. Using the existing field sites as a basis for comparison, the change in p-median following the addition of new sites was calculated as a measure of the redundancy of each potential new site. The calculation was performed for each of 10 000 new sites located randomly within the study area and the results were subjected to a spatial interpolation. Values in the resulting grid varied within a range determined by the most and least redundant sites within the random sample. Assuming that 10 000 sites (approximately 20 times as many as actually sampled) were sufficient to sample environmental diversity within the study area, areas of low redundancy represent gaps in the sample coverage.

Two analyses were completed to assess the adequacy of the sample coverage. In the first analysis environmental diversity was represented by the 3 variables used to stratify field sampling (geology, rainfall and temperature) in order to gauge how well the field survey strategy was executed. The second analysis tested sampling adequacy across environmental gradients that were identified by gradient analysis as highly correlated with floristic variation (Table 3). Environmental diversity was represented by geology, rainfall, temperature, elevation, solar radiation index for July, maximum temperature (January), minimum temperature (July), ruggedness (700 m domain) and slope.

Mapping of woody vegetation

Aerial photograph interpretation (API) was carried out by an independent consultant (Roberts 1999) to determine the extent of remnant woody vegetation. Colour aerial photographs captured at an approximate scale of 1:16 000 were obtained from QUASCO NSW and interpreted stereoscopically by a single observer in conjunction with extensive ground traverses (flown 25/11/97–11/3/98; film nos 3171c, 3172c, 3173c, 3174c, 3175, 3193c, 3194c, 3199c, 3200c; runs 19, 20–23w, 24–27w, 24–27e, 28–30, 31w, 31e, 32–45, 46w, 47–55). Areas with no tree or shrub cover were excluded from analysis. The remaining area was divided into 6 classes on the basis of projected *Eucalyptus* crown cover and land use: A (crown cover ≥10%); B (crown cover < 10%, low intensity agricultural (grazing) activity or no activity); C (no *Eucalyptus* crown cover, low intensity agricultural (grazing) activity or no activity); Tx (crown cover < 10%, high intensity agricultural activity such as cultivation, intensive stocking); TXR (crown cover < 10%, rural residential development); and TXU (crown cover < 10%, urban development). The minimum polygon size delineated for polygon classes A and B was 0.5 and 5 ha, respectively. The delineation of the remaining classes was subjective by nature therefore no minimum polygon size was specified.

The range of API crown cover classes sampled by the survey sites was determined in order to identify the subset of API crown cover classes most closely approximating the extent of remnant native vegetation (i.e. those dominated by a diversity of native species). Associations between structural features mapped by API and vegetation communities were identified using survey quadrat data, general field observations and features such as the shape and position of the structural unit in the landscape. The spatial distribution of each crown cover class was also compared with vegetation maps for the Sydney (Benson & Howell (1994a), Penrith (Benson 1992) and Wollongong (Benson & Howell 1994b) 1:100 000 map sheets.

Map compilation

A map of extant native vegetation was compiled using a geographic information system (GIS) to cut the community distribution model based on information acquired by aerial photograph interpretation. The distribution model was then further refined using a map of canopy species composition, which was derived by API using patterns in texture, structure and colour to interpolate field observations. Polygons for which the canopy composition (determined by API modelling) was not consistent with the community classification (determined by spatial modelling) were assessed to determine if a change in community classification was warranted. Inconsistency was defined as a canopy composition type that was not recorded in field survey samples representing the mapped community type, and indicated that either the spatial model or the API model (or both) was in error. The modelled community classification was retained if it was verified by the presence of field survey sites of the same classification or other field observations in the area. The community classification was changed where it could be demonstrated that the presence of an alternative community was likely, provided that survey sites for the alternative community contained the species listed in the API canopy composition class. API was used extensively to map the distribution of distinctive communities not dominated by *Eucalyptus* species (e.g. *Casuarina* spp., *Melaleuca* spp., mangroves, saltmarsh, freshwater wetlands, swamps, sedgeland).

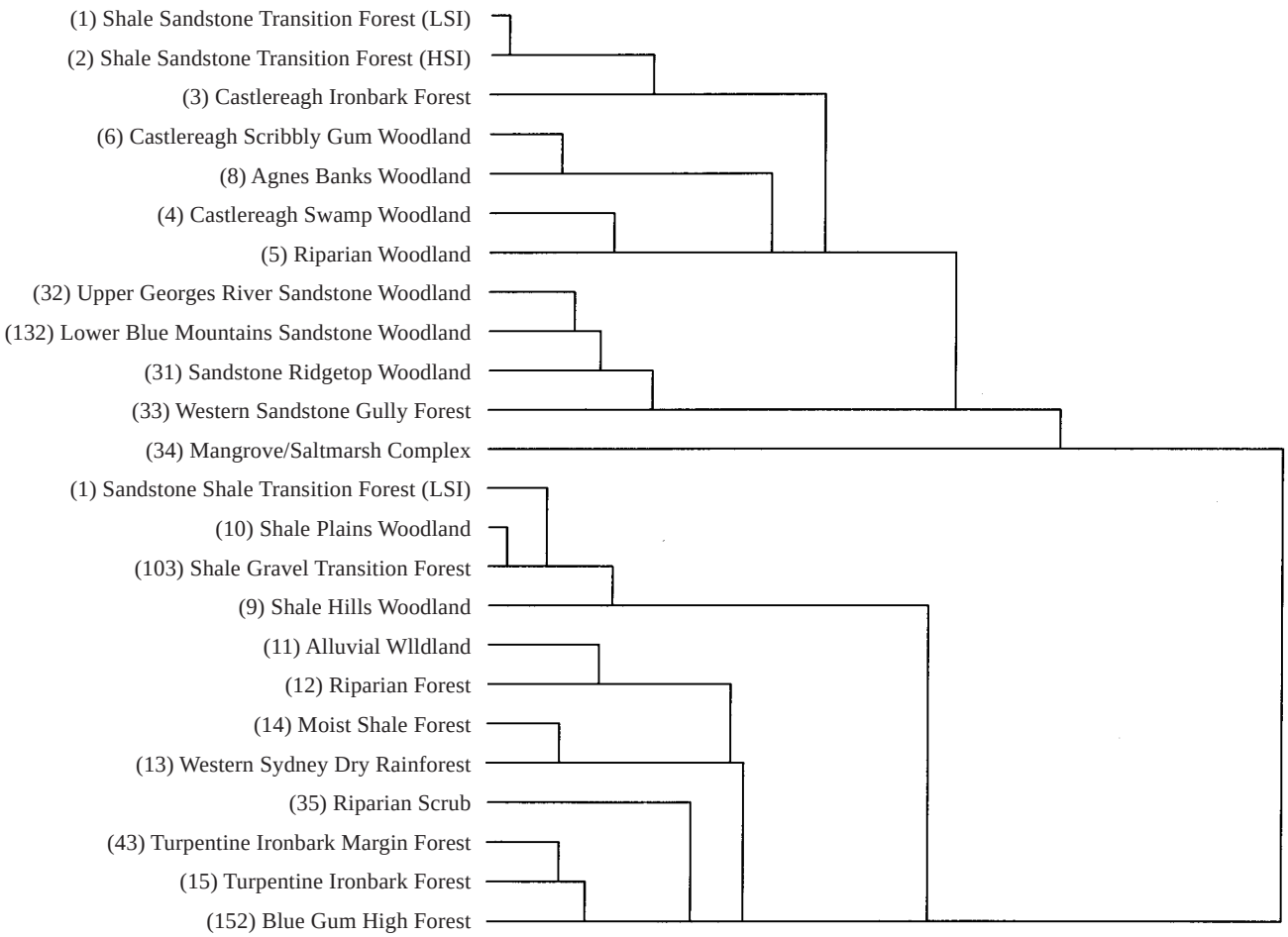

Fig. 3. Dendrogram showing the hierarchical relationship between vegetation communities.

Following the completion of changes suggested by structural features mapped by API, the map was examined to identify anomalies in the distribution of vegetation communities with respect to the location of field survey sites or other field observations. At this stage the map was assessed by independent botanists for consideration of further changes based on expert opinion.

The degree to which observer bias (Roberts 1999) may influence estimates of remaining vegetation cover was assessed by using an independent interpreter to repeat the procedure for a small section (8836 ha) of the study area. The range of observer bias was calculated as the difference between the areas represented by the union and intersection of the two observers' outputs. Based on an assumption that the range magnitude is proportional to the perimeter of remnants, the average area of disagreement was calculated by dividing the range by the length of the perimeter of remnant vegetation in the section used for comparison. This figure was used to calculate the potential range for estimates of the area extant for each vegetation community by multiplying by the length of perimeter over which the community boundary coincided with a remnant boundary. Range estimates were thus based on the assumption that the observer differences measured in a subset of the study area would apply to all communities throughout the study area.

Results

Classification

Cluster analysis of 652 sample sites resolved a hierarchical classification of 24 communities (Figure 3) occurring on or adjoining the Cumberland Plain, including seven communities occurring on soils derived from Wianamatta Shale, four on Tertiary alluvium, three on quaternary alluvium, five on sandstone, one each on estuarine sediments and aeolian sand deposits and three restricted to areas transitional between shale and sandstone soils. The principal dichotomy in the hierarchy was between sites located on sandy soils from those located on clay-loam soils derived from shale or alluvium (Figure 3). One community (Map Unit 1; Sandstone shale transition forest (Low sandstone influence)) was represented in the dendrogram by a cluster on each side of the shale/sandstone dichotomy, reflecting the transitional nature of soils at those sample sites. Repeated clustering using different association measures (Kulczynski v. Bray-Curtis) and various subsets of the data demonstrated that the location of the second cluster was unstable: it would often join with the first cluster in the top half of the dendrogram. Similar behaviour was observed for the cluster representing Map Unit 103 (Shale Gravel Transition Forest). This cluster joined

alternately with Map Units 3 (Castlereagh Ironbark Forest) and 10 (Shale Plains Woodland), which was again a reflection of the transitional nature of the soils at the sample sites. Freshwater wetlands were not sampled in this survey, but are recognised as a unique floristic assemblage and mapped using aerial photograph interpretation. Full descriptions of the structure, physical habitat and lists of characteristic species are present for each community in Appendix 1. Diagnostic species are listed in alphabetical order within broadly defined growth forms.

Species richness

A total of 1195 species (975 native and 220 exotic) were recorded in 652 survey sites. With sites representing sandstone communities excluded, some 831 native species were recorded for the Cumberland Plain. This figure is close to the estimate of a flora of 800 species made by James et al. (1999). Forty-six percent of native species were recorded five times or less, while 22% were recorded in one sample only. Species richness varied considerably between communities from an average of 6.3 (±7.5) taxa per plot recorded for Map Unit 34 (Mangrove/Saltmarsh Complex) to 53.1 (±8.2) taxa per plot recorded on average in Sandstone Ridgetop Woodland (Appendix 1). Species richness tended to increase along a continuum from the central Cumberland Plain to the margins. Communities on shale derived soils generally recorded fewer species per sample than shale/sandstone transitional areas, which in turn had fewer species than communities on sandstone. Species richness in communities on alluvial soils on the Cumberland Plain tended to be slightly lower than in the surrounding shale communities. Communities on Tertiary alluvium were intermediate in species richness, with more species recorded on sandy soils than clay/loam soils.

The highest number of species recorded in any assemblage was 379, in Map Unit 2 (Shale Sandstone Transition Forest (High sandstone influence)). This assemblage also contained a large number of species (15) not recorded in other communities. All communities contained species not recorded in other communities (Appendix 1). Communities with very low numbers of unique species were Shale Gravel Transition Forest (Map Unit 103) (1 species), Agnes Banks Woodland (Map Unit 8) (1 species) and Castlereagh Ironbark Forest (Map Unit 3) (4 species). The number of taxa recorded in each community is likely to be related to sampling intensity. For example, Agnes Banks Woodland (Map Unit 8) was sampled at only 2 sites, and only 52 species were recorded. The actual number of taxa represented in this community is likely to be considerably higher (see Benson 1981, 1992). There was a weak inverse correlation between the number of native species recorded at a survey site and the ratio of perimeter to area for the remnant in which the site was located (R = -0.35, p < 0.001). The number of species recorded was positively correlated with remnant size (R = 0.42, p <0.001), however some sites located in small remnants contained as many species as those in larger remnants.

A total of 220 exotic species was recorded in the survey however this number is likely to be an underestimate of the introduced flora because highly disturbed and weed infested areas were avoided when selecting sites for survey. Exotic species were most common at sites with alluvial soil and least common at sites with soil derived from sandstone or Tertiary alluvium. Exotic species were also common on soils derived from Wianamatta Shale. Nine species were recorded in more than 20% of all sample sites. These species were: *Senecio madagascarensis* (52%), *Cirsium vulgare* (34%), *Hypochaeris radicata* (32%), *Olea europea* subsp. *africana* (27%), *Setaria gracilis* (26%), *Plantago lanceolata* (26%), *Sida rhombifolia* (25%), *Myrsiphyllum asparagoides* (22%), and *Sonchus oleraceus* (22%).

One hundred and nine exotic species showed an association with particular communities, while a further 69 occurred at high frequency across a wide range of communities (Appendix 1). The number of weeds recorded in a survey site was correlated with the perimeter to area ratio for the remnant in which it was located (R = 0.47, p <0.001). There was also a weak inverse correlation between the number of exotic species recorded and the distance at which the survey site was located from the edge of the remnant (R = -0.29, p < 0.001). The relatively low R value reflected the fact that while sites located at greater distances from the remnant edge rarely contained many exotic species, those close to the edge were equally likely to contain large or small numbers.

Field identification of communities

Appendix 1 contains a list of diagnostic species for each community and an outline of the procedure for community identification. Diagnostic species are sorted into two fidelity classes: (i) positive (the species occurs more frequently in the target group than in all survey sites combined); and (ii) constant (the species occurs frequently in the target group and other groups, and is therefore characteristic rather than diagnostic of the target group. Fidelity classes are a measure of the relative likelihood that a species will be recorded in a 0.04 ha sample plot randomly located in the vegetation community. Therefore, obtaining such a sample is a pre-requisite for the use of diagnostic species. The number of positive diagnostic species present in a sample can be used to identify the community type by ruling out all but a few feasible alternatives. For each community type a minimum expected number of positive diagnostic species has been calculated. The presence of the minimum number of species in a sample is strong evidence that the sample belongs to the vegetation community. This assumes that all vascular plant species occurring in the sample area were correctly identified and the total number of species recorded in the sample exceeds a specified minimum (species-poor sites can not be tested).

The presence of fewer than the minimum expected number of diagnostic species may be considered evidence that the sample does not belong to the community type under consideration. In such cases there is a 5% chance of error

(i.e. if the sample does, in fact, belong to that community type then there is a 5% chance that it will nevertheless contain fewer than the minimum expected number of diagnostic species).

In addition to the 'true' community, a sample may contain the minimum expected number of diagnostic species for 1–5 other communities (average 1.25). In most cases, sites contain the minimum number of species for communities closely related to the 'true' community. For example, Shale Plains Woodland (Map Unit 10) grades into Map Units 1, 2, 9, 11 and 103. Sites located in Shale Plains Woodland frequently contain the minimum number of positive diagnostic species for one or more of these communities. In such cases the number of species by which the minimum was exceeded may be used to assess the closeness of the match to each of the possible candidates.

Correlation with environmental variables

Reducing the ratio/ordinal cut values from 0.9 to 0.2 resulted in a marked improvement in stress for ordination solutions in both five and six dimensions. No further improvement in stress resulted when the cut was reduced from 0.2 to 0.0; thus both solutions were equally acceptable. The 6 dimensional solution calculated with a ratio/ordinal cut of 0.0 was used for correlation with environmental variables.

Variables likely to influence floristic composition at a local scale were most strongly correlated with floristic patterns among sites on the Cumberland Plain (Table 3). These include ruggedness (all neighbourhood sizes), slope and solar radiation, which are also expected to correlate strongly with each other given the influence of topography on exposure to solar radiation. Variables such as maximum temperature (January) and annual rainfall that represent patterns in floristic composition at a regional scale were also strongly correlated. Elevation was strongly correlated in the ordination space, but topographic position and terrain (all neighbourhood sizes), which describe the relative position on localised elevation gradients, were less strongly correlated. This suggests that variation in elevation correlates most strongly with floristic patterns at a regional scale. Despite the strong correlation with solar radiation, aspect was not correlated in the ordination space. Large discrepancies were observed between aspect measured in the field and aspect derived from the digital elevation model, which suggests that the elevation model may be insensitive to variation in aspect at a fine scale.

Distribution modelling

A total of 232 rules applying to 27 variables were constructed to estimate the pre-European spatial extent of ecological communities. The final rule set represents a complete revision of an earlier version (NPWS 2000) and incorporated 105 additional field survey sites. Refinements to the rule set have been carried out through approximately 17 iterations.

Each rule defined a subset of the spatial extent of a community by specifying the environmental conditions within which the community was predicted to occur. For example, the following conditions constitute a rule defining a subset of the spatial extent of Western Sydney Dry Rainforest:

Geology = Wianamatta Shale AND Distance to the shale/sandstone Boundary > 1.7 km AND Elevation > 163 m AND Distance to a stream < 60 m AND Slope > 18°.

Table 3. Rank correlation of variables in an ordination space of six dimensions

Variable	Correlation	Scale of influence
Ruggedness (700 m)	0.708	Local
Ruggedness (500 m)	0.701	Local
Ruggedness (900 m)	0.699	Local
Ruggedness (300 m)	0.665	Local
Ruggedness (100 m)	0.651	Local
Slope	0.635	Local
Elevation	0.619	Regional (Local?)
Solar radiation (January)	0.580	Local
Maximum temperature (January)	0.527	Regional
Annual rainfall	0.518	Regional
Distance to sandstone	0.516	Local (Regional?)
Wetness	0.469	Local
Minimum temperature (July)	0.421	Regional
Distance to stream	0.401	Local
Topographic position	0.380	Local
Terrain (900 m)	0.355	Local
Terrain (700 m)	0.351	Local
Terrain (500 m)	0.342	Local
Solar radiation (July)	0.329	Local
Terrain (300 m)	0.306	Local
Distance to coast	0.260	Regional
Terrain (100 m)	0.150	Local

Rules contained between 2 and 14 conditions. The number of rules required to define the full extent of each community varied from 1 (Mangrove/Saltmarsh Complex and Agnes Banks Woodland) to 32 (Cumberland Plain Woodland). The number of rules compiled per community was strongly correlated with the number of field samples representative of that community ($R = 0.8$, $p < 0.001$). This relationship is partly explained by the fact that some communities were strongly associated with geological substrates of limited distribution (and hence were allocated a small number of samples). The distributions of some of these communities were easy to model with a small number of rules. However, in other cases small numbers of samples precluded the compilation of multiple rules because insufficient replicates were available for reliable choices to be made at multiple nodes in the tree. This reduced the extent to which interactions between variables could be explored in explaining community distribution.

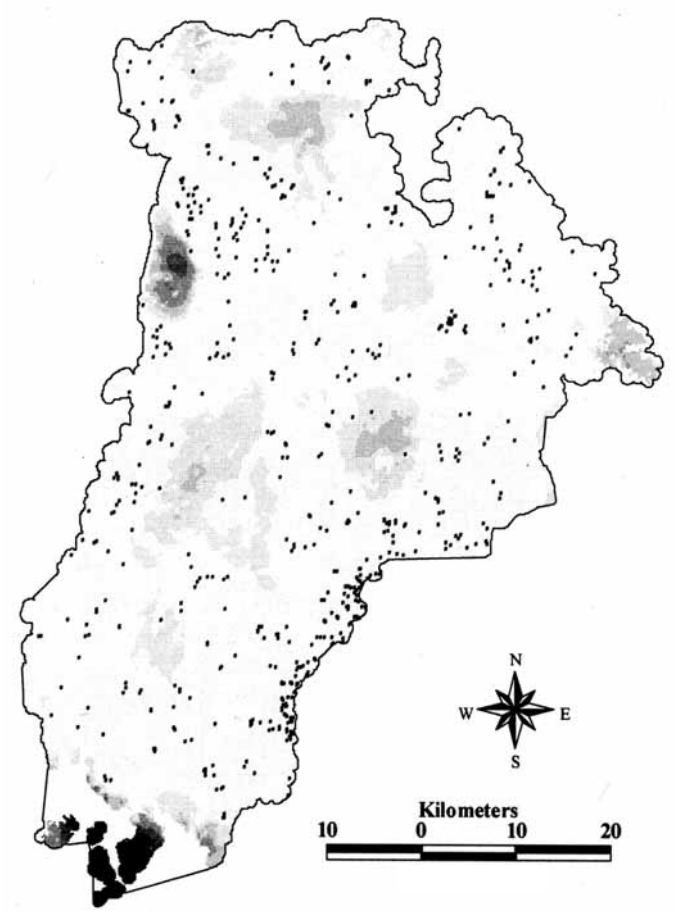

Fig. 4. The location of field sample sites (filled circles) and the intensity with which environmental strata were sampled. Darker shading indicates lower sampling intensity.

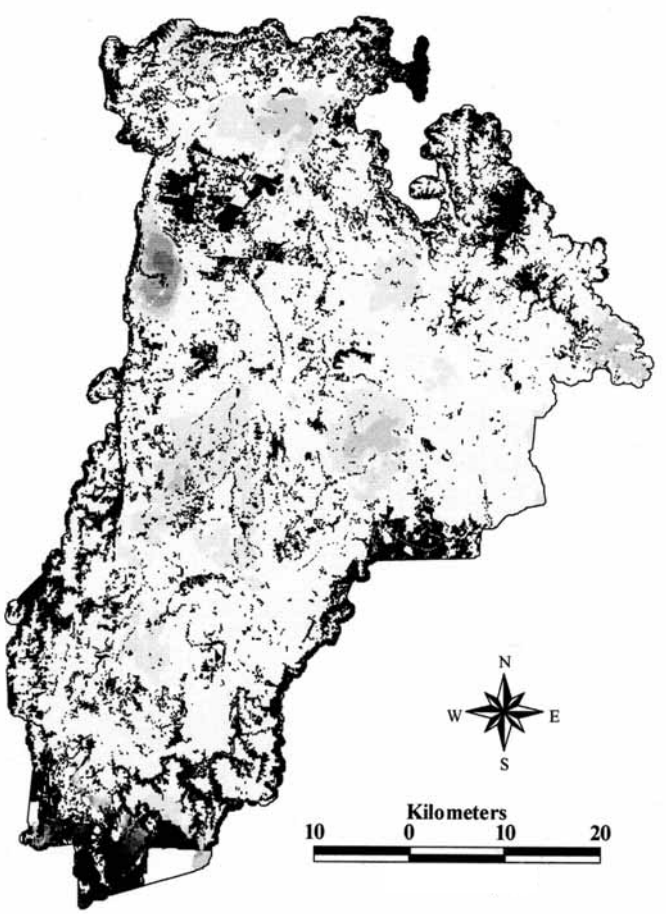

Fig. 5. The location of remnant native vegetation (shaded black) in relation to sampling intensity. Background shading indicates sampling intensity as shown in Figure 4.

The most frequently used variables in the rule set were geology, elevation and distance to stream (Table 4). The primary node of the tree split samples into five geological classes: Wianamatta Shale, Holocene alluvium, Tertiary alluvium, Estuarine sediments and Aeolian Deposits. Higher order splits within shale sites were predominantly based on rainfall and elevation, with slope, aspect and terrain used frequently in lower order splits. Distance to streams, distance to sandstone and distance to Tertiary alluvium were used extensively to model community distribution in areas of transition between substrates. Communities on Tertiary alluvium were split on the basis elevation, slope and ruggedness, with distance to streams and shale soils also used extensively. Distance to streams was used to model the distribution of riparian communities beyond the mapped distribution of alluvial soils. Riparian Woodland was represented by too few samples for modelling and none is represented in the distribution map. However, Riparian Woodland may be assumed to be present along at least the higher order streams in areas mapped as Map Unit 11 (Alluvial Woodland). The extent of Freshwater Wetlands (Map Unit 36) was represented by the mapped distribution of the Bakers Lagoon soil landscape (Bannerman & Hazelton 1990) consistent with the interpretation of Benson (1992). Additional wetlands were added using API.

Model evaluation

Model accuracy statistics are the percentage of independent survey sites for which the model accurately predicted the occurrence of a vegetation community within a given radius of the site. Accuracy ranged from 50 % at the point scale (zero radius) to 98% at a radius of 700 m. At a radius of 100 m (the estimated error in determining the site's true position) the model was accurate in 74% of sites, while an average of 44% of the neighbourhood was predicted to contain the correct vegetation community. Ninety-five percent accuracy was achieved within a 500 m radius. Therefore, a minimum polygon size of 79 ha is required to ensure a 95% chance that a selected area will contain the predicted community type. By comparison, some 2890 of the mapped polygons (97% of all polygons, 52% of extant vegetation) are less than 79 ha in area. Furthermore, 1530 of polygons (51% of all polygons, 6% of extant vegetation) are less than 3.14 ha in area, at which scale 74% accuracy is expected.

Limited conclusions can be drawn about the accuracy with which individual communities were modelled due to the small number of sites that could be spared for accuracy assessment. Based on a limited sample, most communities were modelled with acceptable accuracy at a scale of 500 m. Communities that appear to have been mapped less accurately include 3, 6 and 103. For most communities the correct

community type was the most frequent community type predicted to occur within the neighbourhood.

Table 4. The number of times variables were used in a total set of 94 decision rules.

Variable	Number of rules
Geology	29
Elevation	25
Distance to stream (any order)	25
Distance to shale	14
Annual rainfall	13
Northing	12
Slope	11
Distance to sandstone (2)	11
Easting	11
Ruggedness (700 m)	9
Distance to Tertiary alluvium	9
Aspect	9
Ruggedness (900 m)	7
Terrain (900 m)	6
Topographic position	6
Soil landscape	4
Distance to sandstone (1)	4
Terrain (700 m)	4
Distance to stream (order 5,6 or 7)	2
Solar radiation (January)	2
Ruggedness (500 m)	2
Terrain (300 m)	2
Maximum temperature (July)	1
Ruggedness (300 m)	1
Distance to coast	1
Distance to stream (order 1)	1
Terrain (100 m)	1

The density of field survey sites was approximately 0.2 sites/km^2 across the study area as a whole and 0.7 sites/km^2 of extant vegetation. Samples were distributed relatively evenly among soil substrates and across environmental gradients, although some gaps in the sample coverage were evident (Figure 4). Sampling of the major alluvial deposits of the Hawkesbury–Nepean floodplains was inevitably inadequate due to the scarcity of remnant native vegetation on this substrate (Figure 5). Other gaps were associated with a lower intensity of sampling at the northern and southern extremities of the study area, coincident with extremes of temperature and annual rainfall. These include a combination of relatively high rainfall and summer temperature maxima at higher elevations to the east of Kurrajong compared with lower summer temperatures combined with higher rainfall in the vicinity of Bargo. Areas in the eastern extremity of the study area experiencing a combination of high rainfall, cooler summer maxima and warmer winter maxima were also poorly sampled, but are largely devoid of native vegetation. Some central sections of the study area were also identified as areas warranting further sampling (Figure 4). While sampling in these areas was obviously deficient it is not clear what environmental strata are under-represented.

Table 5. Distribution of study area and survey sites among Aerial Photograph Interpretation classes.

Polygon Class	Area(ha) (% study area)		No. Sites (%)	
A	47887	(14.3)	486	(77.1)
B	26867	(8.0)	65	(10.3)
C	4998	(1.5)	15	(2.4)
TX	24042	(7.2)	39	(6.2)
TXR	10519	(3.1)	10	(1.6)
TXU	13079	(3.9)	11	(1.7)
X	206608	(61.9)	4	(0.6)

Mapping of woody vegetation

Aerial photograph interpretation (API) was carried out over an area of approximately 334 000 ha. Most of this area is devoid of tree cover (Table 5) and only 47 887 ha (14.3%) supports *Eucalyptus* species with cover greater than 10% (class A polygons). Field survey sites were most frequently located in polygons of class A (Table 5), although sites were located in all classes, including 60 sites (10%) in polygons delineating scattered tree cover (TX, TXU, TXR) and 4 sites (0.6%) in polygons devoid of tree cover. This suggests that while most remnant woody vegetation is represented by classes A and B, these classes do not represent the full extent of native vegetation. This conclusion is supported by a comparison with other vegetation maps within the study area. For example, remnant vegetation mapped by Benson (1992) is concentrated in (and evenly distributed between) polygons of classes A and B, but 11% of the area is located in polygons delineating scattered tree cover (TX, TXU, TXR) or polygons devoid of tree cover.

The current extent of woody native vegetation was best represented by polygons of classes A and B combined with a relatively small area mapped with non-*Eucalyptus* canopy cover (class C). The estimated extent of each community prior to clearing and the area extant at the end of 1997 is given in Table 6. Communities occurring on land with a high capacity to support agricultural and urban development have been most extensively cleared. Turpentine–Ironbark Forest (1.4 $\pm$ 0.3% extant) and Blue Gum High Forest (4.5 $\pm$0.8% extant) were the most heavily cleared of all communities. These forests occur in the higher rainfall zone on the east of the study area and were harvested for timber and cleared for market gardens and orchards. Most of the original distribution of these communities has been subjected to urban development, with the exception of parts of the broad Castle Hill–Arcadia ridgeline. On the margins of the plateaus where the shale soils become shallow, clearing has been slightly less severe, with 7.3 $\pm$1.4% of Turpentine–Ironbark Margin Forest remaining.

On the Cumberland Plain, only 7.7 $\pm$1.1% of Shale Plains Woodland is estimated to remain. This proportion increases with increasing sandstone influence in the soil to 26.8 $\pm$2.8%

Table 7. The percentage of field samples in each overstorey canopy type as determined by aerial photograph interpretation.

Typical Soil type:	Sandstone				Sandstone/shale			Shale					Recent alluvium			Tertiary alluvium				Sand
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**
Overstorey species (determined by API)																				
Tristaniopsis laurina, Casuarina spp.	25	2																		
Eucalyptus pilularis	25	49	11	7	7															
E. deanii, E. saligna		8			20		3			28										
E. saligna, E. pilularis, E. paniculata, E. globoidea		2								22										
E. piperita	25	4								17										
E. piperita, E. deanii		4								6										
E. gummifera, E. oblonga, E. sieberi, E. piperita		16	42	19		5														
E. sclerophylla/E. racemosa/E. haemastoma			11																	
E. piperita, E. punctata					7															
E. pilularis, E. punctata	25	10	5	12	13	9	3													
E. punctata		4	26	49	20	50	38	3		22	11		13			5				
E. sclerophylla			5	7		4										5	5	17	40	
E. sclerophylla, Angophora bakeri, Banksia serrata																	5			50
E. moluccana, E. tereticornis				5	7	7	32	64	78		56	63	34	100	14	40	5	33		
E. maculata				2		13	9	4	2		22	25								
E. beyeriana/E. crebra						4	3	18	15			13	3			15				
Syncarpia glomulifera, E. paniculata					7					6							9			
E. fibrosa						5	12									10	5			
E. fibrosa, E. crebra						4		10								25	18	17		
A. subvelotina, E. amplifolia,E. tereticornis								3	5				47							
E. benthamii															14					
E. botryoides															29					
E. baueriana, E. elata													3		43					
E. elata											11									
E. amplifolia, E. parramattensis																		33		
E. resinifera					20															
E. fibrosa, Melaleuca spp.																	50		4	
E. sclerophylla, E. fibrosa																	5		12	
E. parramattensis																			12	
E. parramattensis, E. sclerophylla																			32	50

Table 6. Estimates of contemporary (Nov. 1998) and pre–European extent of native vegetation communities on the Cumberland Plain. No estimates were made for Riparian Woodland (Map Unit 5).

Assemblage	Map Unit	Pre–European Extent (ha)	1997 Extent (ha) (± range)	1997 Extent (%) (± range)
Shale/Sandstone Transition Forest (Low Sandstone Influence)	1	12 834	1 243 (±173)	9.7 (±1.3)
Shale/Sandstone Transition Forest (High Sandstone Influence)	2	32 521	8 717 (±912)	26.8 (±2.8)
Total Shale/Sandstone Transition Forest		**45 355**	**9 960 (±1085)**	**22.0 (±2.4)**
Castlereagh Ironbark Forest	3	12 211	1 012 (±99)	8.3 (±0.8)
Castlereagh Swamp Woodland	4	1 006	616 (±27)	61.2 (±2.7)
Castlereagh Scribbly Gum Woodland	6	5 852	3 083 (±171)	52.7 (±2.9)
Shale/Gravel Transition Forest	103	5 427	1 721 (±170)	31.7 (±3.1)
Agnes Banks Woodland	8	627	98 (±8)	15.6 (±1.3)
Riparian Woodland	5	–	–	–
Alluvial Woodland	11	36 129	4 698 (±903)	13.0 (±2.5)
Riparian Forest	12	2 989	717 (±137)	24.0 (±4.6)
Total Sydney Coastal River Flat Forest		**39 118**	**5 415 (±1040)**	**13.8 (±2.7)**
Shale Hills Woodland	9	38 274	4 309 (±596)	11.3 (±1.5)
Shale Plains Woodland	10	87 175	6 745 (±968)	7.7 (±1.1)
Total Cumberland Plain Woodland		**125 449**	**11 054 (±1564)**	**8.8 (±1.2)**
Dry Rainforest	13	1 282	338 (±35)	26.4 (±2.7)
Moist Shale Woodland	14	2 034	604 (±65)	29.7 (±3.2)
Turpentine–Ironbark Forest	15	17 354	236 (±49)	1.4 (±0.3)
Turpentine–Ironbark Margin Forest	43	12 985	947 (±178)	7.3 (±1.4)
Total Sydney Turpentine Ironbark Forest		**30 339**	**1 183 (±227)**	**3.9 (±0.7)**
Blue Gum High Forest	152	3 720	168 (±31)	4.5 (±0.8)
Freshwater Wetlands	36	1 552	664 (±82)	42.8 (±5.3)
TOTAL		**273 972**	**35 916 (4604)**	**13.1 (±1.7)**

for shale/sandstone transition forest (high sandstone influence). The proportion of pre-European vegetation remaining also increases with increasing topographic variability to 11.3 ±1.5% for Shale Hills Woodland and 29.7 ±3.2% for Moist Shale Woodland. Although the fertile alluvial soils of the floodplains have been highly sought for agriculture, remnants of Alluvial Woodland (13.0 ±2.5%) and Riparian Forest (24.0 ±4.6%) survive immediately adjacent to waterways. The most extensive remnants on the Plain occur on the tertiary sediments of the Castlereagh area where an estimated 52.7 ±2.9% of Castlereagh Scribbly Gum Woodland and 61.2 ±2.7% of Castlereagh Swamp Woodland remain. However, sand and gravel extraction threaten these and other communities in the area such as Agnes Banks Woodland (15.6 ±1.3%) and Castlereagh Ironbark Forest (8.3 ±0.8%). Although a relatively high proportion of some communities may remain, the area occupied by each community on the Cumberland Plain is extremely small.

Map compilation

Field survey sites were located in a total of 30 API canopy composition classes (Table 7). Sites of identical community type were distributed among an average (± s.d.) of 5.5 (± 2.2) API classes. Considerable overlap in canopy composition was evident between community types, particularly those closely related (Table 7). The most widely represented canopy dominants were *Eucalyptus moluccana* and *E. tereticornis*: sites falling within polygons with this canopy composition class represented 15 different vegetation communities. *Eucalyptus punctata* was also widely represented as a dominant (12 vegetation communities).

Polygons covering an area of 6085 ha (12.7% of the total polygon area) contained conflicting classifications for API canopy composition and vegetation community type. Conflicts were resolved by changing the vegetation community classification to match that of a vegetation type occurring nearby (or predicted to occur nearby) for which the API canopy composition was in concord. No change was made where no alternative classification could be suggested or where field observations or other data were judged more reliable than the API.

The range in area allocated to different polygon classes by two independent observers as a percentage of the area compared (8836 ha) was 9% (*Eucalyptus* canopy > 5%), 12% (*Eucalyptus* canopy < 5%) and 9% (cleared land). The potential area attributable to remnant native vegetation ranged from 5891 to 6717 ha. The perimeter length of remnant vegetation estimated by one of the observers (Roberts 1999) was 424 km; thus the average disagreement was 1.9 $ha.km^{-1}$. Estimates of the area of extant vegetation were estimated to range between 6% (Castlereagh Swamp Woodland) and 29% (Turpentine–Ironbark Forest) either side of the mean. Range estimates for the percentage of each community extant are given in Table 6.

Table 8. The relationship between ecological communities defined in this survey and communities described in previous studies, or listed on Schedule 1 of the NSW *Threatened Species Conservation Act* (1995)

This Survey	Map unit	NSW Threatened Species Act (Gazettal Date)	The Natural Vegetation of the Penrith & Sydney 1:100000 Map Sheets; Benson (1992), Benson & Howell (1994a)	Urban Bushland Biodiversity Survey, NPWS (1997)
Shale/Sandstone Transition Forest	1	Shale/Sandstone Transition Forest (11/09/98)	–	Western Shale/Sandstone Transition Forest
(Low Sandstone Influence)				
Shale/Sandstone Transition Forest	2	Shale/Sandstone Transition Forest (11/09/98)	–	Western Shale/Sandstone Transition Forest
(High Sandstone Influence)				
Castlereagh Ironbark Forest	3	Cooks River/Castlereagh Ironbark Forest (10/5/02)	Castlereagh Ironbark Forest (9e),	Castlereagh Ironbark Forest, Shale/Gravel Transition Forest (9d)
Eastern Shale/Sandstone Transition Forest				
Castlereagh Swamp Woodland	4	Castlereagh Swamp Woodland (24/12/99)	Swamp Woodland (14c)	Castlereagh Swamp Woodland
Riparian Woodland	–	Sydney Coastal River Flat Forest (12/02/99)	River Flat Forest (9f)	River-flat Forest (Riparian Habitats)
Alluvial Woodland	11	Sydney Coastal River Flat Forest (12/02/99)	River Flat Forest (9f)	River-flat Forest (Cumberland Plain creek systems)
Riparian Forest	12	Sydney Coastal River Flat Forest (12/02/99)	River Flat Forest (9f), Camden White Gum Forest (6d)	River-flat Forest (Hawkesbury-Nepean River and major tributaries)
Castlereagh Scribbly Gum Woodland	6	Not listed	Castlereagh Scribbly Gum Woodland (14a)	Castlereagh Scribbly Gum Woodland
Agnes Banks Woodland	8	Agnes Banks Woodland (17/11/00)	Agnes Banks Woodland (14b)	Agnes Banks Woodland
Mapped, but not described	–	Elderslie *Banksia* Scrub Forest (9/10/98)	–	Elderslie *Banksia* Scrub/Forest
Shale Hills Woodland	9	Cumberland Plain Woodland (13/06/97)	Spotted Gum Forest (9b), Grey Box Woodland (10c),	Spotted Gum Forest, Grey Box Woodland, Grey Box –Ironbark Woodland (10d)
Grey Box –Ironbark Woodland				
Shale Plains Woodland	10	Cumberland Plain Woodland (13/06/97)	Spotted Gum Forest (9b), Grey Box Woodland (10c),	Spotted Gum Forest, Grey Box Woodland, Grey Box –Ironbark Woodland (10d)
Grey Box –Ironbark Woodland				
Western Sydney Dry Rainforest	13	Western Sydney Dry Rainforest (12/11/99)	–	Dry Rainforest
Moist Shale Woodland	14	Moist Shale Woodland (19/4/02)	–	–
Turpentine-Ironbark Forest	15	Sydney Turpentine Ironbark Forest (16/10/98)	Turpentine-Ironbark Forest (9o)	Turpentine-Ironbark Forest
Turpentine-Ironbark Margin Forest	43	Sydney Turpentine Ironbark Forest (16/10/98)	Turpentine-Ironbark Forest (9o)	Western Shale/Sandstone Transition Forest
Blue Gum High Forest	152	Blue Gum High Forest (05/09/97)	Blue Gum High Forest (6b)	Blue Gum High Forest
Shale/Gravel Transition Forest	103	Shale/Gravel Transition Forest (19/4/02)	Shale/Gravel Transition Forest (9d)	Shale/Gravel Transition Forest
Freshwater Wetlands	36	Sydney Freshwater Wetlands Complex (22/12/00)	Freshwater Wetlands (28a)	River-flat Forest (Wetlands)

Discussion

Classification

The survey results generally corresponded well with previously derived classifications for the Cumberland Plain (Table 8). Seven communities (Castlereagh Ironbark Forest, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland, Castlereagh Swamp Woodland, Shale Gravel Transition Forest, Turpentine Ironbark Forest and Blue Gum High Forest) were judged to be equivalent to those of the same name described by Benson (1992) and Benson and Howell (1990) (subsequently recognised by NPWS (1997).

Cluster analysis did not support the subdivision of Cumberland Plain Woodlands into the three communities proposed by Benson (1992): Grey Box Woodland, Grey Box–Ironbark Woodland and Spotted Gum Forest. Instead, Cumberland Plain Woodlands were divided into two separate communities (Map Unit 10, Shale Plains Woodland and Map Unit 9, Shale Hills Woodland). A third shale woodland community was identified occurring on steep, sheltered slopes in the Razorback Range (Map Unit 14, Moist Shale Woodland). This community may not have been previously recognised. River Flat Forest as described by Benson (1992) was divided into three separate communities: Map Unit 11 (Alluvial Woodland), Map Unit 12 (Riparian Forest) and Map Unit 5 (Riparian Woodland). The first two of these communities correspond with a major dichotomy recognised by NPWS (1997) for alluvial areas draining shale-derived soils:'Cumberland Plain Creek Systems' and 'Hawkesbury–Nepean River and major Tributaries'. Riparian Woodland describes the assemblage of species found within creek lines and poorly drained areas on alluvial soils, and was included within the more extensively distributed alluvial communities by both Benson (1992) and NPWS (1997).

Western Shale Sandstone Transition Forest as described by NPWS (1997) was divided into two separate communities reflecting differences associated with variation in the level of sandstone influence (Map Units 1 and 2; Shale Sandstone Transition Forest (Low sandstone influence and High sandstone influence)). The Low Sandstone Influence variant is floristically similar to Benson and Howell's (1994b) Bargo Brush, however it is likely that these communities are sufficiently different to warrant recognition as distinct vegetation types. Eastern Shale Sandstone Transition Forest (NPWS 1997) was not recognised as a unique assemblage. Areas included by NPWS (1997) under this name fell within Map Unit 43 (Turpentine Ironbark Margin Forest) or Map Unit 3 (Castlereagh Ironbark Forest). Map Unit 13 (Western Sydney Dry Rainforest) was equivalent to the community of the same name described by NPWS (1997), and referred to as Rainforest Scrub by Benson (1992).

Patterns in community distribution: shale communities

Variation in floristic composition on shale soils was associated with regional gradients in elevation and rainfall, as well as local topographic variability and the degree of sandstone influence in the soil. Shale Plains Woodland (Map Unit 10) typically occurs on the flat, lower rainfall areas of the Cumberland Plain and grades into Shale Hills Woodland (Map Unit 9) at higher elevations in the southern half of the study area. Moist Shale Woodland (Map Unit 14) occurs at the upper end of the rainfall gradient, generally on the upper portion of very steep sheltered slopes, while Western Sydney Dry Rainforest (Map Unit 13) is frequently found in sheltered gullies. An overstorey dominated by either *Eucalyptus moluccana*, *E. tereticornis* or to a lesser extent *E. crebra* is typical throughout these communities.

On the eastern extremities of the Cumberland Plain, Shale Plains Woodland (Map Unit 10) grades into Turpentine Ironbark Forest (Map Unit 15) as annual rainfall increases above 950 mm. Ascending to the Hornsby Plateau, Turpentine Ironbark Forest grades into Blue Gum High Forest (Map Unit 152) as rainfall exceeds 1050 mm. This transition occurs at an altitude of approximately 100 m above sea level, although Turpentine Ironbark Forest is found at altitudes of up to 200 m on the western edge of the Hornsby Plateau where rainfall falls below 1050 mm. Floristic differences between these communities are not always reliably indicated by overstorey composition. Turpentine Ironbark forest may be dominated by *Eucalyptus saligna* at the upper end of its rainfall/elevation range, for example in Darvall Park and Denistone Park near Eastwood. Blue Gum High Forest is frequently dominated by *E. pilularis*.

Shale/sandstone transitional communities

A second gradient is apparent approaching the margins of the Plain and relates to an increase in the influence of sandstone in the soil associated with the diminishing thickness of the overlying shale stratum. Pigeon (1941) recognised this gradient as a shale/sandstone ecotone and noted the composition of the overstorey varied with location along the shale/sandstone boundary. A similar observation was made in NPWS (1997), where Shale Sandstone Transition Forest was recognised as a distinct assemblage, with a variable composition dependant on the composition of adjoining communities and the relative influence of shale and sandstone in the soil. Compositional patterns implying a sandstone influence were detected up to 1 km from the mapped location of the shale/sandstone interface. Within this zone the degree of sandstone influence increased with proximity to drainage zones, and with increasing stream order. While the ecotonal nature of shale/sandstone transition communities renders them more difficult to differentiate from adjoining communities, their conservation significance is highlighted by the fact that they contain species not recorded in samples of the adjoining shale and sandstone communities.

Clustering indicated floristic variation in the transitional zone warranted the recognition of three separate communities. Two communities were defined in areas receiving less than 950 mm rainfall annually. These reflected high and low levels of sandstone influence (Map Units 1 & 2). The boundary locations are somewhat arbitrary, and where a boundary between high and low sandstone influence is mapped the two communities are likely to be indistinguishable. The third

community, Turpentine Ironbark Margin Forest (Map Unit 43) was recorded in areas of high sandstone influence and high rainfall, and was represented by sample sites on the edge of the Hornsby and Woronora Plateaus, and between Grose Vale and Bowen Mountain near Kurrajong. This community was floristically most similar to Map Unit 15 (Turpentine Ironbark Forest), but in areas of intermediate rainfall it is likely to be indistinguishable from Map Unit 2. Vegetation occurring on the shale capped ridges of the plateaus was not described in this survey, but it is floristically similar to Turpentine Ironbark Forest (Map Unit 15) as suggested by Benson (1992). Smaller shale remnants are likely to support transitional communities with a low sandstone influence, although none were sampled in this rainfall zone.

Communities occurring on Tertiary alluvium

Four communities were recognised occurring on two separate deposits of Tertiary alluvium in the north-west (Castlereagh) and south-east (Holsworthy) corners of the study area (Map Units 3, 4, 6 and 103). The distribution of these communities is possibly related to the extent of exposure of soils from three depositional phases (the St Marys, Rickabys Creek Gravel and Londonderry Clay formations) (Bannerman & Hazelton 1990), as well as local drainage conditions. Castlereagh Ironbark Forest (Map Unit 3) occurs on soils with a high clay content while Scribbly Gum Woodland (Map Unit 6) is more common on sandy loam soils. Soils with a high clay content underlie sandier soils but are exposed through erosion, especially towards the margins of the alluvial deposits. Scribbly Gum Woodland (Map Unit 6) thus tends to occur on slight rises (> 34 m ASL) deep in the heart of the alluvial deposits. The stand of Castlereagh Ironbark Forest (Map Unit 3) located in Castlereagh Nature Reserve was an exception to this rule, and possibly reflects a local occurrence of the Londonderry Clay Formation laid down in the third depositional phase. Castlereagh Swamp Woodland (Map Unit 4) occurs in poorly drained depressions in both the Holsworthy and Castlereagh areas. Small aeolian deposits in the vicinity of Agnes Banks support a distinct community of sclerophyllous species (Map Unit 8). Variability within this Map Unit was not well sampled in this survey, but was described by Benson (1981, 1992).

On the margins of the alluvial deposits, Castlereagh Ironbark Forest (Map Unit 3) grades into Shale/Gravel Transition Forest (Map Unit 103). As the name implies, this community has features characteristic of an ecotone, but unlike the Shale/Sandstone transitional communities it contains few unique species. Isolated deposits of Tertiary alluvium overlying Wianamatta Shale are mapped throughout the Cumberland plain (Bannerman & Hazelton 1990), and support stands of Shale/Gravel Transition Forest. This assemblage is also present in areas with a high concentration of iron-indurated gravels (laterite) (Benson & Howell 1994a). These gravels are highly resistant to weathering and may accumulate near the soil surface following long term erosion of the clay soils in which they are often embedded.

The few remaining remnants of native vegetation in the vicinity of Ashfield, Auburn and Bankstown have been the focus of some debate. Benson and Howell (1990) constructed a picture of the original vegetation of this area using documents predating the suburban development which took place after World War I. Several communities are thought to have occurred, including dense shrublands, probably dominated by *Melaleuca nodosa*, interspersed with woodland dominated by *Eucalyptus moluccana*, *E. fibrosa*, *E. longifolia* and *E. eugenioides*. A few isolated examples of this vegetation are located at Rookwood Cemetery, in the upper reaches of Salt Pan Creek and Norfolk Park, Greenacre (Benson and Howell 1990). Pure shale communities representative of both higher and lower rainfall areas are also thought to have been present, with patches of Western Sydney Dry Rainforest (Map Unit 13) occurring in sheltered localities (Benson and Howell 1990).

Remnant shrubland and ironbark woodland in this area has been ascribed to various communities. Benson and Howell (1994a) described such areas as Shale/Gravel Transition Forest. In the absence of mapped deposits of Tertiary alluvium, NPWS (1997) concluded they were better described as an eastern form of Shale/Sandstone Transition Forest. This classification recognised the close proximity of the shale/sandstone boundary, as well as outcrops of Minchinbury Sandstone between layers of shale. However, the Scientific Committees determination for the Endangered Ecological Community Shale/Sandstone Transition Forest noted that these areas were considered to be represented by another Endangered Ecological Community; namely, the Cooks River Clay Plain Scrub Forest. In the current survey, samples located at Rookwood Cemetery, Duck River, Norfolk Park (Greenacre), Carysfield Park (Bankstown) and Moorebank Brickworks clustered with sites recognised as Castlereagh Ironbark Forest (Map Unit 3). This is consistent with Benson and Howell's (1994a) observed floristic similarity between these areas and communities further west on Tertiary alluvium (which was the basis for their Shale/Gravel Transitional classification). Despite the isolation of these remnants, and the high potential for floristic anomalies relating to human disturbance, the floristic association with sites representative of Map Unit 3 was consistent, and sites sampled later in the survey joined the dendrogram in the same location. Therefore, despite the obvious structural differences (which may relate to past disturbances such as timber removal), this paper classes these areas as Castlereagh Ironbark Forest (Map Unit 3).

The distribution of these stands of Map Unit 3 around Bankstown and Auburn is correlated with the distribution of the Villawood Soil Series mapped by Walker (1960). The Villawood Series is a yellow podsolic soil extensively permeated with fine, concretionary ironstone (laterite). The link between Shale/Gravel Transition Forest and ironstone gravels has been previously noted (Benson & Howell 1994a). The distribution of the Villawood series accounts for the distribution of shrublands described in historical records

(Benson & Howell 1990) more satisfactorily than other features, such as the Birrong Soil Landscape. The Villawood Series is not differentiated in more recent soil maps (Chapman and Murphy 1989).

Riparian communities

Three communities were recognised occurring on soils of recent alluvial origin (Map Units 5, 11 & 12). Riparian Woodland (Map Unit 5) is confined to streamlines and adjacent swampy areas, and is floristically related to Map Unit 4 (Castlereagh Swamp Woodland). Riparian Woodland was not adequately sampled to enable its distribution to be mapped reliably. Riparian Forest (Map Unit 12) corresponds to communities occurring on the Hawkesbury–Nepean River and major Tributaries described in NPWS (1997), and includes the Camden White Gum Forest Community described by Benson (1992). Samples representative of Map Unit 12 were restricted to within 100 m of the Hawkesbury–Nepean and Georges Rivers. Historical accounts suggest that this assemblage may once have been more extensively distributed across the Hawkesbury–Nepean floodplains (Benson & Howell 1990), but in the absence of comprehensive data the floodplains have been mapped here as supporting Alluvial Woodland (Map Unit 11). This Map Unit corresponds to communities occurring on Cumberland Plain Creek Systems as described in NPWS (1997), but was sampled on major floodplains at distances greater than 100 m from the river. Toward the edge of the floodplain Alluvial Woodland grades into Shale Plains Woodland (Map Unit 10), and this latter assemblage may have occupied some parts of the floodplain. The modelled distribution of Alluvial Woodland may thus slightly overestimate the original extent of this assemblage.

Field identification of communities

Field identification of vegetation communities can be achieved by comparing the species composition, structure and characteristics of the physical environment to the community descriptions contained in Appendix 1. Since the community classification was based primarily on species composition, this provides the most reliable means of community diagnosis. Few communities can be identified on the basis of vegetation structure or the physical characteristics of the site alone, however these are useful for narrowing the field of possible choices.

Lists of species published under Endangered Ecological Community determinations (*TSC Act* 1995) and recent vegetation surveys (e.g. Keith & Bedward 1999) have proven difficult to utilise in the diagnosis of community type because no criteria exist to determine what minimum subset of species is required to confirm the presence of a community. This problem is addressed in this paper by specifying a minimum expected number of diagnostic species for each community based on individual species frequencies. The minimum expected numbers were calculated as the lower bound of a one-tailed 95% confidence interval. Thus a 'true' sample of a community type is expected to contain the minimum number of diagnostic species in 95% of cases. Conversely, in 5% of cases a 'true' sample will not contain sufficient diagnostic species; thus leading to the erroneous conclusion that the site does not belong to the community type in question.

Species count thresholds provide a practical method for applying diagnostic species lists in the identification of community type, however the presence/absence of diagnostic species can not be considered definitive. First, as outlined above, the procedure incorporates an explicit risk of error. Second, test sites frequently contain sufficient diagnostic species to qualify for more than one community type, typically two or three. In such cases the candidate communities usually display similarities in species composition and the test result may indicate that the test site fits any of the candidate communities equally well. This uncertainty reflects, in part, uncertainties inherent in classifying sites by cluster analysis, which is exemplified by the sensitivity of group composition to changes in analysis parameters and the composition of the data set. This problem may be particularly evident in the current study because the partitioning of ecotones resulted in the recognition of communities that frequently display only subtle differences in species composition. Communities may be more reliably identified if replicate test sites are surveyed in the area of interest.

Erroneous conclusions may arise due to sampling problems or if the method is incorrectly applied. First, probability estimates for those communities sampled by relatively few field sites (Communities 4, 5, 8, 12, 13, 34 & 35) are likely to be less accurate than for communities sampled more intensively. Second, threshold predictions are only valid for test sites of area 0.04 ha subject to the following conditions: (i) The test site must be located without bias: if the choice of location was made to either include or exclude particular species then the probability estimates will be invalid; (ii) The test site must be searched thoroughly and all vascular plant species present correctly identified. The majority of diagnostic species comprise herbs and grasses thus there is a high potential for community mis-identification through omission of species, particularly in seasons where reproductive material is not available or immediately following fire; (iii) The vegetation at the test site should not be modified in a way that is atypical of remnant vegetation on the Cumberland Plain. This condition is difficult to quantify, but is intended to exclude the use of the minimum species threshold for sites containing relatively few species in total. Species-poor sites may include those subject to repeated slashing, intensive grazing, soil disturbance or vandalism. A minimum species count has been included for each community; the diagnostic species threshold should not be applied unless this number is exceeded.

Accuracy

One of the principal objectives of this project was to provide a more accurate map of the native vegetation remnants of the Cumberland Plain and adjacent shale-topped plateaus. The features represented on the vegetation map may be interpreted at varying levels of detail and degree of accuracy is dependent on the spatial resolution at which the map is used. The boundaries of vegetation remnants were mapped with a high level of spatial accuracy. This can be demonstrated qualitatively by over-laying the vegetation boundaries on a base of certifiable accuracy such as the Land Information Centre 1:25 000 topographic maps. Keith et al. (2000) estimated the spatial error in locating remnant boundaries to be 20 m based on a comparison with digitally rectified aerial photographs.

The accuracy with which canopy cover classes were delineated is more difficult to quantify because a degree of subjectivity was involved in the interpretation. Based on an independent interpretation of photo-pattern for a subset of the study area (8836 ha), the area attributable to remnant native vegetation could vary between observers by as much as 1.9 ha for each kilometre of perimeter considered. Extrapolating this variation across the study area, the percentage of native vegetation extant is estimated to be between 10.7% and 15.4%. Further work is required to determine if this level of variation is typical for the interpretation of patterns in vegetation from aerial photographs. Nevertheless, these figures reinforce the fact that estimates of vegetation cover are subject to error due to a number of factors and should never be interpreted as absolute. The fact that sample sites were located in polygons of all classes (including cleared land) further highlights that fact that these classes are only an approximate representation of the condition of vegetation remnants.

The level of accuracy achieved in mapping the distribution of vegetation communities (95% within a radius of 500 m) was comparable with the results of other studies employing a decision tree approach (Keith & Bedward 1999, NPWS 2000). This level of accuracy implies that planning units chosen to include specific vegetation communities should be at least 79 ha in area to ensure a high probability that the community of interest is, in fact, contained in the unit. This requirement is likely to be largely unachievable on the Cumberland Plain because 97% of all remnants are estimated to be less than 79 ha in area. Although the map is the most reliable guide to the plant communities present in a site, rigorous field observations remain an essential component of map interpretation.

While the evenness and intensity of field sampling were of a relatively high level the distribution of some communities may have been less accurately modelled due to inadequate numbers of field samples. These include Dry Rainforest (Map Unit 13) and Moist Shale Woodland (Map Unit 14). These communities could be targeted more effectively if some index of topographic variability had been included in the sample stratification. The transition of vegetation communities from shale to sandstone soils could also be modelled more accurately if additional samples were stratified across topographic gradients in the zone of transition. However, gaps in the sample coverage were unavoidable due to high levels of clearing. The floodplains of the Hawkesbury–Nepean River were very poorly sampled for this reason. Some deficiencies in the spatial distribution of sampling were also apparent. Sampling intensity declined around the margins of the study area in part because of the additional travel time required to visit these areas. Map accuracy is likely to show a parallel decline, particularly at the northern and southern extremities of the study area. Communities occurring on Tertiary alluvium in the Castlereagh area were targeted for additional sampling in preparation for this revision. The additional samples greatly improved the accuracy of modelling, however further sampling would still be of benefit in describing this complex area.

The accuracy of the vegetation map was limited by the accuracy of the spatial data layers used in its compilation. Given the strong relationship between vegetation type and geological substrate, soil landscape maps of scale 1:100 000 were acknowledged *a priori* as a limiting factor for map accuracy. A considerable effort was made to overcome this limitation by using large-scale aerial photography to estimate tree canopy composition. This approach was based on the assumption that the distribution of tree species is aligned with the distribution of communities. In reality, there was considerable overlap in canopy composition between adjoining communities (Table 7) with the result that overstorey composition was of limited use in determining the location of boundaries. The extent to which overstorey composition was informative in compiling the map can be partially quantified. Only 12.7% of the total mapped area contained an overstorey species combination that was not recorded in the community type predicted to occur in that area by the spatial model. This high level of agreement between spatial model and API is consistent with the accuracy statistics over a 100–500 m radius. No simple assumptions can be made about the reliability of the model or API where they disagree. The area of the map for which community type was assigned based on overstorey composition alone was thus less than 12.7%.

For some communities, aerial photograph interpretation offers the most practical and efficient method of delineating boundaries accurately. For example, the distribution of wetlands (36) and, to a lesser extent, riparian communities (5, 11 & 12) was assisted by the availability of aerial photo-pattern. For other communities the interpretation of structural features could serve just as well as canopy composition for this purpose. Targeting specific communities and structural features with demonstrated application in the delineation of community boundaries is likely to be the most cost-effective strategy for aerial photograph interpretation. The significant costs associated with the estimation of canopy composition (large-scale

photographs and extensive field reconnaissance) may not be justifiable if the utility of such data can not be demonstrated *a priori*. Given the overall contribution of aerial photo-pattern in compiling the Cumberland Plain vegetation map, it could be argued that aerial photograph interpretation consumed a disproportionate amount of resources (45% of the project budget).

Community conservation and remnant condition

The results of this survey provide a graphic illustration of the extent of depletion and fragmentation of the native vegetation of the Cumberland Plain and adjoining shale-capped plateaus. At the end of 1997, the remaining remnants accounted for only 13% of the original vegetation cover; a figure that has been further reduced by clearing over the ensuing five years. The overwhelming majority of remnants are small (< 79 ha), while many of the larger remnants exhibit a high ratio of perimeter length to area. Thus, there is a high potential for the future degradation of remnants through the impacts of activities on adjoining land and the invasion of weed species.

The high proportion of rare species recorded in field survey plots suggests that there is a high probability of loss of floristic diversity associated with any further clearing activity. Almost a quarter of all native species were recorded only once in the survey, while almost half were recorded five times or less. Loss of diversity is most likely to occur through the clearing of communities with highly restricted distributions such as Castlereagh Ironbark Forest (Map Unit 3) and Agnes Banks Woodland (Map Unit 8). Loss of diversity is also highly likely if further clearing occurs in the eastern part of the study area where native vegetation has been almost eliminated by urban and industrial development.

Few assumptions can be made about the condition of remnants based on the extent of *Eucalyptus* canopy cover as determined by API. Field sampling in this survey was biased toward remnants with high canopy cover while no attempt was made to sample areas with scattered or no tree cover (mapped TX, TXR and TXU). However, a significant proportion (10%) of the sites identified as high diversity remnants by field survey were subsequently classified as scattered or no tree cover by API, which suggests that this method may underestimate the extent of native vegetation communities, particularly secondary grasslands. While continuous tree cover was considered the best indicator for remnant native vegetation, field reconnaissance is essential to determine the conservation value of areas with scattered tree cover.

While it is frequently assumed that the conservation value of a remnant is proportional to its size, the results of this survey suggest that this assumption is inappropriate for conservation planning on the Cumberland Plain. First, small remnants constitute a large proportion of the remaining vegetation therefore the protection of these remnants is required to maintain vegetation cover at its present level. Second, although there was some evidence that small remnants were more susceptible to impacts from adjoining lands, many still contained a high diversity of native species and relatively few weeds. Third, given the large number of rare species recorded in the survey, the protection of all remnants is required to minimise the loss of floristic diversity. Avoiding the cumulative impacts caused by the clearing of small remnants is a significant challenge for biodiversity conservation on the Cumberland Plain.

While the protection of the remaining vegetation on the Cumberland Plain and adjoining plateaus remains a priority, several management problems also require urgent attention to assure the long-term conservation of biological diversity. First, two exotic plant species (*Olea europea* subsp. *africana*, and *Myrsiphyllum asparagoides*) were observed to be both widely dispersed and highly competitive, and appear to have the potential to suppress native understorey species. Second, research is required to identify fire regimes appropriate for the conservation of native biota. Third, the degradation of remnant vegetation through rubbish dumping and recreational vehicle damage is extensive and ongoing. It is undeniable that the prevention of further clearing and the establishment of effective weed and fire management strategies across all land tenures on the Cumberland Plain comprise a substantial challenge. Nevertheless, it is a sad fact that preventable degradation is ongoing.

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Appendix 1: Descriptions of Map Units

A list of diagnostic species has been compiled for all Map Units. For each species the following have been calculated:

- Cover/Abundance[1] within Map Unit (50 percentile): the median cover/abundance score recorded for the species in sites representing the Map Unit;
- Frequency (%) within Map Unit: the number of times the species was recorded in sites representing the Map Unit divided by the total number of sites representing the Map Unit;
- Cover/Abundance[1] in other Map Units (50 percentile): the median cover/abundance score recorded for the species in sites sampled in other Map Units.
- Frequency (%) within other Map Units: the number of times the species was recorded in sites representing other Map Units divided by the number of sites representing other Map Units;
- Fidelity class: positive (the species occurs more frequently in the Map Unit than in sites representing other Map Units; constant (the species occurs frequently within the Map Unit as well as sites representing other Map Units, and is therefore characteristic rather than diagnostic of the Map Unit); uninformative (the species does not occur frequently in the Map Unit nor in sites representing other Map Units).

[1]*Cover/abundance scores:*

1 = Rare, few individuals present AND cover < 5%
2 = Uncommon AND cover < 5%
3 = Common AND Cover < 5%
4 = (Very Abundant AND Cover < 5%) OR (5% ≤ Cover < 20%)
5 = (20% ≤ Cover <50%)
6 = (50% ≤ Cover <75%)
7 = (75% ≤ Cover < 100%)

Procedure for using positive diagnostic species for the identification of Map Unit type.

1. Determine the location of test plots using a random procedure. For example: Use a tape measure to define a grid then consult a table of random numbers to obtain coordinates for the location of the plots.
2. Mark out a search area of 0.04 ha (20 x 20 m is convenient) and record all vascular plant species with stems rooted within the search area.
3. Compile a shortlist of possible Map Unit types by comparing the vegetation structure and physical characteristics of the site with the descriptions contained in Appendix 1. The species composition of the test plot will be compared with each of these Map Unit types.
4. Count the number of **native** species occurring within the test plot. A minimum species count has been specified for each Map Unit type and is located in the diagnostic species table caption. The test can not proceed unless the test plot contains the minimum number of species specified for the Map Unit under consideration.
5. Considering each of the candidate Map Unit types in turn, consult the list of diagnostic species and count the number of species classified **positive** that were found in the test plot. The minimum expected number of positive diagnostic species has been specified for each Map Unit type and is located in the diagnostic species table caption. If the test plot contains the minimum number of positive diagnostic species ('pass') then it is a good match for that Map Unit type. A 'pass' result may be obtained for more than one of the candidate communities. In such cases the number of species by which the minimum was exceeded may be used to assess the closeness of the match to each of the possible candidates. A 'fail' result (the test plot contains fewer species than the expected minimum) does not exclude the possibility that the test plot is a match, however the fewer positive species recorded, the less likely it is that the Map Unit is a match (see discussion).

Map Unit 1:

Shale Sandstone Transition Forest (Low sandstone influence)

Sample sites: (38)
Area (ha) 1750 / 1997 (± range): 12834 / 1243 (±173)
Proportion extant (± range): 9.7 (±1.3)%
No. taxa (total / unique): 264 / 6
No. taxa per plot (±sd): 42.6 (±7.9)

Description:

Shale Sandstone Transition Forest (Low sandstone influence) is dominated by *Eucalyptus tereticornis*, with *E. eugenioides*, *E. crebra*, *E. fibrosa* and *E. punctata* occurring less frequently. A small tree stratum is usually present and dominated by *Eucalyptus* spp., with *Allocasuarina littoralis* and *Acacia decurrens* sometimes present. A shrub layer dominated by *Bursaria spinosa* is usually present, frequently this is of high density, although the foliage of this shrub is sparse and does not translate into high cover values. A diverse array of forb species is always present, frequently exceeding 50% in projected foliage cover. Species frequently present in the ground stratum include *Microlaena stipoides* var. *stipoides*, *Cheilanthes sieberi* subsp. *sieberi*, *Dichondra repens*, *Themeda australis*, *Echinopogon ovatus*, *Entolasia marginata*, *Pratia purpurascens*, *Solanum prinophyllum* and *Oxalis perennans*. Although this community marks the start of the transition from the pure shale communities of the Cumberland Plain to the surrounding sandstone communities, it contains relatively few species commonly observed on sandstone derived soils.

Shale Sandstone Transition Forest (Low sandstone influence) occurs around the margins of the Cumberland Plain on soils derived from Wianamatta Shale. It is most extensive in the south-eastern and south-western sections of the Study area. The community is only found in close proximity to a transition in parent geology from Wianamatta Shale to high-quartz sedimentary substrates such as the Hawkesbury and Narrabeen group Sandstones, as well as fine to medium grain quartz of the Mittagong formation. In these peripheral areas shale soils form a shallow layer over the underlying sandstone. The majority of sample sites were located within approximately 2 km of a sandstone/shale boundary. The community may also be found at greater distances from the sandstone/shale boundary where watercourses have eroded the shale stratum down close to the level of sandstone.

Shale Sandstone Transition Forest (Low sandstone influence) is typically found on the middle or upper slopes of gently undulating land. As distance to the sandstone/shale boundary increases Map Unit 1 grades into Map Unit 10 or, less frequently, Map Unit 9. The boundary between these communities is indistinct by nature, and Shale Sandstone Transition Forest includes areas with only a very slight influence of sandstone. As distance to the sandstone/shale boundary decreases, Map Unit 1 grades into Map Unit 2. Again, the boundary between these communities is indistinct and largely arbitrary.

Previous floristic classifications:

Map Units 1 and 2 combined correspond to the western form of Shale/Sandstone Transition Forest described in NPWS (1997) and subsequently listed under the *TSC Act* (1995). Eastern Shale/Sandstone Transition Forest (*sensu* NPWS (1997)) is herein included in Map Unit 3, an EEC listed under the name Cooks River/Castlereagh Ironbark Forest. Map Unit 43 also occurs on soils transitional between Shale and Sandstone, however this community is floristically most similar to Map Unit 15 and together they comprise the EEC Sydney Turpentine Ironbark Forest. Benson and Howell (1994b) described a Shale/Sandstone Transition Forest (Map Unit 9r) occurring on the sandstone side of the ecotone and this community is considered to fall outside the definition of Map Units 1, 2 and 43. However, Bargo Brush Forest (Benson and Howell 1994b, Map Unit 9mf) may fall within the definition of either Map Unit 1 or Map Unit 2.

Habitat:

Parent geology: Wianamatta Shale (98%), Holocene alluvium (2%)

	Mean	(±sd)	Range
Elevation (m)	146.8	(80.5)	1–360
Slope (° above horizontal)	4.2	(3.3)	0–14
Annual rainfall (mm)	847.1	(57.6)	764–941
Ruggedness (900m)	13.5	(6.8)	0–36
Maximum temperature Jan. (°C)	27.3	(0.6)	26–28
Solar radiation, January	214.7	(2.6)	207–219
Distance from sandstone derived soils (m)	879.1	(1080.6)	0–4650

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	23.0 (3.9)	24.1 (9.9)
Small tree	93	12.6 (3.9)	11.0 (8.2)
Shrub	88	3.3 (1.2)	16.1 (16.6)
Forb	100	0.8 (0.6)	49.7 (22.5)

Diagnostic species:

Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 12 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 33 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 12 positive diagnostic species.

C/A: Cover/Abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/Abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia decurrens	2	45	1	10	positive
Eucalyptus crebra	4	39	3	17	positive
Eucalyptus eugenioides	4	42	2	10	positive
Eucalyptus fibrosa	4	39	4	15	positive
Eucalyptus tereticornis	4	53	4	23	positive
Shrub stratum					
Bossiaea prostrata	1	29	1	6	positive
Hibbertia aspera	2	42	2	16	positive
Kunzea ambigua	2	45	2	15	positive
Leucopogon juniperinus	2	50	2	17	positive
Olearia viscidula	2	24	1	2	positive
Persoonia linearis	2	42	2	32	constant
Ground stratum					
Aristida vagans	2	53	2	44	constant
Brunoniella australis	2	68	3	32	positive
Bursaria spinosa	4	74	3	47	positive
Calotis dentex	3	34	2	4	positive
Cheilanthes sieberi subsp. *sieberi*	2	87	2	50	positive
Cymbopogon refractus	2	39	2	16	positive
Desmodium varians	2	63	2	33	positive
Dichondra repens	3	79	3	46	positive
Digitaria parviflora	2	37	2	9	positive
Echinopogon ovatus	2	87	2	29	positive
Entolasia marginata	2	76	2	23	positive
Eragrostis leptostachya	2	71	2	21	positive
Euchiton sphaericus	1	39	2	16	positive
Gahnia aspera	3	29	2	6	positive
Galium propinquum	2	39	2	8	positive
Lagenifera gracilis	2	42	2	13	positive
Lepidosperma laterale	2	63	2	44	constant
Lomandra confertifolia subsp. *rubiginosa*	2	32	3	8	positive
Microlaena stipoides var. *stipoides*	4	87	3	68	constant
Opercularia diphylla	2	53	2	34	constant
Oxalis perennans	2	66	2	25	positive
Panicum simile	2	42	2	33	constant
Pomax umbellata	2	42	2	35	constant
Poranthera microphylla	2	42	2	22	constant
Pratia purpurascens	2	76	2	42	positive
Solanum prinophyllum	2	76	2	24	positive
Themeda australis	3	76	3	56	constant
Tricoryne elatior	2	34	2	14	positive
Veronica plebeia	2	68	2	20	positive
Climbers					
Glycine clandestina	2	47	2	42	constant
Glycine tabacina	2	53	2	25	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	4	3	2	14	uninform.
Angophora floribunda	1	16	2	7	uninform.
Corymbia gummifera	2	3	2	30	uninform.
Corymbia maculata	4	11	4	3	uninform.
Eucalyptus globoidea	4	13	2	8	uninform.
Eucalyptus moluccana	4	24	4	19	uninform.
Eucalyptus pilularis	5	3	4	14	uninform.
Eucalyptus punctata	4	34	3	24	uninform.
Eucalyptus resinifera	4	5	1	4	uninform.
Eucalyptus saligna	4	3	3	3	uninform.
Eucalyptus sideroxylon	4	3	3	1	uninform.
Syncarpia glomulifera	4	5	3	21	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Olea europaea subsp. *africana*	1	41	2	26	constant
Ground stratum					
Cirsium vulgare	2	43	1	33	constant
Plantago lanceolata	2	41	2	25	constant
Senecio madagascariensis	2	54	2	52	constant

Map Unit 2:

Shale Sandstone Transition Forest (High sandstone influence)

Sample Sites: 70
Area (ha) 1750 / 1997 (± range): 32521 / 8717 (±912)
Proportion Extant (± range): 26.8 (±2.8)%
No. Taxa (total / unique): 380 / 15
No. Taxa per Plot (±sd): 49.5 (±8.1)

Shale Sandstone Transition Forest (High sandstone influence) is dominated by *Eucalyptus punctata* and *E. crebra*, with *E. fibrosa*, *Corymbia gummifera* and *Syncarpia glomulifera* occurring less frequently. A smaller tree stratum is usually present and is most often dominated by *Allocasuarina littoralis*, *Syncarpia glomulifera*, *Persoonia linearis* and *Acacia decurrens*. Map Unit 2 usually has a well-developed shrub layer which is more diverse in species than in communities with less sandstone influence in the soil. The shrub stratum is dominated by *Kunzea ambigua*, *Persoonia linearis* and *Bursaria spinosa*, with *Jacksonia scoparia* becoming more common with increasing sandstone influence. The ground stratum is dominated by *Entolasia stricta*, *Themeda australis*, *Stipa pubescens*, *Lepidosperma laterale*, *Aristida vagans* and *Pomax umbellata*.

Map Unit 2 occurs on the margins of the Cumberland Plain in close proximity to the sandstone/shale boundary, and is most extensively distributed in the south-western and south-eastern sectors of the study area. It is also found on the northern and north western margins of the Cumberland Plain but was not well sampled in those areas in this study. The majority of sample sites for this community were located within

400 m of the shale/sandstone boundary and varied considerably in the degree of sandstone influence evident in the soil. Map Unit 2 is essentially a shale community, and is most likely to occur on shallow, residual clay soils derived from Wianamatta Shale. However, it may also be found on high-quartz sandstone-derived soils where there is a strong colluvial shale influence (eg the upper slopes of sandstone gullies adjoining shale soils), and on outcrops of pure shale soils derived from the Mittagong Formation. Map Unit 2 occurs primarily on upper slopes and ridges on gently undulating terrain.

Map Unit 2 grades into Map Unit 1 with increasing distance from the sandstone/shale boundary. If the transition is abrupt, then Map Unit 2 may grade directly into Map Unit 10. Along the western edge of the Georges River Map Unit 2 makes an abrupt transition into sandstone communities and there is a pronounced change in floristic composition.

Previous floristic classifications:

Shale Sandstone Transition Forest (High sandstone influence) is one of two communities which together correspond to Shale Sandstone Transition Forest as listed under the *TSC Act* (1995). Further discussion is included under the description of Map Unit 1.

Habitat:

Parent Geology: Wianamatta Shale (53%), Mittagong Formation (31%), Hawkesbury Sandstone (16%)

	Mean	(±sd)	Range
Elevation (m)	146.3	(78.2)	14–393
Slope (° above horizontal)	4.2	(3.9)	0–17.7
Annual Rainfall (mm)	880.0	(46.1)	756–981
Ruggedness (900m)	12.3	(6.8)	4–43
Maximum Temperature, Jan. (°C)	27.3	(7.0)	26.3–28.9
Solar Radiation, January	215.0	(2.6)	204–220
Distance from sandstone derived soils (m)	132.8	(234.1)	0–1398.7

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	21.1 (4.4)	19.9 (9.9)
Small Tree	84	10.1 (4.0)	10.9 (9.1)
Shrub	91	3.2 (1.3)	11.6 (10.6)
Forb	96	0.7 (0.7)	33.8 (21.3)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 20 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 40 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 20 positive diagnostic species.

C/A: Cover/Abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/Abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia binervata	2	14	1	1	positive
Acacia decurrens	2	24	1	11	positive
Allocasuarina littoralis	2	50	2	22	positive
Angophora bakeri	1	27	3	12	positive
Corymbia maculata	4	13	4	3	positive
Eucalyptus crebra	3	57	4	14	positive
Eucalyptus fibrosa	4	39	4	14	positive
Eucalyptus punctata	3	61	2	20	positive
Exocarpos cupressiformis	1	26	1	11	positive
Shrub stratum					
Acacia falcata	1	23	1	10	positive
Bursaria spinosa	2	60	3	47	constant
Exocarpos strictus	2	30	2	9	positive
Gompholobium species *B*	2	10	2	2	positive
Hibbertia aspera	2	40	2	15	positive
Hibbertia diffusa	2	36	2	13	positive
Jacksonia scoparia	2	29	1	3	positive
Kunzea ambigua	2	60	2	12	positive
Leucopogon juniperinus	2	47	2	16	positive
Leucopogon muticus	2	13	1	2	positive
Notelaea longifolia f. *longifolia*	1	31	1	16	positive
Olearia microphylla	1	17	1	6	positive
Ozothamnus diosmifolius	2	63	1	25	positive
Persoonia linearis	2	84	2	27	positive
Phyllanthus hirtellus	2	53	2	32	positive
Pimelea linifolia subsp. *linifolia*	2	59	2	25	positive
Pomaderris lanigera	2	10	1	1	positive
Ground stratum					
Aristida vagans	2	90	2	40	positive
Astroloma humifusum	1	20	1	6	positive
Billardiera scandens	2	71	1	34	positive
Calotis dentex	2	26	2	4	positive
Cheilanthes sieberi subsp. *sieberi*	2	81	2	49	positive
Dampiera purpurea	2	13	1	4	positive
Desmodium rhytidophyllum	1	14	1	5	positive
Dianella caerulea	2	44	2	27	constant
Dianella revoluta var. *revoluta*	2	54	2	36	positive
Dichelachne micrantha	2	47	2	30	constant
Digitaria ramularis	2	39	1	4	positive
Echinopogon caespitosus var. *caespitosus*	2	73	2	21	positive
Entolasia stricta	3	90	3	55	positive
Eragrostis brownii	2	39	2	19	positive
Gahnia aspera	1	20	2	6	positive
Gonocarpus tetragynus	2	44	2	20	positive
Goodenia hederacea subsp. *hederacea*	2	49	2	32	constant
Lagenifera gracilis	2	40	2	12	positive
Laxmannia gracilis	1	39	2	15	positive
Lepidosperma laterale	3	90	2	40	positive
Lomandra filiformis subsp. *coriacea*	2	34	2	13	positive
Lomandra multiflora subsp. *multiflora*	2	87	2	46	positive
Microlaena stipoides var. *stipoides*	3	83	3	68	constant
Notodanthonia longifolia	2	11	2	1	positive
Opercularia diphylla	2	54	2	33	positive
Panicum simile	2	79	2	29	positive
Paspalidium distans	2	40	2	25	constant
Poa labillardieri var. *labillardieri*	2	37	2	15	positive
Pomax umbellata	2	84	2	30	positive
Pratia purpurascens	2	74	2	40	positive
Pterostylis concinna	2	9	–	0	positive
Solanum prinophyllum	1	46	2	25	positive
Stipa pubescens	3	56	2	24	positive
Stypandra glauca	2	30	1	2	positive
Themeda australis	3	80	3	54	positive
Veronica plebeia	1	41	2	21	positive
Climbers					
Glycine clandestina	2	77	2	38	positive
Hardenbergia violacea	2	47	1	29	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora costata	1	10	2	20	uninform.
Angophora floribunda	2	9	2	8	uninform.
Corymbia eximia	3	7	2	3	uninform.
Corymbia gummifera	2	29	3	29	uninform.

Eucalyptus agglomerata	1	1	2	2	uninform.
Eucalyptus beyeriana	2	1	–	0	uninform.
Eucalyptus eugenioides	4	19	2	11	uninform.
Eucalyptus globoidea	2	17	2	7	uninform.
Eucalyptus haemastoma	4	1	2	3	uninform.
Eucalyptus longifolia	4	4	1	2	uninform.
Eucalyptus moluccana	1	1	4	21	uninform.
Eucalyptus notabilis	1	4	2	5	uninform.
Eucalyptus oblonga	3	16	2	8	uninform.
Eucalyptus paniculata	1	1	2	3	uninform.
Eucalyptus pilularis	1	14	4	13	uninform.
Eucalyptus resinifera	1	7	1	4	uninform.
Eucalyptus sclerophylla	4	6	4	9	uninform.
Syncarpia glomulifera	4	27	3	19	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Senecio madagascariensis	1	44	2	53	constant

Map Unit 3:

Castlereagh Ironbark Forest

Sample Sites: (28)
Area (ha) 1750 / 1997 (± range): 12211 /1012 (±99)
Proportion Extant (± range): 8.3 (±0.8)%
No. Taxa (total / unique): 227/4
No. Taxa per Plot (±sd): 41.3 (±5.4)

Castlereagh Ironbark Forest is dominated by *Eucalyptus fibrosa* and *Melaleuca decora*, with *E. longifolia* occurring at lower frequency. The height of the overstorey is relatively variable and often merges into a smaller tree stratum dominated by the same species. A relatively dense shrub stratum is typical, and dominated by *M. nodosa* and *Lissanthe strigosa*, and to a lesser extent *M. decora*. A variety of shrub species occur at relatively low frequencies, including *Acacia pubescens*, *Dillwynia tenuifolia*, *Daviesia ulicifolia*, *Pultenaea villosa* and *Grevillea juniperina*. The ground stratum is relatively sparse compared to adjoining communities on Tertiary alluvium or shale soils. Commonly occurring species include *Entolasia stricta*, *Lepidosperma laterale*, *Opercularia diphylla*, *Dianella revoluta* subsp. *revoluta*, *Themeda australis*, *Microlaena stipoides* var. *stipoides* and *Pratia purpurascens*.

Castlereagh Ironbark Forest primarily occurs on clay soils derived from Tertiary alluvium, or on shale soils adjacent to the boundary with Tertiary alluvium. The most extensive stands occur in the Castlereagh and Holsworthy areas. A small patch occurs adjacent to Kemps Creek on an isolated fragment of Tertiary alluvium. Where the Tertiary alluvium is shallow, Map Unit 3 grades into Map Unit 103. This transition is difficult to predict and may be influenced by other factors such as drainage. In very poorly drained depressions Map Unit 3 grades into Map Unit 4. Where the soil is sandier Map Unit 3 grades into Map Unit 6. In the Castlereagh area this often occurs with increasing elevation.

Highly modified remnants of this community occur in the vicinity of Bankstown and exhibit atypical structure: the tree stratum is shorter or absent and dominated by *E. fibrosa*, *E. longifolia* or more rarely *Angophora floribunda* and *E. oblonga*. The shrub stratum was often dense, particularly in the absence of overstorey, and dominated by *Melaleuca nodosa* and *Bursaria spinosa*. These remnants are apparently remote from deposits of Tertiary alluvium, but occur in an area described as having a high concentration of iron-indurated gravel in the soil (Villawood Soil Series; Walker 1960) (See Discussion). Slight floristic differences between sample sites in this area and sample sites further to the west and south-west may be due to the higher influence of shale in the soil or higher rainfall. The highly modified and isolated nature of these remnants is also likely to have contributed to floristic differences.

Previous floristic classifications:

Castlereagh Ironbark Forest corresponds to the community of the same name described by Benson (1992), (Map Unit 9e), and NPWS (1997), although differences exist in the extent of distribution recognised. These differences are primarily related to problems associated with classifying sites in a zone of transitional vegetation, and mainly involve areas being recognised as Castlereagh Ironbark Forest by one author and transitional by another.

Castlereagh Ironbark Forest includes part of the vegetation classified as eastern Shale/Sandstone Transition Forest (NPWS 1997) and that formerly listed under the *TSC Act* (1995) as Cooks River Clay Plain Scrub Forest. This listing was revised to include Map Unit 3 in its entirety under the name Cooks River/Castlereagh Ironbark Forest. This survey distinguished remnants of both Shale Sandstone Transition Forest (Map Units 1 and 2) and Castlereagh Ironbark Forest between Bankstown and Strathfield.

Habitat:

Parent Geology: Tertiary alluvium (52%), Holocene alluvium (18%), Wianamatta Shale (30%)

	Mean (±sd)	Range
Elevation (m)	28.7 (16.5)	1– 61
Slope (° above horizontal)	1.1 (0.8)	0– 2.3
Annual Rainfall (mm)	853.6 (53.5)	799–960
Ruggedness (900m)	3.3 (1.1)	1–5
Maximum temperature, Jan. (°C)	27.9 (0.8)	26.7–29.1
Solar radiation, January	217.4 (1.0)	216–219

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	20.0 (7.5)	18.9 (11.0)
Small Tree	74	10.9 (4.0)	14.3 (10.8)
Shrub	100	3.7 (2.2)	34.8 (23.4)
Forb	100	0.4 (0.5)	17.9 (15.1)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 14 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 34 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 14 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Eucalyptus fibrosa	4	82	3	14	positive
Eucalyptus longifolia	1	29	2	1	positive
Melaleuca decora	4	89	3	9	positive
Shrub stratum					
Acacia elongata	2	29	2	3	positive
Acacia falcata	1	50	1	9	positive
Acacia pubescens	3	25	–	0	positive
Bursaria spinosa	2	46	3	49	constant
Daviesia ulicifolia	2	50	2	14	positive
Dillwynia tenuifolia	3	46	3	3	positive
Dodonaea falcata	3	21	–	0	positive
Lissanthe strigosa	3	68	2	19	positive
Melaleuca nodosa	4	82	3	7	positive
Olearia microphylla	1	43	1	6	positive
Ozothamnus diosmifolius	1	68	2	27	positive
Pultenaea parviflora	3	39	–	0	positive
Ground stratum					
Aristida vagans	2	71	2	44	positive

Austrodanthonia tenuior	2	61	2	14	positive
Calotis cuneifolia	2	21	2	2	positive
Cheilanthes sieberi subsp. *sieberi*	2	89	2	50	positive
Dianella revoluta var. *revoluta*	2	82	2	36	positive
Dichelachne micrantha	1	43	2	31	constant
Entolasia stricta	3	96	3	57	positive
Eragrostis brownii	2	54	2	19	positive
Goodenia hederacea subsp. *hederacea*	2	61	2	32	positive
Lagenifera stipitata	3	36	2	4	positive
Laxmannia gracilis	2	61	1	16	positive
Lepidosperma laterale	3	93	2	43	positive
Lomandra multiflora subsp. *multiflora*	2	71	2	49	constant
Microlaena stipoides var. *stipoides*	3	93	3	68	positive
Opercularia diphylla	3	79	2	33	positive
Panicum simile	2	61	2	32	positive
Paspalidium distans	2	61	2	25	positive
Pomax umbellata	3	57	2	34	constant
Pratia purpurascens	3	79	2	42	positive
Themeda australis	3	54	3	57	constant
Thysanotus tuberosus subsp. *tuberosus*	2	29	1	6	positive
Vernonia cinerea var. *cinerea*	2	54	2	17	positive
Climbers					
Cassytha glabella f. *glabella*	2	46	2	15	positive
Glycine clandestina	2	46	2	42	constant

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	2	7	2	13	uninform.
Angophora floribunda	4	7	2	8	uninform.
Angophora subvelutina	1	4	4	3	uninform.
Eucalyptus crebra	1	4	3	18	uninform.
Eucalyptus eugenioides	1	14	2	11	uninform.
Eucalyptus globoidea	3	4	2	8	uninform.
Eucalyptus moluccana	2	7	4	20	uninform.
Eucalyptus oblonga	4	4	2	9	uninform.
Eucalyptus parramattensis subsp. *parramattensis*	1	7	2	4	uninform.
Eucalyptus resinifera	4	4	1	4	uninform.
Eucalyptus sclerophylla	3	7	4	9	uninform.
Eucalyptus sideroxylon	1	4	4	1	uninform.
Eucalyptus tereticornis	1	7	4	25	uninform.
Syncarpia glomulifera	2	7	3	21	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Hypochaeris radicata	1	41	2	32	constant
Senecio madagascariensis	2	41	2	52	constant

Map Unit 103:

Shale Gravel Transition Forest

Sample Sites: (25)
Area (ha) 1750 / 1997 (± range): 5427 / 1721 (±170)
Proportion Extant (± range): 31.7 (±3.1)%
No. Taxa (total / unique): 216 / 1
No. Taxa per Plot (±sd): 45.1 (7.1)

Shale Gravel Transition Forest is usually dominated by *Eucalyptus fibrosa* with *E. moluccana* and *E. tereticornis* occurring less frequently, but sometimes dominating in the absence of *E. fibrosa*. *Melaleuca decora* is frequently present in a small tree stratum. A sparse shrub stratum is usually present and typically includes species such as *Bursaria spinosa*, *Daviesia ulicifolia* and *Lissanthe strigosa*. A variety of forb species were recorded with high frequency, including *Microlaena stipoides* subsp. *stipoides, Cheilanthes sieberi* subsp. *sieberi, Themeda australis, Opercularia diphylla, Lomandra multiflora* subsp. *multiflora, Aristida vagans, Pratia purpurascens and Wahlenbergia gracilis*.

Shale Gravel Transition Forest occurs primarily in areas where shallow deposits of Tertiary alluvium overlie shale soils, but also in association with localised concentrations of iron-indurated gravel. Ironstone accretions are more resistant to weathering than shale and may become concentrated on ridgelines through the long-term erosion of shale. This community is likely to have been found in the Auburn–Bankstown area in association with the gravels of the Villawood soil series (Walker 1960), although native vegetation in this area has been extensively cleared. Shale Gravel Transition Forest grades into Map Unit 10 as alluvial and ironstone influences decline. On thicker deposits of Tertiary alluvium it grades into Map Units 3 or 6. South of the Tertiary alluvial deposits at Holsworthy, this community apparently occurs on soils of the Mittagong Formation, and forms complex mosaics with shale/sandstone transitional communities.

Previous floristic classifications:

Shale Gravel Transition Forest corresponds to the community of the same name described by Benson (1992), (Map Unit 9d), and NPWS (1997), although differences exist in the extent of distribution recognised. These differences are primarily related to problems associated with classifying sites in a zone of transitional vegetation, and mainly involve areas being recognised as Castlereagh Ironbark Forest by one author and transitional by another.

Habitat:

Parent Geology: Tertiary alluvium (47%), Mittagong Formation (30%), Wianamatta Shale (14%), Holocene alluvium (3%), Aeolian Deposits (3%), Hawkesbury sandstone (3%)

	Mean (±sd)	Range
Elevation (m)	35.3 (16.8)	19–78
Slope (° above horizontal)	1.6 (1.8)	0–7.4
Annual Rainfall (mm)	845.3 (50.9)	788–968
Ruggedness (900m)	5.4 (5.7)	2–31
Maximum Temperature, Jan (°C)	28.0 (0.7)	26.9–29.0
Solar Radiation, January	217.0 (0.7)	215–218

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	21.9 (2.4)	20.3 (10.4)
Small Tree	68	11.2 (3.0)	8.4 (5.9)
Shrub	76	3.3 (1.5)	13.6 (14.5)
Forb	100	0.6 (0.5)	44.6 (24.6)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 15 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 37 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 15 positive diagnostic species.

C/A: Cover/Abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/Abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia parramattensis	2	40	2	22	constant
Eucalyptus fibrosa	4	64	4	15	positive
Eucalyptus moluccana	4	40	4	19	constant
Eucalyptus tereticornis	4	40	4	24	constant

Melaleuca decora	4	64	3	10	positive
Shrub stratum					
Acacia falcata	1	40	1	10	positive
Bursaria spinosa	3	84	3	47	positive
Daviesia ulicifolia	2	68	2	14	positive
Dillwynia sieberi	3	24	2	6	positive
Lissanthe strigosa	2	52	2	20	positive
Pultenaea villosa	2	20	2	3	positive
Ground stratum					
Agrostis avenacea var. *avenacea*	1	36	1	7	positive
Aristida vagans	2	88	2	43	positive
Austrodanthonia tenuior	3	52	2	15	positive
Brunoniella australis	3	60	3	33	constant
Calotis cuneifolia	2	20	2	3	positive
Cheilanthes sieberi subsp. *sieberi*	3	92	2	50	positive
Chorizema parviflorum	2	28	1	1	positive
Desmodium varians	3	68	2	33	positive
Dianella longifolia	2	52	2	18	positive
Dianella revoluta var. *revoluta*	3	56	2	37	constant
Dichelachne micrantha	3	68	2	30	positive
Dichondra repens	3	68	3	47	constant
Echinopogon caespitosus var. *caespitosus*	2	48	2	25	constant
Echinopogon ovatus	2	52	2	31	constant
Entolasia stricta	3	80	3	58	constant
Euchiton sphaericus	1	40	2	16	constant
Fimbristylis dichotoma	2	28	2	7	positive
Goodenia hederacea subsp. *hederacea*	2	68	2	32	positive
Hydrocotyle peduncularis	2	44	2	8	positive
Hypericum gramineum	2	56	2	18	positive
Lagenifera stipitata	3	24	2	4	positive
Laxmannia gracilis	2	52	1	16	positive
Lepidosperma laterale	3	56	2	44	constant
Lomandra filiformis subsp. *filiformis*	3	68	2	33	positive
Lomandra multiflora subsp. *multiflora*	2	92	2	49	positive
Microlaena stipoides var. *stipoides*	3	100	3	68	positive
Opercularia diphylla	3	96	2	33	positive
Oxalis perennans	2	56	2	26	positive
Panicum simile	3	56	2	33	constant
Paspalidium distans	2	44	2	26	constant
Pomax umbellata	3	52	2	35	constant
Poranthera microphylla	3	72	2	21	positive
Pratia purpurascens	2	84	2	42	positive
Themeda australis	4	84	3	56	positive
Thysanotus tuberosus subsp. *tuberosus*	2	28	1	6	positive
Tricoryne elatior	3	52	2	14	positive
Vernonia cinerea var. *cinerea*	2	52	2	17	positive
Wahlenbergia gracilis	2	76	2	28	positive
Climbers					
Glycine clandestina	2	68	2	41	constant
Hardenbergia violacea	2	48	1	30	constant
Polymeria calycina	2	24	1	5	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	4	4	2	13	uninform.
Angophora floribunda	4	8	2	8	uninform.
Angophora subvelutina	1	4	4	3	uninform.
Corymbia maculata	1	4	4	4	uninform.
Eucalyptus crebra	4	36	3	17	uninform.
Eucalyptus eugenioides	1	24	2	11	uninform.
Eucalyptus globoidea	3	12	2	8	uninform.
Eucalyptus punctata	4	8	3	25	uninform.
Eucalyptus sclerophylla	4	8	4	9	uninform.
Eucalyptus sparsifolia	5	4	3	4	uninform.
Syncarpia glomulifera	1	4	3	21	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Centaurium tenuiflorum	1	40	1	9	positive
Cirsium vulgare	1	44	1	34	constant
Gamochaeta americana	1	32	1	8	positive
Gamochaeta calviceps	1	28	1	5	positive
Hypochaeris radicata	2	52	1	31	constant
Senecio madagascariensis	1	84	2	50	positive
Sisymbrium species *A*	1	28	2	3	positive
Sonchus oleraceus	1	48	1	21	positive

Map Unit 4:

Castlereagh Swamp Woodland

Sample Sites: (7)
Area (ha) 1750 / 1997 (± range): 1006 / 616 (±27)
Proportion Extant (± range): 61.2 (±2.7)%
No. Taxa (total / unique): 145 / 12
No. Taxa per Plot (±sd): 44.0 (9.1)

Castlereagh Swamp Woodland is dominated by medium to dense stands of *Melaleuca decora* ranging in height from shrubs of 2–4 m to trees of 15–20 m. *Eucalyptus fibrosa*, *Angophora subvelutina* and *Melaleuca linariifolia* are present less frequently in both the tree and small tree strata. *Eucalyptus parramattensis* subsp. *parramattensis* is frequently present, but is usually represented by only a few individuals. Map Unit 4 has a poorly developed shrub layer consisting of young individuals of *M. decora*, *M. linariifolia* and, less frequently, *Bursaria spinosa* at low cover/abundance. The Ground stratum is often dense and diverse, and includes species tolerant of water-logged conditions such as *Goodenia paniculata*, *Schoenus apogon*, *Centella asiatica* and *Juncus usitatus*.

Castlereagh Swamp Woodland occurs in poorly drained depressions on soils derived from Tertiary alluvium, or on adjacent shale soils where the influence of Tertiary alluvium is strong. Its distribution is highly restricted, with the two main examples occurring in the Castlereagh and Holsworthy areas. Map Unit 4 was also identified at a sample site in the vicinity of Tertiary Alluvial deposits at Kemps Creek. An outlying sample is located north of Camden near the Nepean River, possibly related to Tertiary alluvium associated with the Theresa Park soil landscape. In better drained areas Map Unit 4 grades into Map Unit 6 and sometimes into Map Unit 3.

Previous floristic classifications:

Castlereagh Swamp Woodland corresponds to the community of the same name described by Benson (1992), (Map Unit 14c), and NPWS (1997), although differences exist in the extent of distribution recognised. In particular, this community is more restricted in distribution than previously described in the Castlereagh area. Castlereagh Swamp Woodland is listed as an Endangered Ecological Community under the NSW Threatened Species Act.

Habitat:

Parent Geology: Tertiary alluvium (57%), Wianamatta Shale (29%), Aeolian Deposits (14%)

	Mean (±sd)	Range
Elevation (m)	30.1 (17.8)	12–60
Slope (° above horizontal)	1.5 (3.1)	0–8.4
Annual Rainfall (mm)	807.4 (47.3)	729–871
Ruggedness (900m)	3.1 (2.7)	1–9
Maximum Temperature, Jan. (°C)	28.3 (7.0)	27.4–29.1
Solar Radiation, January	21.7 (0.1)	216–218

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	17.6 (5.1)	24.0 (19.4)
Small Tree	57	11.5 (1.0)	17.5 (9.6)
Shrub	100	4.1 (1.7)	5.9 (4.2)
Forb	86	0.7 (0.5)	53.2 (35.2)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 12 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 34 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 12 positive diagnostic species.

C/A: Cover/Abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/Abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora subvelutina	4	29	4	2	positive
Eucalyptus parramattensis subsp. *parramattensis*	1	57	2	3	positive
Melaleuca decora	5	86	3	11	positive
Melaleuca linariifolia	3	43	1	2	positive
Shrub stratum					
Bursaria spinosa	2	43	3	49	constant
Melaleuca thymifolia	1	29	2	2	positive
Ground stratum					
Agrostis avenacea var. *avenacea*	3	71	1	8	positive
Alternanthera denticulata	2	29	1	2	positive
Aristida vagans	1	43	2	45	constant
Austrodanthonia tenuior	1	57	2	16	constant
Brunoniella pumilio	2	43	2	19	constant
Centella asiatica	3	86	2	10	positive
Centipeda minima var. *minima*	2	43	2	1	positive
Cheilanthes sieberi subsp. *sieberi*	2	86	2	51	constant
Dianella longifolia	1	43	2	19	constant
Dichelachne micrantha	2	43	2	31	constant
Dichondra repens	2	71	3	47	constant
Entolasia stricta	3	57	3	59	constant
Epaltes australis	2	43	2	1	positive
Eragrostis brownii	2	57	2	20	constant
Eragrostis elongata	1	29	1	1	positive
Eragrostis leptostachya	2	43	2	23	constant
Euchiton gymnocephalum	2	29	1	1	positive
Euchiton sphaericus	1	43	2	17	constant
Fimbristylis dichotoma	3	57	2	7	positive
Goodenia paniculata	3	100	2	2	positive
Gratiola pedunculata	2	71	–	0	positive
Haloragis heterophylla	4	29	2	1	positive
Hemarthria uncinata var. *uncinata*	2	29	1	1	positive
Hydrocotyle peduncularis	3	71	2	9	positive
Hypericum gramineum	2	71	2	19	positive
Hypoxis hygrometrica	2	57	2	10	positive
Isolepis inundata	4	43	2	1	positive
Juncus planifolius	3	43	2	1	positive
Juncus prismatocarpus	3	29	–	0	positive
Juncus usitatus	3	86	1	9	positive
Lepyrodia muelleri	4	43	–	0	positive
Lomandra longifolia	4	57	2	32	constant
Lomandra multiflora subsp. *multiflora*	2	71	2	50	constant
Lythrum hyssopifolia	3	43	–	0	positive
Microlaena stipoides var. *stipoides*	3	86	3	69	constant
Opercularia diphylla	2	86	2	34	positive
Panicum simile	2	43	2	33	constant
Paspalidium distans	1	71	2	26	constant
Paspalum orbiculare	1	43	–	0	positive
Poranthera microphylla	2	71	2	23	positive
Pratia purpurascens	3	86	2	43	constant
Schoenus apogon	2	100	1	2	positive
Themeda australis	2	86	3	57	constant
Tricoryne elatior	2	43	2	15	constant
Wahlenbergia gracilis	1	43	2	30	constant
Wurmbea dioica subsp. *dioica*	4	29	2	2	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	4	14	2	8	uninform.
Eucalyptus amplifolia	1	29	4	4	uninform.
Eucalyptus eugenioides	1	14	2	11	uninform.
Eucalyptus fibrosa	4	29	4	16	uninform.
Eucalyptus sclerophylla	1	14	4	9	uninform.
Eucalyptus sideroxylon	4	14	3	1	uninform.
Eucalyptus tereticornis	4	29	4	24	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Andropogon virginicus	3	29	1	1	positive
Aster subulatus	1	43	1	3	positive
Briza minor	2	43	2	1	positive
Centaurium erythraea	1	29	2	2	positive
Ciclospermum leptophyllum	2	43	1	10	constant
Cyperus eragrostis	2	29	2	2	positive
Gamochaeta calviceps	1	43	1	6	positive
Gamochaeta calviceps	1	28	1	5	positive
Hypochaeris radicata	3	71	1	31	constant
Paspalum urvillei	4	29	2	2	positive
Plantago lanceolata	2	43	2	26	constant
Senecio madagascariensis	3	57	2	52	constant
Setaria gracilis	3	71	2	25	constant
Sisymbrium species *A*	1	28	2	3	positive
Sonchus oleraceus	1	71	1	21	positive

Map Unit 6:

Castlereagh Scribbly Gum Woodland

Sample sites: (26)
Area (ha) 1750 / 1997 (± range): 5852 / 3083 (±171)
Proportion extant (± range): 52.7 (±2.9)%
No. taxa (total / unique): 226 / 13
No. taxa per Plot (±sd): 48.8 (±7.2)

Castlereagh Scribbly Gum Woodland is dominated by *Eucalyptus parramattensis* subsp. *parramattensis*, *Angophora bakeri* and *E. sclerophylla*. A small tree stratum of *Melaleuca decora* is sometimes present, generally in areas with poorer drainage. It has a well developed shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa* subsp. *spinulosa*, *M. nodosa*, *Hakea sericea* and *H. dactyloides*. The ground stratum contains a diverse range of forbs including *Themeda australis*, *Entolasia stricta*, *Cyathochaeta diandra*, *Dianella revoluta* subsp. *revoluta*, *Stylidium graminifolium*, *Platysace ericoides*, *Laxmannia gracilis* and *Aristida warburgii*.

Castlereagh Scribbly Gum Woodland occurs almost exclusively on soils derived from Tertiary alluvium, with a small number of sample sites located on adjoining shale or Holocene alluvium where, presumably, the influence of Tertiary alluvium is strong. It is most often found on sandy soils and tends to occur on slightly higher ground (> 27 m) than Map Units 3 and 103, at least in the heart of the Castlereagh area. The Castlereagh Nature Reserve is an exception to

this rule with Castlereagh Ironbark Forest occurring on an area of localised, elevated clay soil. Map Unit 6 grades into either Map Unit 3 or Map Unit 103 with decreasing distance from the Shale/Tertiary alluvium Boundary. The transition is unpredictable, but appears to be a function of the interaction of localised drainage conditions and the thickness of the Tertiary alluvium mantle. The main occurrence of Castlereagh Scribbly Gum Woodland is in the Castlereagh Area, with small patches occurring at Kemps Creek and Longneck Lagoon. This community is also present around Holsworthy, however the floristic composition in this area is closer to Map Unit 3 than at other localities.

Previous floristic classifications:

Castlereagh Scribbly Gum Woodland corresponds to the community of the same name described by Benson (1992), (Map Unit 14a), and NPWS (1997).

Habitat:

Parent Geology: Tertiary alluvium (90%), Holocene alluvium (5%), Wianamatta Shale (5%)

	Mean (±sd)	Range
Elevation (m)	33.1 (10.7)	7–63
Slope (° above horizontal)	0.7 (0.7)	0–1.6
Annual Rainfall (mm)	812.4 (26.2)	781–917
Ruggedness (900m)	2.1 (0.9)	0–4
Maximum temperature, Jan. (°C)	28.8 (4.5)	27.1–29.0
Solar radiation, January	216.3 (0.7)	216–218

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	13.8 (3.1)	15.1 (8.9)
Small tree	40	8.4 (3.5)	7.5 (2.9)
Shrub	100	2.2 (0.9)	22.2 (11.6)
Forb	100	0.7 (0.5)	33.8 (30.1)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 24 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 39 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 24 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	3	73	2	11	positive
Eucalyptus parramattensis subsp. *parramattensis*	2	77	1	1	positive
Eucalyptus sclerophylla	4	69	4	7	positive
Melaleuca decora	4	58	3	10	positive
Shrub stratum					
Acacia brownii	2	54	1	2	positive
Acacia elongata	2	46	2	2	positive
Banksia oblongifolia	2	35	2	4	positive
Banksia spinulosa var. *spinulosa*	3	81	2	23	positive
Bossiaea rhombifolia subsp. *rhombifolia*	2	23	3	2	positive
Callistemon pinifolius	1	38	2	1	positive
Cryptandra amara var. *amara*	2	23	2	2	positive
Daviesia squarrosa	2	42	1	1	positive
Daviesia ulicifolia	2	54	2	14	positive
Dillwynia tenuifolia	3	58	3	3	positive
Gompholobium pinnatum	2	27	–	0	positive
Grevillea mucronulata	2	73	2	14	positive
Hakea dactyloides	2	77	1	15	positive
Hakea sericea	3	81	2	20	positive
Isopogon anemonifolius	1	38	2	14	positive
Leptospermum polygalifolium subsp. *polygalifolium*	2	31	2	6	positive
Leptospermum trinervium	3	54	2	27	constant
Lissanthe strigosa	2	42	2	20	constant
Melaleuca erubescens	1	31	2	1	positive
Melaleuca nodosa	3	81	3	7	positive
Melaleuca thymifolia	2	35	1	1	positive
Micromyrtus ciliata	2	35	–	0	positive
Micromyrtus minutiflora	2	27	–	0	positive
Persoonia nutans	1	35	–	0	positive
Pimelea linifolia subsp. *linifolia*	2	85	2	26	positive
Pultenaea elliptica	2	54	2	7	positive
Ground stratum					
Aristida ramosa	2	50	2	19	positive
Aristida vagans	2	50	2	45	constant
Aristida warburgii	2	58	1	2	positive
Boronia polygalifolia	1	27	2	2	positive
Burchardia umbellata	2	31	1	1	positive
Cheilanthes sieberi subsp. *sieberi*	2	58	2	51	constant
Cyathochaeta diandra	3	88	2	20	positive
Dampiera stricta	1	35	2	9	positive
Dianella revoluta var. *revoluta*	2	77	2	36	positive
Entolasia stricta	3	96	3	57	positive
Eragrostis brownii	2	77	2	18	positive
Gonocarpus tetragynus	2	81	2	20	positive
Goodenia bellidifolia subsp. *bellidifolia*	3	35	2	5	positive
Goodenia paniculata	2	27	2	2	positive
Haemodorum planifolium	1	35	1	3	positive
Hypericum gramineum	2	54	2	18	positive
Laxmannia gracilis	2	50	1	17	positive
Lepyrodia scariosa	3	50	2	7	positive
Lomandra glauca	2	31	2	8	positive
Lomandra multiflora subsp. *multiflora*	2	81	2	49	positive
Microlaena stipoides var. *stipoides*	2	69	3	69	constant
Mitrasacme polymorpha	2	23	1	2	positive
Opercularia diphylla	2	73	2	34	positive
Panicum effusum	3	23	2	6	positive
Panicum simile	2	62	2	32	positive
Patersonia sericea	1	50	1	10	positive
Platysace ericoides	2	50	2	10	positive
Pomax umbellata	2	46	2	35	constant
Ptilothrix deusta	3	23	3	6	positive
Stylidium graminifolium	3	69	1	7	positive
Themeda australis	3	85	3	56	positive
Thysanotus tuberosus subsp. *tuberosus*	2	27	1	6	positive
Xanthorrhoea minor subsp. *minor*	2	77	1	2	positive
Climbers					
Cassytha glabella f. *glabella*	2	58	2	14	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Corymbia gummifera	1	12	2	30	uninform.
Eucalyptus beyeriana	4	4	–	0	uninform.
Eucalyptus eugenioides	3	4	2	12	uninform.
Eucalyptus fibrosa	2	27	4	16	uninform.
Eucalyptus longifolia	2	4	1	2	uninform.
Eucalyptus sideroxylon	3	15	–	0	uninform

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Hypochaeris radicata	2	45	1	31	constant

Map Unit 8:

Agnes Banks Woodland

Sample sites: (2)
Area (ha) 1750 / 1997 (± range): 627 / 98 (±8)
Proportion extant (± range): 15.6 (±1.3)%
No. taxa (total / unique): 56 / 1
No. taxa per plot (±sd): 33.0 (±4.2)

Map Unit 8 is a low woodland dominated By *Eucalyptus sclerophylla* and *Angophora bakeri* with a diverse understorey of sclerophyllous shrub species. These include *Banksia oblongifolia, B. aemula, Conospermum taxifolium, Leptospermum trinervium, Dillwynia sericea, Monotoca scoparia and Persoonia nutans*. The ground stratum includes *Lepidosperma urophorum, Platysace ericoides, Pimelea linifolia* subsp *linifolia, Mitrasacme polymorpha, Trachymene incisa* subsp. *incisa* and *Stylidium graminifolium*.

This community is restricted to small areas of sand dunes overlying Tertiary alluvium at Agnes Banks on the east bank of the Hawkesbury River. In low-lying, poorly drained areas Map Unit 8 grades into Map Unit 3. On higher ground where the aeolian sand deposits overlay sandy alluvial soils the transition is to Map Unit 6, to which Map Unit 8 is closely related.

Previous floristic classifications:

Castlereagh Swamp Woodland corresponds to the community of the same name described by Benson (1992).

Habitat:

Parent Geology: Aeolian Deposits (100%)

	Mean	(±sd)	Range
Elevation (m)	30.5	(0.7)	30–31
Slope (° above horizontal)	0.6	(0.9)	0–1.3
Annual rainfall (mm)	803.0	(0.0)	0–803
Ruggedness (900m)	1.0	(0.0)	1–1
Maximum temperature, Jan. (°C)	29.1	(0.0)	29.1–29.1
Solar radiation, January	216.0	(0.0)	216–216

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	15.0 (0.0)	12.5 (3.5)
Small tree	50	8.0 (–)	20.0 (–)
Shrub	100	3.3 (2.5)	26.7 (5.8)
Forb	100	0.1 (0.0)	22.5 (24.7)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 19 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 28 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 19 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	5	100	2	13	positive
Eucalyptus sclerophylla	4	100	4	9	positive
Shrub stratum					
Acacia brownii	1	50	1	4	constant
Acacia elongata	1	50	2	4	constant
Acacia ulicifolia	1	50	1	24	constant
Amperea xiphoclada	3	50	1	2	positive
Baeckea diosmifolia	2	50	2	1	positive
Banksia aemula	4	50	–	0	positive
Banksia oblongifolia	3	100	2	5	positive
Bossiaea heterophylla	1	50	2	8	constant
Bossiaea rhombifolia subsp. *rhombifolia*	3	50	2	3	positive
Brachyloma daphnoides	3	50	1	5	constant
Callistemon citrinus	1	50	–	0	positive
Callistemon linearis	2	50	1	2	positive
Conospermum taxifolium	3	100	–	0	positive
Dillwynia floribunda	1	50	2	2	positive
Dillwynia sericea	2	100	2	3	positive
Gompholobium huegelii	1	50	2	1	positive
Hibbertia fasciculata	2	50	–	0	positive
Isopogon anemonifolius	2	50	2	15	constant
Isopogon anethifolius	1	50	2	1	positive
Kunzea capitata	3	50	2	3	positive
Leptospermum polygalifolium subsp. *polygalifolium*	4	50	2	7	constant
Leptospermum trinervium	3	100	2	28	positive
Leucopogon virgatus	1	50	2	2	positive
Monotoca scoparia	3	100	1	15	positive
Olax stricta	2	50	1	1	positive
Persoonia linearis	1	50	2	32	constant
Persoonia nutans	2	100	1	1	positive
Petrophile pulchella	1	50	1	4	constant
Philotheca salsolifolia	3	50	3	1	positive
Pimelea linifolia subsp. *linifolia*	3	100	2	28	positive
Ricinocarpos pinifolius	3	50	1	3	positive
Ground stratum					
Caleana major	3	50	–	0	positive
Cyathochaeta diandra	4	50	2	23	constant
Dianella revoluta var. *revoluta*	2	50	2	37	constant
Haemodorum corymbosum	2	50	1	2	positive
Lepidosperma laterale	2	50	2	45	constant
Lepidosperma urophorum	3	100	2	1	positive
Leptocarpus tenax	4	50	–	0	positive
Lepyrodia scariosa	5	50	2	9	constant
Lomandra glauca	3	50	2	9	constant
Mitrasacme polymorpha	2	100	1	3	positive
Platysace ericoides	3	100	2	11	positive
Schizaea bifida	1	50	1	3	constant
Schoenus imberbis	2	50	1	2	positive
Stylidium graminifolium	3	100	2	9	positive
Themeda australis	1	50	3	57	constant
Trachymene incisa subsp. *incisa*	3	100	2	3	positive
Xanthorrhoea minor subsp. *minor*	2	50	2	5	constant
Climbers					
Cassytha glabella f. *glabella*	2	50	2	16	constant
Cassytha pubescens	1	50	2	19	constant

Map Unit 11:

Alluvial Woodland

Sample sites: (37)
Area (ha) 1750 / 1997 (± range): 36129 / 4698 (±903)
Proportion extant (± range): 13.0 (±2.5)%
No. taxa (total / unique): 256 / 11
No. taxa per plot (±sd): 37.5 (±11.7)

Alluvial Woodland is most often dominated by *Eucalyptus amplifolia* and *E. tereticornis* with *Angophora floribunda* occurring less frequently. Map Unit 11 often includes a stratum of small trees, frequently including *Acacia parramattensis* subsp. *parramattensis*, and less frequently *Casuarina glauca, Angophora floribunda* and *Melaleuca linariifolia*. A shrub stratum is usually evident, but is often sparse and invariably dominated by *Bursaria spinosa*. Map Unit 11 often has a dense ground cover dominated by grasses such as

Oplismenus aemulus, *Microlaena stipoides* var. *stipoides*, *Entolasia marginata* and *Echinopogon ovatus*. Herb species are also common, including *Solanum prinophyllum*, *Pratia purpurascens* and *Commelina cyanea*.

Map Unit 11 typically occurs in close proximity to minor watercourses draining soils derived from Wianamatta Shale. It is the most common community found on soils of recent alluvial deposition. Map Unit 11 is also found on the floodplains of the major watercourse, the Hawkesbury–Nepean River, but grades into Map Unit 12 on the terraces immediately adjacent to the river.

Previous floristic classifications:

River Flat Forest as described by Benson (1992), (Map Unit 9f), is herein divided into three separate communities: Map Units 11, 12 and 5. Map Units 11 and 12 correspond to the major groupings: Cumberland Plain Creek Systems and Hawkesbury–Nepean River and major Tributaries defined by NPWS (1997). Map Unit 5 was included as a component of the riverine vegetation by both Benson (1992) and NPWS (1997). Forest Red Gum–Cabbage Gum Forest, Forest Red Gum – Blue Gum Forest and Swamp Oak Forest (*sensu* NPWS 1997) are included in Map Unit 11. Camden White Gum Forest as described by Benson (1992), (Map Unit 6d), is included within Map Unit 12. Map Units 11, 12 and 5 fall within the definition of Sydney Coastal River Flat Forest listed under the *TSC Act* (1995).

Habitat:

Parent Geology: Holocene alluvium (59%), Wianamatta Shale (22%), Mittagong Formation (8%), Hawkesbury Sandstone (8%), Tertiary alluvium (3%)

	Mean (±sd)	Range
Elevation (m)	78.6 (91.8)	3–303
Slope (° above horizontal)	2.2 (3.1)	0–13.5
Annual Rainfall (mm)	811.2 (45.5)	707–895
Ruggedness (900m)	6.6 (3.5)	2–18
Maximum Temperature, Jan. (°C)	28.3 (0.6)	27.1–29.1
Solar Radiation, January	215.5 (2.2)	210–219

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	23.7 (5.5)	23.2 (11.7)
Small tree	78	11.6 (4.2)	14.5 (8.5)
Shrub	92	3.7 (1.3)	12.9 (9.6)
Forb	95	0.5 (0.6)	60.9 (25.0)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 12 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 23 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 12 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia parramattensis	3	84	2	19	positive
Angophora floribunda	2	32	2	6	positive
Casuarina glauca	4	32	3	1	positive
Eucalyptus amplifolia	4	46	4	2	positive
Eucalyptus tereticornis	2	46	4	23	positive
Shrub stratum					
Acacia floribunda	3	32	1	6	positive
Bursaria spinosa	3	100	3	46	positive
Phyllanthus similis	3	30	2	1	positive
Sigesbeckia orientalis subsp. *orientalis*	2	49	2	7	positive
Ground stratum					
Adiantum aethiopicum	3	43	2	10	positive
Agrostis avenacea var. *avenacea*	1	24	1	7	positive
Brunoniella australis	3	54	3	33	constant
Centella asiatica	2	49	2	9	positive
Cheilanthes sieberi subsp. *sieberi*	2	51	2	52	constant
Commelina cyanea	3	59	2	10	positive
Desmodium varians	2	57	2	33	constant
Dichondra repens	3	97	3	45	positive
Echinopogon ovatus	3	84	2	29	positive
Einadia hastata	1	30	2	10	positive
Entolasia marginata	3	89	2	22	positive
Galium propinquum	2	35	2	9	positive
Juncus usitatus	2	35	1	8	positive
Lomandra longifolia	2	57	2	31	positive
Microlaena stipoides var. *stipoides*	4	97	3	67	positive
Oplismenus aemulus	3	95	2	15	positive
Oxalis perennans	3	57	2	26	positive
Plectranthus parviflorus	2	38	2	8	positive
Poranthera microphylla	2	41	2	22	constant
Pratia purpurascens	2	68	2	42	positive
Solanum prinophyllum	2	70	2	25	positive
Wahlenbergia gracilis	2	49	2	29	constant
Climbers					
Clematis glycinoides var. *glycinoides*	2	49	2	12	positive
Geitonoplesium cymosum	1	24	2	5	positive
Glycine clandestina	2	54	2	41	constant
Glycine tabacina	3	57	2	25	positive
Polymeria calycina	1	24	1	5	positive
Rubus parvifolius	2	35	2	5	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora subvelutina	4	14	4	2	uninform.
Corymbia maculata	4	3	4	4	uninform.
Eucalyptus baueriana	5	5	3	1	uninform.
Eucalyptus deanei	3	3	4	1	uninform.
Eucalyptus elata	1	3	–	0	uninform.
Eucalyptus eugenioides	1	19	2	11	uninform.
Eucalyptus globoidea	1	8	2	8	uninform.
Eucalyptus moluccana	1	14	4	20	uninform.
Eucalyptus piperita	1	3	2	7	uninform.
Eucalyptus punctata	1	8	3	25	uninform.
Eucalyptus sclerophylla	1	3	4	9	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Ligustrum sinense	1	46	1	13	positive
Olea europaea subsp. *africana*	2	41	2	26	constant
Ground stratum					
Anagallis arvensis	1	24	2	8	positive
Bidens pilosa	2	43	1	14	positive
Ciclospermum leptophyllum	2	27	1	9	positive
Cirsium vulgare	2	59	1	32	positive
Hypochaeris radicata	2	41	1	31	constant
Lantana camara	1	35	2	14	positive
Paspalum dilatatum	2	43	2	13	positive
Plantago lanceolata	2	46	2	24	constant
Senecio madagascariensis	2	57	2	51	constant
Setaria gracilis	2	46	2	25	constant
Sida rhombifolia	2	76	2	21	positive
Solanum chenopodioides	1	22	1	3	positive

Solanum pseudocapsicum	2	43	1	4	positive
Sonchus oleraceus	2	43	1	20	positive
Tradescantia fluminensis	3	32	4	3	positive
Climbers					
Araujia sericiflora	2	54	2	14	positive

Map Unit 5:

Riparian Woodland

Sample Sites: (2)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): N/A
No. Taxa (total / unique): 45 / 11
No. Taxa per Plot (±sd): 23.5 (±2.1)

Map Unit 5 is a highly restricted community occurring within creeklines and adjacent swampy areas draining Wianamatta Shale soils. It is likely to be found in association with Map Unit 11, but is distinct from this community in occupying the wettest areas along watercourses. Although poorly sampled in this study, Map Unit 5 is likely to have an overstorey dominated by *Eucalyptus amplifolia* and *Casuarina glauca*. A shrub stratum is not usually present, but the ground stratum may be dense and include species such as *Alternanthera denticulata, Carex appressa, Persicaria decipiens* and *Juncus usitatus.*

Previous floristic classifications:

Riparian Woodland was included in a discussion on Riparian Habitats by NPWS (1997).

Habitat:

Parent Geology: Wianamatta Shale (50%), Holocene alluvium (50%)

	Mean	(±sd)	Range
Elevation (m)	34.0	(5.7)	30–38
Slope (° above horizontal)	1.3	(0.5)	0.9–1.7
Annual Rainfall (mm)	829.0	(0.0)	829–929
Ruggedness (900m)	3.5	(0.7)	3–4
Maximum Temperature, Jan. (°C)	27.9	(0.4)	27.6–28.2
Solar Radiation, January	217.0	(0.0)	217–217

Structure:

Growth form	Frequency (%)	Mean height (m)	(±sd)	Mean foliage cover (%)	(±sd)
Tree	100	26.0	(8.5)	27.5	(31.8)
Small Tree	50	10	(–)	15	(–)
Rushes	50	2	(–)	5	(–)
Forb	100	0.5	(0.7)	57.5	(3.5)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 14 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 21 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 14 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Casuarina glauca	6	50	3	3	positive
Eucalyptus amplifolia	4	50	4	4	constant
Melaleuca styphelioides	1	50	4	3	constant
Shrub stratum					
Bursaria spinosa	1	50	3	49	constant
Ground stratum					
Agrostis avenacea var. *avenacea*	3	100	1	8	positive
Alternanthera denticulata	4	100	1	2	positive
Azolla filiculoides var. *rubra*	2	50	–	0	positive
Brunoniella australis	1	50	3	34	constant
Cardamine paucijuga	1	50	1	1	positive
Carex appressa	3	100	2	2	positive
Centella asiatica	4	50	2	11	constant
Centipeda minima var. *minima*	3	50	2	1	positive
Commelina cyanea	2	50	2	13	constant
Cynodon dactylon	4	100	2	5	positive
Damasonium minus	4	100	–	0	positive
Echinopogon ovatus	2	50	2	32	constant
Eclipta platyglossa	2	50	2	1	positive
Elatine gratioloides	4	50	–	0	positive
Eleocharis cylindrostachys	1	50	–	0	positive
Eleocharis sphacelata	2	50	–	0	positive
Entolasia marginata	1	50	2	26	constant
Eriochloa pseudoacrotricha	1	50	1	2	positive
Isolepis inundata	1	50	2	1	positive
Juncus planifolius	4	50	2	1	positive
Juncus usitatus	3	100	1	10	positive
Lemna disperma	3	50	–	0	positive
Ludwigia peploides subsp. *montevidensis*	3	50	–	0	positive
Lythrum hyssopifolia	1	50	3	1	positive
Marsilea hirsuta	1	50	–	0	positive
Maundia triglochinoides	1	50	–	0	positive
Microlaena stipoides var. *stipoides*	2	50	3	69	constant
Myriophyllum simulans	2	50	–	0	positive
Paspalum distichum	3	50	–	0	positive
Persicaria decipiens	4	100	1	1	positive
Pratia purpurascens	3	50	2	44	constant
Ranunculus inundatus	2	50	–	0	positive
Triglochin microtuberosum	1	50	–	0	positive
Triglochin striatum	5	50	–	0	positive
Typha orientalis	3	50	–	0	positive
Climbers					
Glyceria australis	5	50	–	0	positive
Parsonsia straminea	1	50	1	4	constant

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Ligustrum sinense	1	50	1	15	constant
Olea europaea subsp. *africana*	2	50	2	27	constant
Shrub stratum					
Rubus sp.	1	50	1	5	constant
Sida rhombifolia	1	50	2	24	constant
Solanum pseudocapsicum	3	50	1	6	constant
Verbena bonariensis	3	50	1	5	constant
Ground stratum					
Anagallis arvensis	2	50	1	9	constant
Aster subulatus	1	100	1	3	positive
Bidens pilosa	2	50	1	16	constant
Bryophyllum delagoense	1	50	3	1	positive
Ciclospermum leptophyllum	1	50	1	10	constant
Cirsium vulgare	1	50	1	34	constant
Cotula coronopifolia	1	50	–	0	positive
Crassula sarmentosa var sarmentosa	1	50	–	0	positive
Cyperus eragrostis	4	100	2	2	positive
Leontodon taraxacoides subsp *taraxacoides*	3	50	2	11	constant
Paspalum dilatatum	2	50	2	15	constant
Plantago lanceolata	3	50	2	26	constant
Senecio madagascariensis	2	50	2	52	constant
Setaria gracilis	3	50	2	26	constant
Solanum nigrum	1	50	1	18	constant
Sonchus oleraceus	3	100	1	22	positive
Tradescantia fluminensis	3	50	3	5	constant

Climbers					
Araujia sericiflora	2	50	2	17	constant
Myriophyllum aquaticum	2	50	–	0	positive
Myrsiphyllum asparagoides	3	50	2	22	constant

Map Unit 12:

Riparian Forest

Sample Sites: (9)
Area (ha) 1750 / 1997 (± range): 2989 / 717 (±137)
Proportion Extant (± range): 24.0 (±4.6)%
No. Taxa (total / unique): 113 / 5
No. Taxa per Plot (±sd): 30.9 (±7.6)

Riparian Forest is dominated by one or more of the following tree species: *Eucalyptus botryoides*, *E. elata* and *Angophora subvelutina*. A small tree stratum is usually present, and often contains species such as *Acacia binervia*, *A. floribunda* and *A. mearnsii*, although no particular species occurred consistently across the sample sites. Common species occurring in the ground stratum include *Oplismenus aemulus*, *Pteridium esculentum*, *Microlaena stipoides* var. *stipoides*, *Stipa ramosissima* and *Echinopogon ovatus*.

Map Unit 12 is not widely distributed and only occurred at sample sites on the banks of the Hawkesbury–Nepean River or on the terraces immediately adjacent to the river.

Previous floristic classifications:

Riparian Forest falls within Benson's (1992) River Flat Forest (Map Unit 9f), but includes Map Unit 6d, Camden White Gum Forest. This community falls within the definition of the Sydney Coastal River Flat Forest listed under the *TSC Act* (1995). The relationship between these communities is discussed in more detail in the description of Map Unit 11. Riparian Forest broadly corresponds with NPWS (1997) grouping Hawkesbury–Nepean River and Major Tributaries and includes the sub-units Blue Gum – River Peppermint – Blue Box Forest, Camden White Gum – River Peppermint Forest, Cabbage Gum – Broad-leaved Apple Forest, River-Oak Forest and possibly Swamp Mahogany Forest (NPWS 1997).

Habitat:

Parent Geology: Holocene alluvium (100%)

	Mean (±sd)	Range
Elevation (m)	43.1 (26.3)	10–73
Slope (° above horizontal)	3.5 (4.0)	0–10.6
Annual Rainfall (mm)	769.2 (68.3)	708–861
Ruggedness (900m)	5.9 (3.9)	2–14
Maximum Temperature, Jan. (°C)	28.0 (0.4)	27.5–28.8
Solar Radiation, January	215.1 (1.8)	213–217

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	24.7 (5.9)	20.9 (11.5)
Small Tree	89	12.0 (3.3)	23.8 (15.5)
Shrub	100	4.0 (1.8)	14.6 (20.4)
Forb	100	1.0 (0.0)	46.3 (27.7)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 6 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 17 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 6 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia binervia	4	44	4	1	positive
Angophora subvelutina	4	44	4	2	positive
Backhousia myrtifolia	3	33	5	2	positive
Eucalyptus benthamii	3	22	–	0	positive
Eucalyptus botryoides	5	33	–	0	positive
Eucalyptus elata	4	33	–	0	positive
Stenocarpus salignus	1	22	1	1	positive
Shrub stratum					
Acacia floribunda	3	44	1	7	positive
Hymenanthera dentata	3	67	2	2	positive
Lomatia myricoides	2	33	2	1	positive
Phebalium squamulosum subsp. *squamulosum*	2	33	–	0	positive
Phyllanthus gunnii	3	44	2	2	positive
Sigesbeckia orientalis subsp. *orientalis*	3	44	2	8	positive
Austrostipa ramosissima	3	78	2	2	positive
Carex longebrachiata	2	22	2	2	positive
Cyperus enervis	3	22	2	1	positive
Dichelachne crinita	3	22	–	0	positive
Dichondra repens	3	78	3	47	constant
Echinopogon ovatus	2	67	2	32	constant
Entolasia marginata	2	44	2	26	constant
Gonocarpus longifolius	3	22	–	0	positive
Hydrocotyle laxiflora	2	22	2	2	positive
Lomandra longifolia	2	56	2	32	constant
Microlaena stipoides var. *stipoides*	4	100	3	69	positive
Oplismenus aemulus	3	89	2	18	positive
Oxalis perennans	3	44	2	27	constant
Pelargonium inodorum	1	22	–	0	positive
Poa affinis	3	44	2	7	positive
Poranthera microphylla	3	56	2	23	constant
Pratia purpurascens	3	56	2	43	constant
Pteridium esculentum	3	78	2	14	positive
Rumex brownii	1	33	1	4	positive
Veronica plebeia	3	56	2	22	constant
Wahlenbergia gracilis	2	56	2	29	constant
Climbers					
Glycine clandestina	2	56	2	42	constant

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	1	22	2	7	uniform.
Eucalyptus baueriana	3	11	4	1	uniform.
Eucalyptus saligna × *botryoides*	5	11	–	0	uniform.
Eucalyptus tereticornis	2	11	4	25	uniform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Celtis occidentalis	4	22	1	1	positive
Gleditsia triacanthos	2	33	–	0	positive
Ligustrum sinense	3	100	1	14	positive
Olea europaea subsp. *africana*	3	56	2	27	constant
Shrub stratum					
Sida rhombifolia	1	67	2	24	constant
Ground stratum					
Acetosella vulgaris	3	33	–	0	positive
Bidens pilosa	2	44	1	16	constant
Bromus catharticus	1	22	1	2	positive
Delairea odorata	3	33	–	0	positive
Ehrharta erecta	5	33	2	3	positive
Lonicera japonica	4	44	1	1	positive
Polycarpon tetraphyllum	2	22	1	1	positive

Senecio madagascariensis	3	44	2	52	constant
Setaria gracilis	1	78	2	25	positive
Tradescantia fluminensis	5	67	3	4	positive
Climbers					
Araujia sericiflora	2	56	2	17	constant
Cardiospermum grandiflorum	3	44	2	1	positive
Myrsiphyllum asparagoides	2	44	2	22	constant
Passiflora subpeltata	2	22	–	0	positive

Map Unit 9:

Shale Hills Woodland

Sample Sites: (61)
Area (ha) 1750 / 1997 (± range): 38274 / 4309 (±596)
Proportion Extant (± range): 11.3 (±1.5)%
No. Taxa (total / unique): 260 / 14
No. Taxa per Plot (±sd): 37.5 (±6.9)

Map Unit 9 is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra* occurring less frequently. A small tree stratum is often present and frequently includes *Acacia implexa* together with a variety of the commonly occurring *Eucalyptus* species. Map Unit 9 typically has a shrub stratum dominated by *Bursaria spinosa*, and more rarely includes other species such as *A. falcata, Breynia oblongifolia, Indigofera australis* and *Dodonaea viscosa* subsp. *cuneata*. The ground stratum is variable in cover. A dense cover of grass and herb species is typical, but this may become quite sparse under a dense shrub canopy of *B. spinosa* or the exotic species *Olea europaea* subsp. *africana*. Species include *Dichondra repens, Brunoniella australis, Aristida ramosa, Desmodium varians, Microlaena stipoides* var. *stipoides, Themeda australis* and *Cheilanthes sieberi* subsp. *sieberi*.

Shale Hills Woodland occurs almost exclusively on soils derived from Wianamatta Shale however three sample sites were located on soils that were clearly alluvial in nature. This result is difficult to explain and no attempt was made to model the distribution of Map Unit 9 on this geology. Map Unit 9 is closely related to Map Unit 10 but there is a reasonably clear differentiation between the habitats of the two communities. Map Unit 9 is largely confined to the southern half of the study area and occurs at higher elevations and on steeper slopes than Map Unit 10. It is most often found on undulating country with a relatively high degree of ruggedness and rarely north of Mulgoa Nature Reserve and Prospect Reservoir. Sample sites at these locations were sometimes difficult to distinguish from Map Unit 10. On very steep, sheltered hillsides Map Unit 9 grades into Map Unit 14.

Previous floristic classifications:

Cumberland Plains Woodland as described by Benson 1992 (Map Units 9b?, 10c and 10d) and as listed under the *TSC Act* (1995), is herein divided into two separate communities: Map Units 9 and 10. Map Unit 9 includes areas previously recognised as Map Units 9b, 10c and 10d (Benson 1992), but most often corresponds with Map Unit 10d in the southern half of the study area. Although Benson (1992) ascribed vegetation in the north of the study area to Map Unit 10d these areas are included in Map Unit 10 in this survey.

Habitat:

Parent Geology: Wianamatta Shale (92%), Holocene alluvium (8%)

	Mean	(±sd)	Range
Elevation (m)	111.5	(68.8)	36–328
Slope (° above horizontal)	6.1	(5.3)	0–22.0
Annual Rainfall (mm)	811.6	(42.9)	722–903
Ruggedness (900m)	12.1	(7.5)	1–40
Maximum Temperature, Jan. (°C)	27.8	(5.9)	26.7–28.9
Solar Radiation, January	214.1	(3.3)	201–217

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	22.8 (6.1)	18.5 (9.4)
Small Tree	59	10.5 (4.2)	11.1 (11.4)
Shrub	95	3.8 (1.6)	19.6 (13.6)
Forb	100	0.5 (0.5)	43.9 (24.3)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 15 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 28 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 15 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia implexa	2	57	2	10	positive
Eucalyptus moluccana	4	70	4	15	positive
Eucalyptus tereticornis	4	70	4	20	positive
Shrub stratum					
Bursaria spinosa	4	92	3	45	positive
Dodonaea viscosa subsp. *cuneata*	1	11	2	2	positive
Phyllanthus virgatus	2	23	1	5	positive
Ground stratum					
Ajuga australis	2	25	1	4	positive
Aristida ramosa	3	84	2	15	positive
Arthropodium milleflorum	2	38	2	16	positive
Asperula conferta	2	61	2	6	positive
Austrodanthonia caespitosa	3	10	2	1	positive
Austrodanthonia racemosa var. *racemosa*	2	31	2	8	positive
Bothriochloa macra	1	28	1	2	positive
Brunoniella australis	3	85	3	29	positive
Carex inversa	2	62	2	6	positive
Cheilanthes distans	1	31	1	3	positive
Cheilanthes sieberi subsp. *sieberi*	2	69	2	50	constant
Chloris truncata	2	20	1	2	positive
Chloris ventricosa	3	41	2	4	positive
Crassula sieberiana	2	13	1	3	positive
Cyperus gracilis	2	48	2	7	positive
Desmodium brachypodum	2	46	1	6	positive
Desmodium varians	3	82	2	30	positive
Dichanthium sericeum	2	16	1	1	positive
Dichelachne micrantha	2	61	2	29	positive
Dichondra repens	3	97	3	43	positive
Echinopogon ovatus	2	48	2	31	constant
Einadia nutans	2	30	2	3	positive
Einadia polygonoides	3	13	2	1	positive
Einadia trigonos	2	23	2	5	positive
Elymus scaber var. *scaber*	1	20	1	1	positive
Eremophila debilis	2	31	2	5	positive
Eriochloa pseudoacrotricha	2	10	1	1	positive
Euchiton sphaericus	2	39	1	15	positive
Galium migrans	2	15	2	1	positive
Galium propinquum	2	23	2	9	positive
Geranium homeanum	2	15	2	3	positive
Geranium solanderi var. *solanderi*	1	15	1	2	positive
Hypericum gramineum	2	39	2	18	positive
Hypoxis hygrometrica	1	25	2	9	positive
Microlaena stipoides var. *stipoides*	3	79	3	68	constant
Oxalis perennans	2	52	2	25	positive

Panicum effusum	1	18	2	5	positive
Plectranthus parviflorus	2	26	2	8	positive
Poa labillardieri var. *labillardieri*	3	38	2	16	positive
Scleria mackaviensis	3	23	2	1	positive
Scutellaria humilis	2	13	2	2	positive
Senecio diaschides	1	13	1	1	positive
Senecio hispidulus var. *hispidulus*	2	15	2	4	positive
Sida corrugata	2	39	–	0	positive
Solanum prinophyllum	1	46	2	25	positive
Sorghum leiocladum	2	11	1	1	positive
Sporobolus creber	2	36	1	5	positive
Sporobolus elongatus	2	21	1	3	positive
Themeda australis	4	77	3	55	positive
Wahlenbergia gracilis	2	49	2	28	positive
Wahlenbergia stricta subsp. *stricta*	2	11	2	3	positive
Zornia dyctiocarpa var. *dyctiocarpa*	1	10	1	1	positive
Climbers					
Clematis glycinoides var. *glycinoides*	2	31	2	12	positive
Glycine microphylla	2	39	2	18	positive
Glycine tabacina	2	56	2	24	positive
Rubus parvifolius	2	18	2	6	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	3	3	2	8	uninform.
Angophora subvelutina	3	2	4	3	uninform.
Corymbia maculata	5	3	4	4	uninform.
Eucalyptus amplifolia	4	5	4	4	uninform.
Eucalyptus crebra	4	31	3	17	uninform.
Eucalyptus eugenioides	3	13	2	11	uninform.
Eucalyptus fibrosa	1	2	4	18	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Olea europaea subsp. *africana*	3	84	2	20	positive
Shrub stratum					
Sida rhombifolia	2	54	2	21	positive
Ground stratum					
Centaurium tenuiflorum	2	28	1	9	positive
Ciclospermum leptophyllum	1	28	1	8	positive
Cirsium vulgare	2	70	1	29	positive
Paspalum dilatatum	2	36	2	12	positive
Plantago lanceolata	2	59	2	21	positive
Richardia stellaris	1	21	1	6	positive
Senecio madagascariensis	2	87	2	47	positive
Solanum nigrum	1	38	1	15	positive
Araujia sericiflora	2	52	2	13	positive

Map Unit 10:

Shale Plains Woodland

Sample Sites: (93)
Area (ha) 1750 / 1997 (± range): 87175 / 6745 (±968)
Proportion Extant (± range): 7.7 (±1.1)%
No. Taxa (total / unique): 301 / 14
No. Taxa per Plot (±sd): 42.5 (±9.1)

Shale Plains Woodland is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra*, *E. eugenioides* and *Corymbia maculata* occurring less frequently. These species often form a separate small tree stratum, occasionally including other species such as *Exocarpos cupressiformis*, *Acacia parramattensis* subsp. *parramattensis* and *Acacia decurrens*. A shrub stratum is usually present and dominated by *Bursaria spinosa*. Common ground stratum species include *Dichondra repens, Aristida vagans, Microlaena stipoides var stipoides, Themeda australis, Brunoniella australis, Desmodium varians, Opercularia diphylla, Wahlenbergia gracilis* and *Dichelachne micrantha*.

Shale Plains Woodland is the most widely distributed community on the Cumberland Plain. It predominantly occurs on soils derived from Wianamatta Shale, but also occurs on Holocene alluvium in well-drained areas. Isolated patches of Map Unit 10 may be found on soils derived from the Mittagong Formation, but only in the vicinity of outcrops of almost pure shale. Very rarely, it may occur on soils derived from Tertiary alluvium, but it is more usual for Map Unit 10 to grade into Map Unit 103 near the boundary of Shale and Tertiary alluvium. Towards the edge of the Cumberland Plain Map Unit 10 grades into Map Unit 1 as the depth of the shale soil decreases and the influence of the underlying sandstone increases. In the southern half of the study area Map Unit 10 grades into Map Unit 9 with increasing elevation and ruggedness. This gradation commences on the gentle rises running south from Prospect Reservoir in the centre of the plain, and south of Mulgoa Nature Reserve on the western boundary of the plain.

Previous floristic classifications:

Cumberland Plains Woodland as described by Benson (1992) (Map Units 9b, 10c and 10d) and as listed under the NSW Threatened Species Act (1995), is herein divided into two separate communities: Map Unit 9 and Map Unit 10. Map Unit 10 includes areas previously recognised as Map Units 9b, 10c and 10d (Benson 1992), but most often corresponds with Map Unit 10c. Although Benson (1992) ascribed vegetation in the north of the study area to Map Unit 10d these areas are included in Map Unit 10 in this survey.

Habitat:

Parent Geology: Wianamatta Shale (68%), Holocene alluvium (21%), Mittagong Formation (4%), Tertiary alluvium (3%), Hawkesbury Sandstone (3%), Aeolian Deposits (1%)

	Mean	(±sd)	Range
Elevation (m)	55.1	(34.0)	1–167
Slope (° above horizontal)	2.1	(2.5)	0–17.4
Annual Rainfall (mm)	829.0	(38.8)	739–923
Ruggedness (900m)	6.2	(3.5)	1–22
Maximum Temperature, Jan. (°C)	28.1	(0.6)	27.0–29.1
Solar Radiation, January	216.5	(2.0)	203–219

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	20.8 (5.1)	17.2 (9.3)
Small Tree	57	9.8 (3.5)	9.5 (7.3)
Shrub	100	3.1 (1.3)	14.0 (9.6)
Forb	99	0.5 (0.5)	45.1 (19.2)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 22 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 30 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 22 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Eucalyptus crebra	4	31	3	16	positive
Eucalyptus eugenioides	2	22	2	10	positive
Eucalyptus moluccana	4	69	4	12	positive
Eucalyptus tereticornis	4	67	3	18	positive

Exocarpos cupressiformis	1	24	1	11	positive
Shrub stratum					
Bossiaea prostrata	2	16	1	6	positive
Bursaria spinosa	4	97	3	42	positive
Daviesia ulicifolia	2	39	2	12	positive
Dillwynia sieberi	2	33	2	2	positive
Dodonaea viscosa subsp. *cuneata*	2	12	1	2	positive
Indigofera australis	2	17	2	6	positive
Phyllanthus virgatus	2	32	2	3	positive
Pultenaea microphylla	3	8	1	1	positive
Ground stratum					
Agrostis avenacea var. *avenacea*	1	23	1	6	positive
Ajuga australis	2	17	1	4	positive
Aristida ramosa	2	55	2	16	positive
Aristida vagans	3	91	2	38	positive
Arthropodium milleflorum	2	45	2	14	positive
Arthropodium minus	1	8	2	2	positive
Asperula conferta	2	32	2	7	positive
Austrodanthonia racemosa var. *racemosa*	2	30	2	7	positive
Austrodanthonia tenuior	2	43	2	12	positive
Bothriochloa decipiens	2	11	–	0	positive
Bothriochloa macra	1	15	1	3	positive
Brunoniella australis	3	88	3	26	positive
Centaurium spicatum	1	5	1	1	positive
Centella asiatica	2	20	2	10	positive
Cheilanthes sieberi subsp. *sieberi*	3	87	2	47	positive
Chloris ventricosa	2	18	2	5	positive
Chorizema parviflorum	1	8	2	2	positive
Chrysocephalum apiculatum	2	8	2	1	positive
Commelina cyanea	2	24	2	11	positive
Cymbonotus lawsonianus	1	8	1	1	positive
Cymbopogon refractus	2	47	2	13	positive
Daucus glochidiatus	2	9	2	1	positive
Desmodium varians	3	84	2	27	positive
Dianella longifolia	2	60	1	13	positive
Dichelachne micrantha	2	72	2	26	positive
Dichelachne parva	1	13	2	3	positive
Dichondra repens	3	98	3	40	positive
Dichopogon fimbriatus	1	5	1	1	positive
Dichopogon strictus	1	8	–	0	positive
Digitaria diffusa	1	5	1	1	positive
Echinopogon caespitosus var. *caespitosus*	2	46	2	23	positive
Einadia hastata	1	26	2	9	positive
Eragrostis leptostachya	2	68	2	17	positive
Eremophila debilis	2	35	2	3	positive
Eriochloa pseudoacrotricha	1	6	1	1	positive
Euchiton sphaericus	2	47	1	13	positive
Fimbristylis dichotoma	2	27	2	5	positive
Glossogyne tannensis	2	10	–	0	positive
Goodenia hederacea subsp. *hederacea*	2	48	2	31	positive
Hypericum gramineum	2	34	2	17	positive
Hypoxis hygrometrica	2	33	2	7	positive
Hypoxis pratensis var. *pratensis*	2	6	2	1	positive
Juncus usitatus	1	28	2	7	positive
Lomandra filiformis subsp. *filiformis*	3	65	2	30	positive
Lomandra multiflora subsp. *multiflora*	2	55	2	49	constant
Mentha diemenica	2	8	3	1	positive
Microlaena stipoides var. *stipoides*	4	92	3	66	positive
Opercularia diphylla	2	75	2	29	positive
Oxalis perennans	3	53	2	23	positive
Panicum effusum	2	19	2	5	positive
Paspalidium distans	3	74	2	19	positive
Plantago debilis	2	24	2	6	positive
Plantago gaudichaudii	2	6	1	1	positive
Pratia purpurascens	2	44	2	43	constant
Sporobolus creber	1	17	2	6	positive
Sporobolus elongatus	2	17	1	3	positive
Stackhousia viminea	1	47	1	7	positive
Themeda australis	4	89	3	52	positive
Tricoryne elatior	2	43	2	11	positive
Vernonia cinerea var. *cinerea*	2	46	2	14	positive
Veronica plebeia	2	39	2	20	positive
Wahlenbergia gracilis	2	71	2	24	positive
Wurmbea dioica subsp. *dioica*	2	11	2	1	positive
Zornia dyctiocarpa var. *dyctiocarpa*	1	6	1	1	positive
Climbers					
Glycine clandestina	2	49	2	41	constant
Glycine microphylla	2	37	2	17	positive
Glycine tabacina	2	67	2	20	positive
Hardenbergia violacea	2	45	1	29	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	1	1	2	15	uninform.
Angophora floribunda	1	8	2	8	uninform.
Angophora subvelutina	4	5	4	2	uninform.
Corymbia maculata	4	5	4	3	uninform.
Eucalyptus amplifolia	4	5	4	4	uninform.
Eucalyptus baueriana	1	1	4	1	uninform.
Eucalyptus bosistoana	4	1	–	0	uninform.
Eucalyptus fibrosa	2	19	4	16	uninform.
Eucalyptus globoidea	1	1	2	9	uninform.
Eucalyptus longifolia	1	2	1	2	uninform.
Eucalyptus paniculata	4	2	2	3	uninform.
Eucalyptus punctata	3	4	3	27	uninform.
Syncarpia glomulifera	1	1	3	23	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Shrub stratum					
Sida rhombifolia	2	42	2	22	positive
Ground stratum					
Anagallis arvensis	2	20	1	7	positive
Bidens pilosa	2	31	1	14	positive
Centaurium tenuiflorum	2	27	1	8	positive
Cirsium vulgare	1	57	1	30	positive
Hypochaeris radicata	2	51	1	29	positive
Leontodon taraxacoides subsp. *taraxacoides*	2	28	2	8	positive
Plantago lanceolata	2	47	2	22	positive
Richardia stellaris	1	27	1	5	positive
Senecio madagascariensis	2	91	2	45	positive
Setaria gracilis	2	55	2	21	positive
Solanum nigrum	1	31	1	16	positive
Sonchus oleraceus	1	42	1	19	positive
Climbers					
Myrsiphyllum asparagoides	2	36	2	20	positive

Map Unit 13:

Western Sydney Dry Rainforest

Sample Sites: (13)
Area (ha) 1750 / 1997 (± range): 1282 / 338 (±35)
Proportion Extant (± range): 26.4 (±2.7)%
No. Taxa (total / unique): 185 / 23
No. Taxa per Plot (±sd): 42.4 (±12.8)

Western Sydney Dry Rainforest is typically dominated by a mixture of tree species including *Melaleuca styphelioides, Acacia implexa, Alectryon subcinereus* and, less frequently, *Streblus brunonianus*. Mesic

species are predominant in the shrub stratum, such as *Pittosporum revolutum, Breynia oblongifolia, Clerodendrum tomentosum, Notelaea longifolia f. longifolia* and *Sigesbeckia orientalis* subsp. *orientalis*. The ground stratum consists primarily of a mixture of fern and herb species with relatively few grass species present. Frequently recorded species include *Adiantum aethiopicum, Pellaea falcata* var. *falcata, Asplenium flabellifolium, Dichondra repens, Microlaena stipoides* var. *stipoides, Oplismenus imbecillis, Plectranthus parvifolius, Desmodium varians, Galium propinquum* and *Stellaria flaccida*. Vine species are also common, including *Cayratia clematidea, Eustrephus latifolius, Geitonoplesium cymosum, Pandorea pandorana, Aphanopetalum resinosum* and *Stephania japonica* var. *discolor*.

Map Unit 13 is highly restricted in distribution. It occurs almost exclusively on soils derived from Wianamatta Shale and generally occupies sheltered lower slopes and gullies on steeply sloping, rugged topography. It is often found at higher elevations in areas receiving higher rainfall than Map Units 9 and 10. The transition from Map Unit 13 to Map Units 9 or 10 is often abrupt, and is likely to relate primarily to moisture availability and possibly fire history.

Previous floristic classifications:

Western Sydney Dry Rainforest is equivalent to Benson and Howell's (1994b) Map Unit 8d: Rainforest (Vine Thicket Rainforest). NPWS (1997) recognised this community under the name Dry Rainforest and considered it to be a variant of Floyd's (1990) Alliance VI, Sub-alliance 23 (*Ficus* spp. – *Streblus – Dendrocnide – Cassine*)). Western Sydney Dry Rainforest is listed as an Endangered Ecological Community under the *TSC Act* (1995).

Habitat:

Parent Geology: Wianamatta Shale (89%), Mittagong Formation (11%)

	Mean	(±sd)	Range
Elevation (m)	200.8	(81.9)	10–275
Slope (° above horizontal)	15.9	(6.4)	8.5–29.6
Annual Rainfall (mm)	868	(41.2)	809–918
Ruggedness (900m)	21.6	(7.5)	7–34
Maximum Temperature, Jan. (°C)	27.4	(0.6)	26.6–28.6
Solar Radiation, January	206.2	(6.4)	196–215

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	20.9 (10.3)	35.1 (22.3)
Small Tree	67	10.3 (4.9)	22.5 (14.7)
Shrub	78	3.3 (1.0)	26.4 (19.7)
Forb	67	0.2 (0.4)	45.0 (25.9)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 18 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 28 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 18 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia implexa	2	54	2	13	positive
Alectryon subcinereus	2	62	–	0	positive
Brachychiton populneus	4	23	1	2	positive
Corymbia maculata	3	23	4	3	positive
Melaleuca styphelioides	4	77	2	2	positive
Melicope micrococca	1	38	–	0	positive
Streblus brunonianus	3	23	–	0	positive
Shrub stratum					
Abutilon oxycarpum	2	23	–	0	positive
Breynia oblongifolia	2	85	2	19	positive
Citriobatus pauciflorus	3	23	–	0	positive
Clerodendrum tomentosum	2	62	1	7	positive
Deeringia amaranthoides	2	31	–	0	positive
Hymenanthera dentata	2	54	2	2	positive
Notelaea longifolia f. *longifolia*	2	77	1	16	positive
Pittosporum revolutum	2	92	2	8	positive
Rapanea variabilis	2	46	2	7	positive
Sigesbeckia orientalis subsp. *orientalis*	2	62	2	8	positive
Solanum stelligerum	2	38	–	0	positive
Ground stratum					
Adiantum aethiopicum	4	100	2	10	positive
Asplenium flabellifolium	2	62	2	2	positive
Carex longebrachiata	1	23	2	1	positive
Cyperus enervis	1	23	2	1	positive
Cyperus imbecillis	2	31	2	1	positive
Desmodium varians	2	54	2	34	constant
Dichondra repens	3	69	3	47	constant
Doodia aspera	3	31	2	3	positive
Echinopogon ovatus	2	46	2	32	constant
Galium propinquum	2	46	2	9	positive
Geranium homeanum	3	46	2	4	positive
Microlaena stipoides var. *stipoides*	2	69	3	69	constant
Oplismenus imbecillis	3	77	2	9	positive
Pellaea falcata	3	85	2	3	positive
Plectranthus parviflorus	2	62	2	8	positive
Pseuderanthemum variabile	2	69	2	11	positive
Pyrrosia rupestris	2	23	–	0	positive
Stellaria flaccida	3	54	2	2	positive
Urtica incisa	1	38	–	0	positive
Climbers					
Aphanopetalum resinosum	3	62	–	0	positive
Cayratia clematidea	3	92	2	6	positive
Celastrus australis	2	31	2	1	positive
Cissus antarctica	3	46	2	1	positive
Eustrephus latifolius	2	85	2	8	positive
Geitonoplesium cymosum	2	92	1	5	positive
Marsdenia flavescens	3	31	–	0	positive
Marsdenia rostrata	3	31	2	1	positive
Pandorea pandorana	2	85	2	13	positive
Ripogonum album	1	23	–	0	positive
Rubus parvifolius	2	46	2	6	positive
Sarcopetalum harveyanum	2	23	1	2	positive
Stephania japonica var. *discolor*	2	54	2	2	positive
Tylophora barbata	3	31	2	6	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	1	8	2	8	uninform.
Eucalyptus moluccana	4	8	4	20	uninform.
Eucalyptus pilularis	4	8	4	13	uninform.
Eucalyptus tereticornis	4	38	4	24	uninform.
Syncarpia glomulifera	1	8	3	20	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Olea europaea subsp. *africana*	3	89	2	26	positive
Shrub stratum					
Lantana camara	3	89	1	15	positive
Phytolacca octandra	3	22	1	2	positive
Solanum pseudocapsicum	2	44	1	6	positive
Ground stratum					
Cirsium vulgare	1	44	1	34	constant
Solanum nigrum	2	44	1	18	constant

Map Unit 14:

Moist Shale Woodland

Sample Sites: (10)
Area (ha) 1750 / 1997 (± range): 2034 / 604 (±65)
Proportion Extant (± range): 29.7 (±3.2)%
No. Taxa (total / unique): 124 / 5
No. Taxa per Plot (±sd): 35.9 (±8.4)

Moist Shale Woodland is dominated by *Eucalyptus tereticornis* and *E. moluccana* with *E. crebra* and *Corymbia maculata* occurring less frequently. These species may also comprise a small tree stratum together with *Acacia implexa* or *Acacia parramattensis* subsp. *parramattensis*. A relatively sparse shrub stratum is usually present and dominated by mesomorphic species. *Breynia oblongifolia, Clerodendrum tomentosum, Sigesbeckia orientalis* subsp. *orientalis, Bursaria spinosa and Olearia viscidula* are commonly occurring shrub species. The ground stratum is variable in cover and contains species such as *Desmodium varians, Cyperus gracilis, Galium propinquum, Cayratia clematidea, Glycine clandestina, Brunoniella australis, Desmodium brachypodum, Dichondra repens, Microlaena stipoides* var. *stipoides* and *Solanum prinophyllum*.

Moist Shale Woodland occurs exclusively on soils derived from Wianamatta Shale and is restricted to rugged areas at higher elevations in the southern half of the study area. This community appears to represent the endpoint of the gradient in elevation, rainfall and ruggedness from the central Cumberland Plain to the Razorback range at Picton. This gradient is parallelled by a transition from Map Unit 10 through Map Unit 9 with Map Unit 14 occurring on the upper portion of very steep sheltered slopes. Map Unit 14 is found in very similar environments to Map Unit 13 and since both communities are highly restricted, and were sampled at relatively few sites it is difficult to determine what factors are responsible for their relative distributions. Map Unit 14 tends to occupy upper slopes while Map Unit 13 is often found on lower slopes and in gullies, which presumably provide a more reliably moist environment for the constituent rainforest species. It is possible that Map Unit 14 represents a stage in the recovery of Map Unit 13 from fire.

Previous floristic classifications:

None known.

Habitat:

Parent Geology: Wianamatta Shale (100%)

	Mean	(±sd)	Range
Elevation (m)	221.8	(85.5)	61–304
Slope (° above horizontal)	12.4	(8.3)	3.3–24.9
Annual Rainfall (mm)	862.2	(33.6)	803–899
Ruggedness (900m)	27.9	(10.2)	13–39
Maximum Temperature, Jan. (°C)	27.3	(0.7)	26.5–28.8
Solar Radiation, January	207.4	(7.0)	193–215

Structure:

Growth form	Frequency (%)	Mean height (m)	(±sd)	Mean foliage cover (%)	(±sd)
Tree	100	24.7	(4.6)	18.9	(7.8)
Small Tree	89	10.8	(4.7)	18.1	(15.3)
Shrub	78	3.3	(1.0)	15.1	(15.1)
Forb	100	0.3	(0.5)	30.3	(25.0)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 12 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 26 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 12 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia implexa	3	40	2	13	constant
Brachychiton populneus	2	50	1	2	positive
Eucalyptus moluccana	4	60	4	19	positive
Eucalyptus tereticornis	4	60	4	24	constant
Shrub stratum					
Breynia oblongifolia	2	80	2	19	positive
Bursaria spinosa	2	70	3	48	constant
Clerodendrum tomentosum	2	70	1	7	positive
Myoporum montanum	1	60	–	0	positive
Olearia viscidula	2	50	1	3	positive
Sigesbeckia orientalis subsp. *orientalis*	2	70	2	8	positive
Ground stratum					
Adiantum aethiopicum	4	40	3	12	constant
Arthropodium milleflorum	2	50	2	18	constant
Asplenium flabellifolium	2	30	2	3	positive
Brunoniella australis	3	60	3	33	constant
Carex inversa	2	50	2	10	positive
Cheilanthes distans	2	40	1	5	positive
Chloris truncata	2	30	2	3	positive
Commelina cyanea	2	40	2	13	constant
Crassula sieberiana	2	30	1	3	positive
Cyperus gracilis	2	70	2	9	positive
Cyperus imbecillis	3	20	2	1	positive
Desmodium brachypodum	2	70	1	9	positive
Desmodium varians	2	100	2	33	positive
Dichondra repens	3	100	3	47	positive
Echinopogon ovatus	2	50	2	32	constant
Einadia hastata	2	50	2	11	positive
Einadia nutans	3	30	2	5	positive
Einadia polygonoides	2	30	3	2	positive
Galium propinquum	2	70	2	9	positive
Geranium homeanum	1	30	2	4	positive
Microlaena stipoides var. *stipoides*	1	70	3	69	constant
Notodanthonia longifolia	3	20	2	2	positive
Nyssanthes diffusa	2	60	–	0	positive
Oplismenus aemulus	3	40	2	19	constant
Oxalis perennans	2	50	2	27	constant
Paspalidium criniforme	2	20	2	2	positive
Pellaea falcata	2	40	2	4	positive
Plantago debilis	1	60	2	8	positive
Plectranthus parviflorus	2	60	2	9	positive
Poa sieberiana var. *sieberiana*	4	40	2	4	positive
Rumex brownii	2	50	1	4	positive
Scaevola albida var. *albida*	3	20	2	1	positive
Senecio quadridentatus	2	50	1	2	positive
Solanum prinophyllum	2	60	2	26	constant
Wahlenbergia gracilis	2	50	2	30	constant
Climbers					
Aphanopetalum resinosum	1	20	3	1	positive
Cayratia clematidea	2	80	2	6	positive
Celastrus australis	2	30	2	1	positive
Cissus antarctica	3	20	3	2	positive
Clematis glycinoides var. *glycinoides*	2	40	2	13	constant
Glycine clandestina	3	80	2	41	constant
Pandorea pandorana	2	40	2	14	constant

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Corymbia maculata	4	20	4	3	uninform.
Eucalyptus crebra	5	30	3	18	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Olea europaea subsp. *africana*	3	89	2	26	positive
Shrub stratum					
Lantana camara	2	44	1	15	constant
Opuntia aurantiaca	2	22	–	0	positive
Opuntia stricta	1	33	1	3	positive
Ground stratum					
Cirsium vulgare	2	67	1	33	constant
Lepidium africanum	1	33	1	2	positive
Plantago lanceolata	1	44	2	26	constant
Senecio madagascariensis	3	56	2	52	constant
Climbers					
Araujia sericiflora	1	56	2	17	constant

Map Unit 15:

Turpentine Ironbark Forest

Sample Sites: (22)
Area (ha) 1750 / 1997 (± range): 17354 / 236 (±49)
Proportion Extant (± range): 1.4 (±0.3)%
No. Taxa (total / unique): 208 / 14
No. Taxa per Plot (±sd): 42.6 (±9.0)

Turpentine Ironbark Forest is dominated by *Syncarpia glomulifera* with *E. paniculata* and *E. eugenioides* occurring less frequently. In areas of higher rainfall (1050–1080 mm *per annum*), *E. saligna* is dominant. *Eucalyptus punctata* occurs occasionally in areas where the shale soils form a relatively shallow mantle over the underlying sandstone. A stratum of small trees is usually present and is composed of a mixture of species including *Syncarpia glomulifera, Pittosporum undulatum, Trema aspera* and *Acacia parramattensis* subsp. *parramattensis*. The shrub stratum is usually sparse, and contains predominantly mesic species such as *Pittosporum revolutum, Breynia oblongifolia, Maytenus sylvestris, Polyscias sambucifolia* subsp. A, *Notelaea longifolia* f. *longifolia* and *Ozothamnus diosmifolius*. The ground stratum consists of a dense mixture of herb and grass species dominated by *Oplismenus aemulus, Pseuderanthemum variabile* and *Echinopogon ovatus*. Other frequently recorded species include *Entolasia marginata, Pratia purpurascens, Dianella longifolia, Arthropodium milleflorum* and *Rubus parvifolia*.

Turpentine Ironbark Forest occurs on soils derived from Wianamatta Shale and is restricted to the eastern edge of the Cumberland Plain where the average annual rainfall exceeds approximately 950 mm. Ascending to the Hornsby Plateau, Turpentine Ironbark Forest grades into Map Unit 152 as rainfall exceeds 1050 mm. This transition occurs at an altitude of approximately 100 m above sea level although Turpentine Ironbark Forest is found at altitudes of up to 200 m on the Western edge of the Hornsby Plateau where rainfall falls below 1050 mm. Close to the shale/sandstone boundary the community grades into Map Unit 43.

Turpentine Ironbark forest has been almost entirely cleared and has been listed under the *TSC Act* (1995) as Sydney Turpentine Ironbark Forest. Both Map Units 15 and 43 are considered to fall within this definition. Scattered remnants are located between Bankstown and Eastwood. Remnants at Denistone Park and Darvall Park (Eastwood), and Mobbs Hill (Carlingford) are at the upper limit of the rainfall range for this community. These remnants have previously been described as Blue Gum High Forest (Benson and Howell 1994a, NPWS 1997), but despite the dominance of *E. saligna* are floristically more similar to vegetation of the lower rainfall zone.

Previous floristic classifications:

Map Units 15 and 43 combined are equivalent to Turpentine Ironbark Forest as described by Benson and Howell (1994a), and listed under the *TSC Act* (1995) as Sydney Turpentine–Ironbark Forest.

Habitat:

Parent Geology: Wianamatta Shale (67%), Holocene alluvium (17%), Mittagong Formation (17%)

	Mean	(±sd)	Range
Elevation (m)	69.8	(60.9)	9–184
Slope (° above horizontal)	3.9	(4.6)	0.4–12.8
Annual Rainfall (mm)	1018.0	(68.7)	886–1080
Ruggedness (900m)	12.8	(7.4)	4–21
Maximum Temperature, Jan. (°C)	26.9	(0.1)	26.8–27.0
Solar Radiation, January	216.7	(2.9)	211–219

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	23.3 (6.8)	35.8 (19.6)
Small Tree	83	9.6 (1.7)	29.4 (18.1)
Shrub	83	2.6 (0.9)	14.4 (20.1)
Forb	100	0.7 (0.5)	70.8 (31.1)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 18 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 33 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 18 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia parramattensis	2	59	2	21	positive
Elaeocarpus reticulatus	1	36	1	8	positive
Eucalyptus acmenoides	1	23	–	0	positive
Eucalyptus paniculata	3	45	2	2	positive
Eucalyptus pilularis	3	36	4	12	positive
Eucalyptus saligna	3	50	3	1	positive
Pittosporum undulatum	3	86	2	13	positive
Syncarpia glomulifera	4	77	3	18	positive
Shrub stratum					
Acacia floribunda	1	41	2	6	positive
Breynia oblongifolia	2	64	2	18	positive
Clerodendrum tomentosum	1	36	1	7	positive
Maytenus silvestris	1	55	2	3	positive
Notelaea longifolia f. *longifolia*	2	50	1	16	positive
Ozothamnus diosmifolius	2	59	1	27	positive
Pittosporum revolutum	2	73	2	8	positive
Polyscias sambucifolia subsp. *A*	2	68	2	10	positive
Rapanea variabilis	2	45	2	7	positive
Sigesbeckia orientalis subsp. *orientalis*	2	36	2	8	positive
Trema tomentosa var. *viridis*	3	36	1	2	positive
Ground stratum					
Adiantum aethiopicum	2	55	3	11	positive
Desmodium varians	1	41	2	34	constant
Dianella caerulea	2	73	2	27	positive
Dichondra repens	2	77	3	47	positive
Doodia aspera	2	36	2	2	positive
Echinopogon ovatus	2	55	2	31	constant
Entolasia marginata	2	82	2	24	positive
Entolasia stricta	2	45	3	59	constant
Geranium solanderi var. *solanderi*	1	23	1	3	positive
Lomandra longifolia	2	68	2	31	positive
Microlaena stipoides var. *stipoides*	3	95	3	68	positive
Oplismenus aemulus	2	82	2	17	positive

Oplismenus imbecillis	2	41	2	9	positive
Poa affinis	3	68	2	6	positive
Pratia purpurascens	2	64	2	43	constant
Pseuderanthemum variabile	3	91	2	9	positive
Rumex brownii	1	23	1	4	positive
Solanum prinophyllum	1	59	2	26	positive
Climbers					
Cayratia clematidea	3	45	2	6	positive
Clematis aristata	1	32	2	5	positive
Clematis glycinoides var. *glycinoides*	2	59	2	12	positive
Eustrephus latifolius	2	86	2	7	positive
Glycine clandestina	1	41	2	42	constant
Pandorea pandorana	2	86	2	12	positive
Passiflora herbertiana subsp. *herbertiana*	2	41	1	3	positive
Rubus parvifolius	2	41	2	6	positive
Sarcopetalum harveyanum	1	32	2	1	positive
Smilax australis	1	23	2	3	positive
Tylophora barbata	2	55	2	5	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora costata	1	23	2	19	uninform.
Angophora floribunda	5	9	2	8	uninform.
Eucalyptus deanei	4	5	4	1	uninform.
Eucalyptus eugenioides	4	5	2	12	uninform.
Eucalyptus globoidea	3	9	2	8	uninform.
Eucalyptus moluccana	1	5	4	20	uninform.
Eucalyptus punctata	1	32	3	24	uninform.
Eucalyptus resinifera	1	5	1	4	uninform.
Eucalyptus tereticornis	1	5	4	25	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Ligustrum lucidum	1	50	2	7	positive
Ligustrum sinense	1	83	1	15	positive
Shrub stratum					
Lantana camara	2	67	1	15	positive
Ochna serrulata	1	83	1	4	positive
Phytolacca octandra	1	33	1	2	positive
Sida rhombifolia	1	83	2	24	positive
Ground stratum					
Cirsium vulgare	1	50	1	34	constant
Conyza albida	1	50	2	9	positive
Ehrharta erecta	3	50	2	3	positive
Paspalum dilatatum	2	67	2	14	positive
Plantago lanceolata	1	50	2	26	constant
Protasparagus aethiopicus	2	50	1	8	positive
Rubus sp.	1	50	1	4	positive
Setaria gracilis	1	50	2	26	constant
Solanum nigrum	1	50	1	18	constant
Climbers					
Araujia sericiflora	1	50	2	17	constant
Hedera helix	1	33	–	0	positive

Map Unit 43:

Turpentine Ironbark Margin Forest

Sample Sites: (37)
Area (ha) 1750 / 1997 (± range): 12985 / 947 (±178)
Proportion Extant (± range): 7.3 (±1.4)%
No. Taxa (total / unique): 312 / 12
No. Taxa per Plot (±sd): 47.7 (±7.7)

Turpentine Ironbark Margin Forest is dominated by *Eucalyptus punctata* and *Syncarpia glomulifera* with a sparse stratum of small trees including *Acacia parramattensis* and *Pittosporum undulatum*. A variety of tree species occur more sporadically, including *Corymbia gummifera* and *E. globoidea*. The shrub stratum is usually relatively sparse and features mesic species such as *Polyscias sambucifolia* subsp. *A, Breynia oblongifolia* and *Notelaea longifolia f. longifolia*, as well as some sclerophyllous species such as *Leucopogon juniperinus*. The ground stratum is frequently dense and dominated by a range of grass species including *Entolasia marginata, E. stricta, Panicum simile, Themeda australis, Microlaena stipoides* var. *stipoides, Echinopogon caespitosus* var. *caespitosus* and *Oplismenus aemulus*. A variety of herb species are also represented. Frequently recorded species include *Pratia purpurascens, Gonocarpus tetragynus, Dianella caerulea, Dichondra repens* and *Pseuderanthemum variabile*.

Map Unit 43 occurs in higher rainfall areas on the margins of the Cumberland Plain in close proximity to the sandstone/shale boundary. Sample sites representative of this Map Unit were located on the south-western edge of the Hornsby Plateau, the northern end of the Woronora Plateau and west of Kurrajong. The majority of sample sites were located within 600 m of the shale/sandstone boundary. Soils typically had a relatively high level of sandstone influence. Areas with a lower level of sandstone influence have been extensively cleared and were not sampled in this survey. Where rainfall exceeds 1050 mm *per annum*, Map Unit 43 grades into Map Unit 152 as the level of sandstone influence in the soil decreases. In areas with lower rainfall Map Unit 43 grades into Map Unit 15.

Previous floristic classifications:

Map Units 15 and 43 combined are equivalent to Turpentine Ironbark Forest as described by Benson and Howell (1994a), and listed under the *TSC Act* (1995) as Sydney Turpentine-Ironbark Forest.

Habitat:

Parent Geology: Wianamatta Shale (75%), Mittagong Formation (17%), Hawkesbury Sandstone (8%)

	Mean	(±sd)	Range
Elevation (m)	116.8	(101.8)	2–308
Slope (º above horizontal)	7.6	(5.8)	0–18.0
Annual Rainfall (mm)	1009.3	(113.9)	825–1155
Ruggedness (900m)	15.2	(13.5)	2–43
Maximum Temperature, Jan. (ºC)	27.6	(1.1)	26.0–29.1
Solar Radiation, January	213.1	(4.9)	205 – 219
Distance to Sandstone (m)	265.6	(296.9)	0 – 843.4

Structure:

Growth form	Frequency (%)	Mean height (m)	(±sd)	Mean foliage cover (%)	(±sd)
Tree	100	21.8	(5.0)	24.2	(10.8)
Small Tree	100	10.3	(3.6)	7.2	(4.7)
Shrub	100	2.6	(1.6)	11.0	(9.7)
Forb	100	0.8	(0.6)	51.3	(23.7)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 11 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 38 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 11 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acacia parramattensis	2	43	2	21	positive
Allocasuarina torulosa	2	46	2	10	positive
Angophora costata	2	54	2	17	positive
Eucalyptus globoidea	2	41	3	6	positive

Eucalyptus resinifera	2	32	1	3	positive
Pittosporum undulatum	2	84	2	12	positive
Syncarpia glomulifera	3	76	3	17	positive
Shrub stratum					
Acacia longifolia	2	32	1	7	positive
Bursaria spinosa	2	51	3	48	constant
Dodonaea triquetra	4	38	2	13	positive
Hibbertia aspera	2	51	2	16	positive
Leucopogon juniperinus	2	49	2	17	positive
Notelaea longifolia f. *longifolia*	1	41	1	16	positive
Ozothamnus diosmifolius	1	51	2	27	positive
Pittosporum revolutum	2	32	2	9	positive
Polyscias sambucifolia subsp. *A*	2	49	2	9	positive
Ground stratum					
Aristida vagans	3	49	2	45	constant
Austrostipa rudis	3	22	2	5	positive
Billardiera scandens	2	62	1	36	positive
Cheilanthes sieberi subsp. *sieberi*	2	54	2	52	constant
Dianella caerulea	2	78	2	26	positive
Dianella revoluta var. *revoluta*	1	43	2	37	constant
Dichondra repens	2	57	3	47	constant
Echinopogon ovatus	2	51	2	31	constant
Entolasia marginata	2	54	2	24	positive
Entolasia stricta	2	78	3	58	constant
Gonocarpus tetragynus	2	49	2	21	positive
Goodenia hederacea subsp. *hederacea*	2	49	2	33	constant
Imperata cylindrica var. *major*	3	54	2	11	positive
Lepidosperma laterale	2	62	2	44	constant
Lomandra longifolia	2	70	2	30	positive
Lomandra multiflora subsp. *multiflora*	1	57	2	50	constant
Microlaena stipoides var. *stipoides*	4	86	3	68	constant
Opercularia hispida	2	24	2	2	positive
Opercularia varia	1	22	2	2	positive
Oplismenus imbecillis	2	38	2	9	positive
Oxalis exilis	2	41	1	5	positive
Panicum simile	1	49	2	33	constant
Poa affinis	3	27	2	7	positive
Poa sieberiana var. *sieberiana*	1	22	2	3	positive
Pomax umbellata	1	43	2	35	constant
Pratia purpurascens	2	76	2	42	positive
Pseuderanthemum variabile	3	46	2	10	positive
Themeda australis	3	84	3	55	positive
Climbers					
Eustrephus latifolius	2	32	2	8	positive
Glycine clandestina	3	78	2	40	positive
Hardenbergia violacea	1	49	1	30	constant
Kennedia rubicunda	2	22	1	6	positive
Pandorea pandorana	2	51	2	12	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	4	14	2	7	uninform.
Corymbia eximia	3	5	2	3	uninform.
Corymbia gummifera	3	27	2	29	uninform.
Eucalyptus acmenoides	5	5	1	1	uninform.
Eucalyptus crebra	2	11	4	18	uninform.
Eucalyptus deanei	3	8	4	1	uninform.
Eucalyptus eugenioides	2	8	2	12	uninform.
Eucalyptus fibrosa	4	19	4	16	uninform.
Eucalyptus haemastoma	1	3	2	3	uninform.
Eucalyptus moluccana	1	3	4	20	uninform.
Eucalyptus notabilis	2	19	2	5	uninform.
Eucalyptus paniculata	2	19	2	2	uninform.
Eucalyptus pilularis	2	30	4	12	uninform.
Eucalyptus piperita	1	3	2	7	uninform.
Eucalyptus punctata	3	30	3	24	uninform.
Eucalyptus saligna	2	5	3	2	uninform.
Eucalyptus sclerophylla	1	8	4	9	uninform.
Eucalyptus sparsifolia	1	14	3	4	uninform.
Eucalyptus tereticornis	2	3	4	26	uninform.
Eucalyptus umbra	1	3	–	0	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Ligustrum sinense	2	40	1	15	constant
Shrub stratum					
Chrysanthemoides moniliferum	2	40	–	0	positive
Lantana camara	2	80	1	15	positive
Ground stratum					
Bidens pilosa	1	40	2	16	constant
Hypochaeris radicata	1	60	2	32	constant
Paspalum dilatatum	1	40	2	15	constant
Plantago lanceolata	1	40	2	26	constant
Setaria gracilis	2	40	2	26	constant
Climbers					
Myrsiphyllum asparagoides	3	40	2	22	constant

Map Unit 152:

Blue Gum High Forest

Sample Sites: (8)
Area (ha) 1750 / 1997 (± range): 3720 / 168 (±31)
Proportion Extant (± range): 4.5 (±0.8)%
No. Taxa (total / unique): 143 / 8
No. Taxa per Plot (±sd): 44.1 (±8.6)

Blue Gum High Forest is dominated by either *Eucalyptus pilularis* or *E. saligna*. *Angophora costata* is also frequently observed in remnants close to the shale/sandstone boundary, but would have occurred infrequently on deep shale soils. A relatively diverse stratum of small trees is usually present, and includes *Pittosporum undulatum*, *Elaeocarpus reticulatus* and *Allocasuarina torulosa*. Shrub species are typically mesic, such as *Breynia oblongifolia*, *Pittosporum revolutum*, *Clerodendrum tomentosum*, *Notelaea longifolia f. longifolia*, *Maytenus sylvestris*, *Polyscias sambucifolia* subsp. A and *Rapanea variabilis*. Sclerophyllous species such as *Persoonia linearis* and *Leucopogon juniperinum* occur more frequently closer to the shale/sandstone boundary. The ground stratum is often dense and contains a mixture of herb, grass and fern species including *Adiantum aethiopicum*, *Entolasia marginata*, *Lomandra longifolia*, *Calochlaena dubia*, *Dianella caerulea*, *Pseuderanthemum variabile* and *Oplismenus imbecillis*. Vine species are also frequently present, in particular *Tylophora barbata*, *Eustrephus latifolia*, *Clematis aristata* and *Pandorea pandorana*.

Blue Gum High Forest occurs mainly in areas with shale derived soil receiving more than 1050 mm rainfall per year, although it may be present in sheltered locations with lower rainfall. The community is generally confined to altitudes higher than 100 m above sea level on the Hornsby Plateau. In lower rainfall zones it grades into Map Unit 15. Approaching the shale sandstone boundary, Blue Gum High Forest grades into Map Unit 43.

Habitat:

Parent Geology: Wianamatta Shale (57%), Hawkesbury Sandstone (29%), Mittagong Formation (14%)

	Mean	(±sd)	Range
Elevation (m)	113.7	(44.1)	50–178
Slope (° above horizontal)	6.8	(5.3)	2.6–17.3
Annual Rainfall (mm)	1050	(183.1)	816–1250
Ruggedness (900m)	15.3	(2.3)	12–18
Maximum Temperature, Jan. (°C)	27.4	(1.2)	26.2–29.0
Solar Radiation, January	214.7	(5.0)	205–218

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	39.3 (16.2)	30.7 (13.7)
Small tree	86	14.7 (0.8)	20.0 (15.8)
Shrub	86	4.8 (1.3)	8.0 (4.0)
Forb	100	1.7 (1.6)	44.2 (30.2)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 17 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 34 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 17 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Acmena smithii	1	38	2	1	positive
Allocasuarina torulosa	3	75	2	11	positive
Alphitonia excelsa	2	25	1	1	positive
Angophora costata	2	63	2	19	positive
Backhousia myrtifolia	5	25	4	2	positive
Brachychiton acerifolius	1	25	1	1	positive
Elaeocarpus reticulatus	2	63	1	8	positive
Eucalyptus pilularis	5	50	4	13	constant
Eucalyptus saligna	5	50	3	2	positive
Ficus coronata	1	25	–	0	positive
Glochidion ferdinandi var. *ferdinandi*	3	38	1	2	positive
Pittosporum undulatum	3	75	2	15	positive
Shrub stratum					
Breynia oblongifolia	2	88	2	19	positive
Clerodendrum tomentosum	2	50	1	7	positive
Leucopogon juniperinus	2	75	2	18	positive
Maytenus silvestris	2	63	1	4	positive
Notelaea longifolia f. *longifolia*	2	50	1	17	constant
Persoonia linearis	2	50	2	32	constant
Pittosporum revolutum	3	75	2	9	positive
Platylobium formosum	3	50	1	1	positive
Polyscias sambucifolia subsp. *A*	3	50	2	11	positive
Rapanea variabilis	3	50	2	8	positive
Ground stratum					
Adiantum aethiopicum	3	88	3	11	positive
Asplenium flabellifolium	2	38	2	3	positive
Blechnum cartilagineum	4	50	1	2	positive
Calochlaena dubia	2	63	2	2	positive
Carex maculata	2	25	–	0	positive
Dianella caerulea	2	75	2	28	positive
Doodia aspera	3	38	2	3	positive
Entolasia marginata	3	88	2	25	positive
Entolasia stricta	1	50	3	59	constant
Hydrocotyle laxiflora	2	38	2	2	positive
Lomandra longifolia	3	100	2	31	positive
Morinda jasminoides	4	50	2	3	positive
Oplismenus aemulus	3	50	2	19	constant
Oplismenus imbecillis	2	63	2	10	positive
Oxalis perennans	1	50	2	27	constant
Poa affinis	3	63	2	7	positive
Pratia purpurascens	3	63	2	43	constant
Pseuderanthemum variabile	3	75	2	11	positive
Pteridium esculentum	2	50	2	15	constant
Viola hederacea	2	25	2	2	positive
Climbers					
Cissus hypoglauca	5	25	1	1	positive
Clematis aristata	2	63	2	6	positive
Eustrephus latifolius	3	88	2	9	positive
Glycine clandestina	2	63	2	42	constant
Marsdenia rostrata	2	38	3	1	positive
Pandorea pandorana	3	75	2	13	positive
Smilax australis	1	38	2	3	positive
Smilax glyciphylla	1	50	1	13	constant
Tylophora barbata	2	100	2	5	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora floribunda	2	38	2	7	uninform.
Corymbia gummifera	1	13	2	29	uninform.
Eucalyptus globoidea	1	25	2	8	uninform.
Eucalyptus paniculata	4	25	2	3	uninform.
Eucalyptus punctata	1	13	3	24	uninform.
Eucalyptus tereticornis	2	13	4	25	uninform.
Syncarpia glomulifera	1	13	3	20	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Cinnamomum camphora	2	29	1	1	positive
Ligustrum lucidum	3	43	1	7	positive
Ligustrum sinense	2	86	1	15	positive
Shrub stratum					
Lantana camara	2	71	1	15	positive
Ochna serrulata	2	71	1	4	positive
Rubus ulmifolius	1	29	2	1	positive
Climbers					
Passiflora edulis	1	43	1	2	positive
Passiflora subpeltata	1	29	–	0	positive

Map Unit 36:

Freshwater Wetlands

Sample Sites: Not sampled
Area (ha) 1750 / 1997 (± range): 1552 / 664 (±82)
Proportion Extant (± range): 42.8 (±5.3)%
No. Taxa (total / unique): Unknown
No. Taxa per Plot (±sd): Unknown

Freshwater Wetlands were not sampled in this survey. Benson (1992) notes that the floristic composition of wetlands is quite variable and may depend on factors such as water depth and period of inundation. Typical species in permanent or semi-permanent wetlands include *Eleocharis sphacelata*, which may form an emergent reedland over smaller species such as *Ludwigia peploides* subsp. *montevidensis*, *Triglochin procera* and *Philydrum lanuginosum* (Benson 1992). Wetlands that are only intermittently inundated may support scattered shrub species including *Melaleuca linariifolia*, *M. styphelioides* and *Casuarina glauca*. Ground species include *Juncus usitatus* and *Persicaria* spp. (Benson 1992).

Map Unit 31:

Sandstone Ridgetop Woodland

Sample Sites: (41)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): Not calculated
No. Taxa (total / unique): 273 / 14
No. Taxa per Plot (±sd): 52.4 (±8.2)

Sandstone Ridgetop Woodland is dominated by *Corymbia gummifera* and *Eucalyptus sclerophylla* with *Banksia serrata* frequently present at lower abundance. A variety of other tree species occur more sporadically, including *E. punctata*, *E. oblonga* and *Angophora costata*. A diverse array of shrub species is always present, although

depending on the time of the last fire a shrub stratum may not be fully developed. Shrub species frequently recorded included *Banksia spinulosa* var. *spinulosa, Isopogon anemonifolius, Leptospermum trinervium, Phyllanthus hirtellus, Dillwynia retorta* and *Eriostemon australasius* subsp. *australasius*. The ground stratum is similarly diverse and features species such as *Lomandra obliqua, Entolasia stricta, Cyathochaeta diandra, Dampiera stricta* and *Stipa pubescens*.

This community occurs predominantly on sandstone ridgetops and plateaux, but may extend to the floor of shallow gullies. Sandstone Ridgetop Woodland is structurally variable and may lack a tree stratum. Shrub density is highly variable, with the density of serotinous obligate seeders varying as a function of fire frequency. In steeper gullies, the community grades into Map Unit 33. Isolated patches of rock pavement heath (Keith 1994) occur sporadically within this Map Unit, predominantly along the ridge lines. In poorly drained areas Map Unit 31 abruptly changes to sedgeland. Rock pavement heath and sedgeland are floristically distinct from Map Unit 31 but were neither sampled nor described in this survey (but see Keith 1994 and French et al. 2001).

Previous floristic classifications:

Sandstone Ridgetop Woodland is equivalent to Sydney Sandstone Ridgetop Woodland described by Benson (1994). Five communities recognised by Keith (1994) based on structural variation and soil characteristics are amalgamated under this classification. These include Ironstone Heath, Ironstone Woodland, Sandstone Woodland, Heath Woodland and Mallee Heath.

Habitat:

Parent Geology: Hawkesbury Sandstone (66%), Mittagong formation (31%), Holocene alluvium (3%)

	Mean	(±sd)	Range
Elevation (m)	239.9	(104.1)	1–412
Slope (° above horizontal)	6.2	(5.2)	0–29.3
Annual Rainfall (mm)	1178.8	(159.8)	837–1509
Ruggedness (900m)	20.0	(9.0)	2–49
Terrain (900m)	10.6	(13.5)	-37–47
Maximum Temperature, Jan. (°C)	25.5	(8.1)	24.3–28.3
Solar Radiation, January	212.1	(3.9)	187–219

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	13.6 (4.8)	12.2 (5.9)
Small tree	50	5.9 (1.4)	14.5 (12.2)
Shrub	96	2.4 (1.1)	21.7 (15.2)
Forb	100	0.5 (0.6)	17.3 (15.7)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 28 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 43 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 28 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Banksia serrata	2	71	2	5	positive
Corymbia gummifera	3	93	2	25	positive
Eucalyptus haemastoma	2	22	2	2	positive
Eucalyptus oblonga	2	32	3	7	positive
Eucalyptus piperita	3	22	2	5	positive
Eucalyptus sclerophylla	4	32	4	8	positive
Shrub stratum					
Acacia linifolia	2	54	2	18	positive
Acacia myrtifolia	1	32	1	5	positive
Acacia suaveolens	2	66	1	7	positive
Acacia ulicifolia	2	59	1	22	positive
Angophora hispida	2	29	3	3	positive
Banksia ericifolia	2	24	3	2	positive
Banksia marginata	3	20	1	1	positive
Banksia spinulosa var. *spinulosa*	2	93	2	21	positive
Boronia ledifolia	1	29	1	3	positive
Bossiaea ensata	1	22	1	1	positive
Bossiaea heterophylla	2	71	2	4	positive
Bossiaea obcordata	2	32	2	11	positive
Brachyloma daphnoides	2	20	1	4	positive
Conospermum longifolium	1	34	1	1	positive
Dillwynia retorta	2	71	2	11	positive
Epacris pulchella	2	37	1	5	positive
Eriostemon australasius	2	61	2	7	positive
Gompholobium glabratum	1	27	2	3	positive
Gompholobium grandiflorum	2	44	1	4	positive
Grevillea buxifolia	2	44	1	2	positive
Grevillea diffusa subsp. *diffusa*	1	24	2	2	positive
Grevillea sericea	2	27	2	5	positive
Grevillea sphacelata	2	39	1	3	positive
Hakea dactyloides	1	73	2	14	positive
Hakea sericea	2	71	2	19	positive
Hibbertia riparia	2	20	2	1	positive
Hibbertia serpyllifolia	2	22	2	3	positive
Hovea linearis	1	56	1	14	positive
Isopogon anemonifolius	2	85	2	11	positive
Lambertia formosa	2	78	2	10	positive
Leptospermum arachnoides	1	22	2	2	positive
Leptospermum trinervium	2	90	2	25	positive
Leucopogon microphyllus var. *microphyllus*	1	29	2	2	positive
Lomatia silaifolia	1	59	1	15	positive
Micrantheum ericoides	2	37	2	6	positive
Monotoca scoparia	1	68	1	12	positive
Persoonia levis	1	98	1	20	positive
Persoonia pinifolia	1	41	1	5	positive
Petrophile pulchella	2	24	1	3	positive
Petrophile sessilis	2	54	2	5	positive
Phyllanthus hirtellus	2	80	2	32	positive
Pimelea linifolia subsp. *linifolia*	2	46	2	27	constant
Platysace linearifolia	2	61	2	10	positive
Pultenaea elliptica	1	46	2	6	positive
Xanthosia pilosa	2	44	2	11	positive
Ground stratum					
Actinotus minor	2	54	4	3	positive
Anisopogon avenaceus	2	37	2	10	positive
Billardiera scandens	1	51	1	36	constant
Caustis flexuosa	2	51	2	5	positive
Cyathochaeta diandra	3	85	2	19	positive
Dampiera stricta	2	78	2	6	positive
Entolasia stricta	2	80	3	57	positive
Lepidosperma laterale	2	49	2	44	constant
Lepyrodia scariosa	2	54	3	6	positive
Lindsaea linearis	2	32	2	5	positive
Lindsaea microphylla	1	32	1	9	positive
Lomandra cylindrica	2	44	2	15	positive
Lomandra glauca	2	44	2	7	positive
Lomandra gracilis	2	29	2	11	positive
Lomandra multiflora subsp. *multiflora*	1	54	2	50	constant
Lomandra obliqua	2	78	2	27	positive
Mitrasacme polymorpha	1	20	1	2	positive
Patersonia glabrata	2	24	2	7	positive
Patersonia sericea	1	37	1	10	positive
Platysace ericoides	2	39	2	10	positive
Ptilothrix deusta	2	27	3	5	positive

Schoenus ericetorum	1	34	2	1	positive
Stipa pubescens	2	56	3	25	positive
Tetratheca neglecta	1	32	2	1	positive
Xanthorrhoea concava	1	37	1	8	positive
Xanthorrhoea media	2	56	2	7	positive
Xanthosia tridentata	2	32	1	6	positive
Climbers					
Cassytha pubescens	2	54	2	17	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	3	7	2	13	uninform.
Angophora costata	2	24	2	19	uninform.
Corymbia eximia	2	2	2	3	uninform.
Eucalyptus agglomerata	1	2	2	2	uninform.
Eucalyptus consideniana	3	10	–	0	uninform.
Eucalyptus globoidea	3	10	2	8	uninform.
Eucalyptus parramattensis subsp. *parramattensis*	3	2	1	4	uninform.
Eucalyptus pilularis	1	7	4	13	uninform.
Eucalyptus punctata	2	22	3	24	uninform.
Eucalyptus sieberi	3	12	–	0	uninform.
Eucalyptus sparsifolia	2	10	3	4	uninform.
Eucalyptus squamosa	2	2	2	1	uninform.
Syncarpia glomulifera	2	2	3	21	uninform.

Map Unit 32:

Upper Georges River Sandstone Woodland

Sample Sites: (59)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): Not calculated
No. Taxa (total / unique): 338 / 5
No. Taxa per Plot (±sd): 51.9 (±8.5)

Upper Georges River Sandstone Woodland is dominated by *Eucalyptus punctata* and *Corymbia gummifera*, with *E. oblonga* occurring frequently at lower abundance. *Allocasuarina littoralis* is frequently present, particular on the upper slopes of gullies where it forms a small tree layer. Diverse shrub and ground strata are always present. Typical shrub species include *Acacia ulicifolia, A. terminalis, A. linifolia, Persoonia linearis, Leptospermum trinervium* and *Exocarpos strictus*. The ground stratum is often dominated by grass species such as *Entolasia stricta, Themeda australis, Stipa pubescens Aristida vagans* and *Danthonia linkii*. Other species frequently recorded in the ground stratum include *Dianella revoluta, Pomax umbellata, Lepidosperma laterale, Cyathochaeta diandra, Lomandra multiflora* and *Lomandra cylindrica*.

Field sampling of this community was restricted to two main areas; along the south-eastern boundary of the Cumberland Plain between Appin and Holsworthy and to the north-west between Springwood and Bowen Mountain. Map Unit 32 is most commonly found on soils of the Mittagong Formation and further sampling is warranted to verify its presence in other parts of the study area where this soil landscape occurs. South of Campbelltown, the community is restricted to within 1 km of the shale/sandstone boundary, but this zone extends to approximately 4.5 km further north. This community is typically found on upper slopes and ridges, with *E. pilularis* becoming dominant descending into the gullies. Field survey sites always contained sandy soils and sandstone outcropping was often evident. Nevertheless, a strong shale influence in the soil was implied at most sites by landscape position and proximity to the shale/sandstone boundary. Map Unit 32 grades into Map Unit 31 with increasing distance from the shale/sandstone boundary. Descending into gullies, the community grades into Map Unit 33, a transition that may be abrupt in steep sided gullies and is often associated with a break in slope.

Previous floristic classifications:

Upper Georges River Sandstone Woodland is likely to be floristically similar to Sandstone/Shale Transition community described by Benson and Howell (1994) in the Bargo area.

Habitat:

Parent Geology: Mittagong Formation (65%), Wianamatta Shale (17%), Hawkesbury Sandstone (17%), Tertiary alluvium (1%)

	Mean	(±sd)	Range
Elevation (m)	129.8	(61.8)	23–275
Slope (° above horizontal)	4.7	(4.8)	0–20.5
Annual Rainfall (mm)	932.0	(43.4)	855–1069
Ruggedness (900m)	15.5	(7.0)	3–32
Maximum Temperature, Jan. (°C)	26.8	(3.8)	25.7–27.4
Solar Radiation, January	215.1	(3.2)	200–218
Distance to Shale (m)	694.6	(774.0)	0–4536.6

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	16.3 (3.9)	21.4 (10.4)
Small tree	43	8.1 (2.3)	10.2 (6.0)
Shrub	98	2.6 (0.9)	16.3 (14.6)
Forb	100	0.6 (0.6)	26.6 (17.7)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 27 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 42 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 27 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Allocasuarina littoralis	2	66	2	21	positive
Angophora bakeri	2	34	2	11	positive
Angophora costata	2	39	2	17	positive
Corymbia gummifera	3	81	2	24	positive
Eucalyptus oblonga	2	44	3	6	positive
Eucalyptus pilularis	4	27	4	12	positive
Eucalyptus punctata	4	78	2	20	positive
Shrub stratum					
Acacia linifolia	2	63	2	16	positive
Acacia longifolia	2	20	1	8	positive
Acacia myrtifolia	1	25	1	5	positive
Acacia suaveolens	1	24	2	9	positive
Acacia terminalis	2	63	2	14	positive
Acacia ulicifolia	2	76	1	19	positive
Astroloma pinifolium	1	12	1	1	positive
Banksia spinulosa var. *spinulosa*	2	75	2	20	positive
Bossiaea obcordata	2	25	2	11	positive
Brachyloma daphnoides	2	20	1	3	positive
Dillwynia retorta	2	53	2	11	positive
Eriostemon australasius	2	41	2	8	positive
Exocarpos strictus	2	49	1	8	positive
Gompholobium minus	2	32	2	2	positive
Grevillea diffusa subsp. *diffusa*	2	15	2	2	positive
Grevillea mucronulata	2	34	2	15	positive
Grevillea sphacelata	1	19	2	4	positive
Hakea dactyloides	1	46	2	15	positive
Hakea sericea	2	54	2	20	positive
Hibbertia serpyllifolia	1	17	2	3	positive

Hovea linearis	1	63	1	13	positive
Isopogon anemonifolius	2	47	2	12	positive
Kunzea ambigua	2	37	2	15	positive
Lambertia formosa	2	31	2	12	positive
Leptomeria acida	1	17	1	4	positive
Leptospermum parvifolium	2	14	1	1	positive
Leptospermum trinervium	2	73	2	24	positive
Leucopogon ericoides	1	12	1	2	positive
Leucopogon virgatus	2	17	–	0	positive
Lissanthe strigosa	2	59	2	18	positive
Lomatia silaifolia	1	46	1	15	positive
Monotoca scoparia	2	58	1	12	positive
Persoonia levis	1	69	1	20	positive
Persoonia linearis	2	69	2	29	positive
Petrophile sessilis	2	19	2	7	positive
Phyllanthus hirtellus	2	95	2	29	positive
Pimelea linifolia subsp. *linifolia*	2	63	2	25	positive
Xanthosia pilosa	2	29	2	12	positive
Xylomelum pyriforme	1	24	1	6	positive
Ground stratum					
Acianthus fornicatus	2	20	2	4	positive
Aristida vagans	2	51	2	44	constant
Astroloma humifusum	1	19	1	7	positive
Billardiera scandens	1	81	1	33	positive
Brunoniella pumilio	2	39	2	17	positive
Cyathochaeta diandra	2	73	2	18	positive
Danthonia linkii	2	53	2	8	positive
Dianella revoluta var. *revoluta*	2	85	2	33	positive
Entolasia stricta	3	100	3	55	positive
Eragrostis benthamii	1	12	1	1	positive
Gonocarpus tetragynus	2	46	2	20	positive
Goodenia hederacea subsp. *hederacea*	1	61	2	31	positive
Helichrysum scorpioides	1	12	2	3	positive
Lepidosperma laterale	2	76	2	42	positive
Lomandra confertifolia subsp. *rubiginosa*	3	22	2	8	positive
Lomandra cylindrica	2	58	2	13	positive
Lomandra filiformis subsp. *coriacea*	2	44	2	13	positive
Lomandra multiflora subsp. *multiflora*	2	76	2	48	positive
Lomandra obliqua	2	95	2	25	positive
Patersonia glabrata	1	29	2	6	positive
Patersonia sericea	1	37	1	10	positive
Platysace ericoides	2	34	2	9	positive
Poa labillardieri var. *labillardieri*	2	41	2	15	positive
Pomax umbellata	2	76	2	32	positive
Stipa pubescens	3	78	2	22	positive
Stylidium graminifolium	1	34	2	7	positive
Themeda australis	3	68	3	56	constant
Trachymene incisa subsp. *incisa*	2	14	3	3	positive
Xanthorrhoea concava	2	44	1	7	positive
Xanthorrhoea media	2	29	2	8	positive
Climbers					
Cassytha pubescens	2	64	2	15	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Corymbia eximia	2	8	2	3	uniform.
Eucalyptus agglomerata	4	5	1	2	uniform.
Eucalyptus capitellata	1	2	–	0	uniform.
Eucalyptus crebra	1	5	3	19	uniform.
Eucalyptus eugenioides	4	5	2	12	uniform.
Eucalyptus fibrosa	4	2	4	18	uniform.
Eucalyptus globoidea	4	3	2	9	uniform.
Eucalyptus haemastoma	2	3	2	3	uniform.
Eucalyptus notabilis	1	2	2	6	uniform.
Eucalyptus paniculata	1	2	2	3	uniform.
Eucalyptus piperita	4	7	2	6	uniform.
Eucalyptus resinifera	2	10	1	4	uniform.
Eucalyptus sclerophylla	4	19	4	8	uniform.
Eucalyptus sieberi	4	2	3	1	uniform.
Eucalyptus sparsifolia	4	2	3	4	uniform.
Eucalyptus squamosa	1	7	3	1	uniform.
Syncarpia glomulifera	2	29	3	19	uniform.

Map Unit 33:

Western Sandstone Gully Forest

Sample Sites: (62)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): Not calculated
No. Taxa (total / unique): 361 / 24
No. Taxa per Plot (±sd): 52.7 (±10.7)

Western Sandstone Gully Forest is dominated by *Angophora costata, Corymbia gummifera* and *E. pilularis*, with *E. punctata* occurring sporadically on mid-slopes. A sparse layer of smaller trees is usually present, and dominated by *Ceratopetalum gummiferum* and *Allocasuarina littoralis*. The shrub and ground strata are also sparse and often contain slightly fewer species relative to ridgetop communities. Shrub species include *Acacia terminalis, Leptospermum trinervium, Persoonia linearis* and *Banksia spinulosa* var. *spinulosa*. In the ground stratum, the fern species *Pteridium esculentum* is invariably present, along with the climber *Smilax glyciphylla*. These species were seldom recorded in other communities. Other species frequently recorded in the ground stratum include *Entolasia stricta, Dianella caerulea, Lomandra obliqua, L. longifolia, L. gracilis, Lepidosperma laterale* and *Gonocarpus teucrioides*.

Western Sandstone Gully Forest occurs on the lower slopes of sandstone gullies. The gradation into Map Unit 31 generally occurs less than half way up the slope from the gully floor. In particularly sheltered gullies, mesic species such as *Backhousia myrtifolia* and *Pittosporum undulatum* form a dense small tree stratum. Vines such as *Cissus hypoglauca* may also be locally abundant, and dense patches of fern such as *Calochlaena dubia* also occur. A narrow band of Riparian Scrub (Map Unit 35) usually occupies the creekline.

Previous floristic classifications:

Western Sandstone Gully Forest is equivalent to Western Gully Forest described by Keith (1994) and is included under Sydney Sandstone Gully Forest by Benson (1992).

Habitat:

Parent Geology: Hawkesbury Sandstone (82%), Mittagong Formation (18%)

	Mean	(±sd)	Range
Elevation (m)	101.2	(66.7)	4–264
Slope (° above horizontal)	17.1	(9.2)	1.3–35.0
Annual Rainfall (mm)	956.5	(66.1)	846–1081
Ruggedness (900 m)	23.1	(8.1)	11–46
Terrain (900 m)	-13.5	(20.5)	-48–54
Maximum Temperature, Jan. (°C)	26.7	(0.4)	25.9–27.4
Solar Radiation, January	205.7	(9.6)	182–218

Structure:

Growth form	Frequency (%)	Mean height (m)	(±sd)	Mean foliage cover (%)	(±sd)
Tree	100	22.4	(4.3)	17.8	(8.9)
Small tree	67	9.5	(3.5)	11.8	(7.1)
Shrub	86	2.8	(1.1)	18.8	(15.4)
Forb	100	0.8	(0.7)	14.3	(13.6)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 27 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 39 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 27 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Allocasuarina littoralis	2	61	2	21	positive
Allocasuarina torulosa	2	27	2	11	positive
Angophora costata	4	71	2	14	positive
Banksia serrata	2	40	2	6	positive
Ceratopetalum gummiferum	2	60	2	3	positive
Corymbia gummifera	2	81	3	24	positive
Elaeocarpus reticulatus	1	48	1	5	positive
Eucalyptus pilularis	4	65	3	8	positive
Eucalyptus piperita	3	32	2	4	positive
Shrub stratum					
Acacia linifolia	2	48	2	17	positive
Acacia longifolia	2	26	1	7	positive
Acacia suaveolens	2	35	1	8	positive
Acacia terminalis	2	66	2	13	positive
Acacia ulicifolia	1	60	1	20	positive
Amperea xiphoclada	1	11	1	1	positive
Banksia spinulosa var. *spinulosa*	2	61	2	21	positive
Boronia ledifolia	1	23	1	3	positive
Bossiaea heterophylla	2	31	2	6	positive
Bossiaea obcordata	2	29	2	10	positive
Correa reflexa var. *reflexa*	2	21	1	3	positive
Dillwynia retorta	2	39	2	12	positive
Dodonaea triquetra	2	58	2	11	positive
Epacris pulchella	1	19	1	6	positive
Eriostemon australasius	2	29	2	9	positive
Grevillea buxifolia	1	15	2	3	positive
Grevillea linearifolia	2	16	1	1	positive
Grevillea mucronulata	2	37	2	14	positive
Grevillea sericea	2	16	2	5	positive
Hovea linearis	1	32	1	15	positive
Lambertia formosa	2	37	2	11	positive
Lasiopetalum ferrugineum var. *ferrugineum*	2	10	1	2	positive
Leptomeria acida	2	23	1	3	positive
Leptospermum polygalifolium subsp. *polygalifolium*	2	18	2	6	positive
Leptospermum trinervium	2	81	2	23	positive
Leucopogon ericoides	1	10	1	2	positive
Leucopogon lanceolatus var. *lanceolatus*	1	19	1	3	positive
Logania albiflora	1	13	1	1	positive
Lomatia silaifolia	1	68	1	13	positive
Micrantheum ericoides	3	18	2	6	positive
Monotoca elliptica	1	11	1	1	positive
Notelaea longifolia f. *longifolia*	1	34	1	16	positive
Persoonia levis	1	82	1	19	positive
Persoonia linearis	2	76	2	28	positive
Persoonia pinifolia	1	19	1	6	positive
Philotheca scabra subsp. *scabra*	2	13	–	0	positive
Phyllanthus hirtellus	2	77	2	30	positive
Platysace lanceolata	3	19	2	1	positive
Platysace linearifolia	2	52	2	9	positive
Pultenaea daphnoides	3	13	-	0	positive
Pultenaea flexilis	2	24	2	2	positive
Ricinocarpos pinifolius	1	24	1	1	positive
Woollsia pungens	1	11	2	1	positive
Xanthosia pilosa	2	81	2	7	positive
Xylomelum pyriforme	1	42	1	4	positive
Ground stratum					
Acianthus fornicatus	2	24	2	4	positive
Actinotus helianthi	2	42	1	2	positive
Billardiera scandens	1	76	1	34	positive
Calochlaena dubia	3	13	2	2	positive
Caustis flexuosa	2	21	2	7	positive
Crassula sieberiana	1	11	2	3	positive
Dampiera purpurea	1	24	2	3	positive
Dendrobium linguiforme	1	13	–	0	positive
Dianella caerulea	2	89	2	23	positive
Dianella revoluta var. *revoluta*	2	52	2	36	constant
Entolasia stricta	3	94	3	55	positive
Galium binifolium	1	16	2	4	positive
Gonocarpus teucrioides	2	40	2	6	positive
Haemodorum planifolium	1	13	1	3	positive
Hybanthus monopetalus	1	10	1	2	positive
Lepidosperma filiforme	2	13	1	1	positive
Lepidosperma laterale	2	71	2	42	positive
Lindsaea microphylla	1	31	1	8	positive
Lomandra confertifolia subsp. *rubiginosa*	3	23	2	8	positive
Lomandra cylindrica	2	39	2	14	positive
Lomandra filiformis subsp. *filiformis*	1	42	2	34	constant
Lomandra gracilis	2	55	2	8	positive
Lomandra longifolia	2	71	2	28	positive
Lomandra multiflora subsp. *multiflora*	1	53	2	50	constant
Lomandra obliqua	2	79	2	26	positive
Opercularia aspera	1	27	1	3	positive
Patersonia glabrata	2	35	2	5	positive
Pomax umbellata	2	40	2	35	constant
Pteridium esculentum	2	85	2	9	positive
Schoenus melanostachys	1	13	1	2	positive
Stipa pubescens	2	47	3	25	positive
Stylidium laricifolium	2	16	1	1	positive
Stylidium productum	2	15	1	1	positive
Xanthorrhoea arborea	2	34	2	1	positive
Xanthosia tridentata	1	31	2	5	positive
Climbers					
Cassytha pubescens	1	37	2	18	positive
Hardenbergia violacea	1	48	1	29	positive
Kennedia rubicunda	1	21	1	5	positive
Marsdenia suaveolens	2	10	2	1	positive
Pandorea pandorana	1	27	2	13	positive
Smilax glyciphylla	2	77	1	7	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Angophora bakeri	2	24	3	12	uninform.
Angophora floribunda	1	2	2	8	uninform.
Corymbia eximia	3	2	2	3	uninform.
Eucalyptus agglomerata	1	5	2	2	uninform.
Eucalyptus globoidea	3	3	2	9	uninform.
Eucalyptus haemastoma	4	3	2	3	uninform.
Eucalyptus punctata	1	26	3	24	uninform.
Eucalyptus resinifera	1	6	1	4	uninform.
Eucalyptus umbra	4	2	–	0	uninform.
Syncarpia glomulifera	2	32	3	19	uninform.

Map Unit 34:

Mangrove/Saltmarsh Complex

Sample Sites: (3)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): Not calculated
No. Taxa (total / unique): 15 / 9
No. Taxa per Plot (±sd): 6.3 (±7.5)

Mangrove and Saltmarsh communities were poorly sampled in this survey and were therefore amalgamated as a complex for mapping. The three sites surveyed were relatively poor in species, and only three species were recorded more than once: *Avicennia marina* var. *australasica, Aegiceras corniculatum* and *Sarcocornia quinqueflora* subsp. *quinqueflora*. Further sampling is required to adequately characterise the floristic composition of this complex.

Habitat:

Parent Geology: Estuarine (100%)

	Mean	(±sd)	Range
Elevation (m)	1.3	(0.6)	1–2
Slope (° above horizontal)	1.1	(0.2)	0.9–1.3
Annual Rainfall (mm)	1025.3	(59.8)	985–1094
Ruggedness (900m)	11.3	(13.7)	2–27
Maximum Temperature, Jan. (°C)	26.4	(0.6)	25.7–26.7
Solar Radiation, January	217.7	(0.6)	217–218

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	67	10.5 (2.1)	42.5 (38.9)
Small tree	33	3.0 (–)	60.0 (–)
Shrub	–	– –	
Forb	67	– –	

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 2 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 2 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 2 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Aegiceras corniculatum	2	67	–	0	positive
Avicennia marina subsp *australasica*	6	100	–	0	positive
Shrub stratum					
Goodenia ovata	1	33	3	1	positive
Senecio minimus	1	33	–	0	positive
Ground stratum					
Apium prostratum	2	33	–	0	positive
Baumea juncea	2	33	–	0	positive
Juncus kraussii subsp. *australiensis*	4	33	–	0	positive
Samolus repens	2	33	–	0	positive
Sarcocornia quinqueflora subsp. *quinqueflora*	3	67	–	0	positive
Sporobolus virginicus var. *minor*	3	33	–	0	positive
Suaeda australis	3	33	–	0	positive
Tetragonia tetragonoides	2	33	–	0	positive

Map Unit 35:

Riparian Scrub

Sample Sites: (7)
Area (ha) 1750 / 1997 (± range): Not calculated
Proportion Extant (± range): Not calculated
No. Taxa (total / unique): 173 / 15
No. Taxa per Plot (±sd): 42.7 (±11.1)

Riparian Scrub is dominated by *Ceratopetalum apetalum* and *Tristaniopsis laurina*. *Angophora costata* is frequently present along the banks of smaller streams. Along the Georges River *Eucalyptus pilularis* is more common, but this species is restricted to the river banks and was rarely recorded in a survey site. Common species recorded in the shrub stratum include *Lomatia myricoides, Acacia obtusifolia, Leptospermum morrisonii* and *Grevillea oleoides*. The shrub stratum is locally dense, but shrub patches are frequently interspersed between rock pavement, recent deposits of sediment and water. The ground stratum is similarly variable. *Schoenus melanostachys, Sticherus flabellatus* and *Todea barbara* occur frequently on the banks and consolidated sediments within streams. Water plants such as *Triglochin procerum* occur intermittently.

Previous floristic classifications:

Riparian Scrub was described by Keith (1994).

Habitat:

Parent Geology: Hawkesbury Sandstone (100%)

	Mean	(±sd)	Range
Elevation (m)	154.6	(111.6)	10–349
Slope (° above horizontal)	11.4	(4.7)	4.5–19.6
Annual Rainfall (mm)	1063.4	(180.2)	864–1524
Ruggedness (900 m)	26.5	(6.3)	13–34
Maximum Temperature, Jan. (°C)	26.4	(1.1)	24.6–28.5
Solar Radiation, January	207.7–4.8		198–216

Structure:

Growth form	Frequency (%)	Mean height (m) (±sd)	Mean foliage cover (%)(±sd)
Tree	100	12 (7.2)	40.3 (34.1)
Small tree	33	10.0 (–)	5.0 (–)
Shrub	67	2.5 (0.7)	10.0 (7.1)
Forb	100	1.0 (–)	20 (–)

Diagnostic Species: Positive diagnostic species are shaded. A 0.04 ha plot located in this Map Unit is expected to contain at least 31 positive diagnostic species (95% confidence interval) provided the total number of native species in the plot is 10 or greater. A 95% confidence interval means that five percent of plots sampled (1 in 20 plots) in this Map Unit may contain fewer than 31 positive diagnostic species.

C/A: Cover/abundance within Map Unit (50 percentile)
Freq: Frequency (%) within Map Unit
C/A O: Cover/abundance in other Map Units (50 percentile)
FreqO: Frequency (%) within other Map Units
FC: Fidelity class

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Allocasuarina littoralis	3	43	2	24	constant
Angophora costata	3	43	2	19	constant
Backhousia myrtifolia	3	29	4	2	positive
Ceratopetalum apetalum	3	71	–	0	positive
Ceratopetalum gummiferum	3	57	2	7	positive
Stenocarpus salignus	2	57	1	1	positive
Tristania neriifolia	2	29	–	0	positive
Tristaniopsis laurina	4	86	1	1	positive
Shrub stratum					
Acacia floribunda	2	43	2	7	positive
Acacia longissima	1	29	1	1	positive

Acacia obtusifolia	4	29	–	0	positive
Acacia terminalis	2	43	2	17	constant
Banksia marginata	1	29	2	2	positive
Daviesia corymbosa	2	57	1	1	positive
Dodonaea triquetra	2	43	2	14	constant
Grevillea mucronulata	2	43	2	16	constant
Grevillea oleoides	3	43	–	0	positive
Hakea salicifolia	3	29	1	1	positive
Lasiopetalum ferrugineum var. *ferrugineum*	1	29	2	2	positive
Leionema dentatum	1	43	–	0	positive
Leptospermum morrisonii	3	43	–	0	positive
Leptospermum polygalifolium subsp. *polygalifolium*	2	43	2	7	positive
Logania albiflora	3	29	1	1	positive
Lomatia myricoides	3	100	2	1	positive
Micrantheum hexandrum	2	29	–	0	positive
Pomaderris ferruginea	2	29	1	1	positive
Westringia longifolia	2	29	1	1	positive
Ground stratum					
Baumea juncea	2	29	–	0	positive
Billardiera scandens	1	43	1	37	constant
Blechnum cartilagineum	2	29	1	2	positive
Calochlaena dubia	3	29	2	3	positive
Caustis pentandra	2	29	1	1	positive
Entolasia stricta	2	86	3	58	constant
Gleichenia dicarpa	2	43	–	0	positive
Gonocarpus teucrioides	1	57	2	8	positive
Lepidosperma laterale	1	71	2	44	constant
Lomandra fluviatilis	4	29	–	0	positive
Lomandra longifolia	2	71	2	31	constant
Morinda jasminoides	2	29	2	3	positive
Pteridium esculentum	2	43	2	15	constant
Schoenus melanostachys	2	71	1	2	positive
Sticherus flabellatus	4	57	–	0	positive
Todea barbara	2	43	–	0	positive
Triglochin procerum	2	29	–	0	positive
Viola hederacea	2	29	2	2	positive
Xanthosia tridentata	1	71	2	7	positive
Climbers					
Cassytha glabella f. *glabella*	1	43	2	16	constant
Cassytha pubescens	3	43	2	19	constant
Smilax glyciphylla	1	57	1	13	positive

Other tree species occurring less frequently in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Tree stratum					
Eucalyptus pilularis	2	29	4	13	uninform.
Eucalyptus piperita	1	29	2	6	uninform.
Eucalyptus punctata	1	14	3	24	uninform.
Eucalyptus saligna × *botryoides*	1	14	–	0	uninform.

Weed species commonly found in this community:

Species	C/A	Freq	C/AO	FreqO	FC
Ground stratum					
Ageratina adenophora	1	33	–	0	positive
Andropogon virginicus	1	33	1	1	positive
Cirsium vulgare	1	67	1	34	constant
Myriophyllum aquaticum	1	33	–	0	positive
Senecio madagascariensis	2	67	2	52	constant
Senecio vulgaris	2	33	–	0	positive
Tradescantia zebrina	1	33	–	0	positive

Appendix 2: Frequency (%) with which native species were recorded in each Map Unit (blank cells indicate the species was not recorded).

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Native species																						
Abutilon oxycarpum												23										
Acacia binervata		5				14	5															
Acacia binervia	14					7										44						
Acacia brownii		3		7	3	3	3											4		54	50	
Acacia buxifolia								1														
Acacia bynoeana																				4		
Acacia decurrens			2	5	14	24	45	19	7	9	12		10	5		22	32	11	14			
Acacia echinula																		4				
Acacia elata					3							8										
Acacia elongata				2		1	11											29	29	46	50	
Acacia falcata				3	27	23		17	5	14				3			40	50		12		
Acacia falciformis						1	3							5			8					
Acacia fimbriata						1		1										4				
Acacia floribunda	43	3		2	11	9	11	1		41	12	8		32		44			14			
Acacia hispidula		3	10	3																		
Acacia implexa				2	24	20	13	11	57	5	38	54	40	11				4				
Acacia irrorata subsp. *irrorata*				2			8		2													
Acacia leiocalyx subsp. *leiocalyx*						1		1														
Acacia linifolia	29	48	54	63	30	6				5				3				4				
Acacia longifolia	14	26	12	20	32	9				5								7		4		
Acacia longissima	29	2				1	3	1		5	12						8					
Acacia maidenii												15										
Acacia mearnsii																11						
Acacia myrtifolia		8	32	25	14	3																
Acacia obtusifolia	29	2				1																
Acacia paradoxa						1																
Acacia parramattensis		2		2	43	34	13	23	16	59	12	15	20	84		11	40	14	14	12		
Acacia parvipinnula		3		2	3	6	3										4	11				
Acacia penninervis												8										
Acacia pubescens					3			1										25				
Acacia stricta					5																	
Acacia suaveolens		35	66	24	5	1																
Acacia terminalis	43	66	32	63	11	19	3															
Acacia trinervata					3	1																
Acacia ulicifolia		60	59	76	30	24	3	1			12							7			50	
Acaena echinata												8										

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Acaena novae-zelandiae													10									
Acianthus fornicatus		24	12	20		9																
Acianthus pusillus				2																		
Acmena smithii					3					5	38	8										
Acronychia oblongifolia												8										
Acrotriche divaricata	14	3		7	3	9	3			5	12											
Actinotus helianthi		42	15	5																		
Actinotus minor	14	10	54	3																		
Adiantum aethiopicum	29	3			22	7	8		7	55	88	100	40	43		22			14			
Adiantum formosum										5												
Adiantum hispidulum							3		2	9	12											
Aegiceras corniculatum																						67
Agrostis aemula					3			3														
Agrostis avenacea var. *avenacea*					3	1	11	23	10					24	100		36	7	71	4		
Ajuga australis						1	11	17	25				10				16					
Alchornea ilicifolia												8										
Alectryon subcinereus										9	12	62										
Allocasuarina distyla		2	5																			
Allocasuarina littoralis	43	61	39	66	22	50	37	5									16	18		4		
Allocasuarina torulosa	14	27		8	46	19	8	2		14	75	31		5			8					
Alphitonia excelsa					3				2	5	25	15		3				4				
Alternanthera denticulata						1		1	3	5				16	100				29	4		
Alternanthera species *A*									2													
Amperea xiphoclada		11	10	5																	50	
Amphipogon strictus var. *strictus*																				8		
Amyema gaudichaudii						1	3	3									12	18	14	12		
Amyema miquelii								3	2				10				4	4				
Amyema pendulum subsp. *pendulum*			2				3							3								
Angophora bakeri		24	7	34		27	3	1									4	7		73	100	
Angophora costata	43	71	24	39	54	10				23	62											
Angophora floribunda		2			14	9	16	8	3	9	38	8		32		22	8	7	14			
Angophora hispida		3	29	7																		
Angophora subvelutina								5	2					14		44	4	4	29			
Anisopogon avenaceus		23	37	17	14	10	5	1		5								7		4		
Aotus ericoides	14		12																			
Aphanopetalum resinosum												62	20	3								
Apium prostratum																						33
Aristida benthamii var. *spinulifera*			2	7		3																

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Aristida calycina var. *calycina*							13		2											4		
Aristida jerichoensis																				4		
Aristida ramosa			7	2	8	7	18	55	84				30	5		11	20	18	14	50		
Aristida vagans		23	2	51	49	90	53	91	23			8		8			88	71	43	50		
Aristida warburgii				7	3	4											4			58		
Arthropodium milleflorum		2			5	19	18	45	38	14	12	23	50	32		11	36	14	14	19		
Arthropodium minus						4		8	5	5		8		3			4					
Arthropodium species *B*		2		2		3		3	2								4					
Asperula conferta							8	32	61					8			4		14			
Asplenium australasicum f. *australasicum*					3					5												
Asplenium flabellifolium		6									38	62	30	8								
Astroloma humifusum		2	2	19		20	21	13	2							11	20	7		4		
Astroloma pinifolium		6		12		7																
Astrotricha floccosa					3																	
Astrotricha latifolia		3									12	8				11						
Astrotricha longifolia				2																		
Austrodanthonia bipartita		13	7	53		21	18	6	15								4	4		8		
Austrodanthonia caespitosa						1			10					5				7				
Austrodanthonia laevis							3		2													
Austrodanthonia pilosa								4	3													
Austrodanthonia racemosa var. *obtusata*									2													
Austrodanthonia racemosa var. *racemosa*		2			3	3	3	30	31			23	30	22		11	16	4				
Austrodanthonia setacea								1		5												
Austrodanthonia tenuior		2		2	11	13	5	43	23					11		11	52	61	57	15		
Austromyrtus tenuifolia	14																					
Austrostipa nodosa							3						10									
Austrostipa pubescens		47	56	78	22	56	3		3								4	11		27		
Austrostipa ramosissima						1	5			14	12	15	10	14		78						
Austrostipa rudis		2			22	4	8	6		18				8			12	7		8		
Austrostipa scabra						1	3															
Austrostipa setacea							3		3								4					
Austrostipa verticillata					3		5		2													
Avicennia marina subsp. *australasica*																						100
Azolla filiculoides var. *rubra*															50							
Babingtonia pluriflora						1																
Backhousia myrtifolia	29				5	1	3			9	25	15		5		33						

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Baeckea diosmifolia																				4	50	
Baeckea imbricata			2																			
Baeckea linifolia	14	2																				
Baeckea ramosissima subsp. *ramosissima*			7		3																	
Banksia aemula																					50	
Banksia cunninghamii			2																			
Banksia ericifolia	14	3	24																	4		
Banksia integrifolia var. *integrifolia*		2																				
Banksia marginata	29	3	20																			
Banksia oblongifolia		3	15	5														4		35	100	
Banksia serrata	14	40	71	7																		
Banksia spinulosa var. *spinulosa*	14	61	93	75		1												4		81		
Bauera rubioides	14	2																				
Baumea juncea	29																					33
Bertya pomaderroides		2																				
Beyeria lasiocarpa	14																					
Beyeria viscosa	14	2		3												11						
Billardiera scandens	43	76	51	81	62	71	21			18				3		22	16	39		8		
Blandfordia nobilis			2																			
Blechnum ambiguum	14																					
Blechnum cartilagineum	29	6			5	1				18	50											
Blechnum nudum											12											
Bolboschoenus caldwellii														3								
Boronia ledifolia		23	29	10																		
Boronia pinnata			10																			
Boronia polygalifolia						6	5	1									8	18		27		
Boronia ruppii			2																			
Bossiaea buxifolia						1											4	4				
Bossiaea ensata			22	8																		
Bossiaea heterophylla	14	31	71	8																	50	
Bossiaea lenticularis						1																
Bossiaea obcordata		29	32	25	5	7																
Bossiaea prostrata		2	2	10	5	10	29	16	7								12	4		4		
Bossiaea rhombifolia subsp. *rhombifolia*		3		3																23	50	
Bossiaea scolopendria		2	5																			
Bossiaea stephensonii		2																				

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Bothriochloa decipiens								11	2													
Bothriochloa macra							3	15	28					3								
Brachychiton acerifolius					8					18	25											
Brachychiton populneus						3	5	1	7			23	50				4					
Brachycome angustifolia var. *angustifolia*						6	3	1	3			8	10	3			4	4		8		
Brachycome graminea					3	1					12							4				
Brachycome multifida								2														
Brachyloma daphnoides		3	20	20		1											4	4		12	50	
Bracteantha bracteata						1		1						5								
Breynia oblongifolia	14	11		2	38	23	37	18	16	64	88	85	80	30		22	8			4		
Brunoniella australis				2	5	24	68	88	85	18	38	15	60	54	50		60	36	14	12		
Brunoniella pumilio		13	10	39	19	29	11	6	16	18	12			11			28	21	43	38		
Burchardia umbellata		2	2	3																31		
Bursaria lasiophylla var. *atriplicina*		2																				
Bursaria spinosa	14	16		5	51	60	74	97	92	32	25	15	70	100	50	22	84	46	43	4		
Caesia parviflora		2	5	5	5	16	11	19	23	9	12			22			12	14	14	31		
Calandrinia calyptrata						1																
Calandrinia pickeringii								1														
Caleana major		2																			50	
Callicoma serratifolia	14									5												
Callistemon citrinus	14	2																			50	
Callistemon linearifolius					3																	
Callistemon linearis				10			8	1										4		8	50	
Callistemon pinifolius				2													4	7		38		
Callistemon salignus										9		15		3		11	4		14			
Callitriche muelleri	14																					
Calochlaena dubia	29	13		2	5					14	62			5								
Calotis cuneifolia					5		3	8						3			20	21	14			
Calotis dentex						26	34	4						3			4	4				
Calotis lappulacea								2	7													
Calystegia marginata										5												
Calytrix tetragona	14	2	2			1																
Capillipedium parviflorum								1	2													
Capillipedium spicigerum									3													
Cardamine paucijuga								2	3					11	50							
Carex appressa									2			15		11	100	11			14			
Carex breviculmis					5	4	3	5	7				10	8			4					

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Carex declinata												8		3								
Carex inversa					3	1	3	18	62	14		23	50	8		22	4		29			
Carex longebrachiata							3		3			23		14		22						
Carex maculata											25											
Cassine australis var. *australis*										5		15										
Cassinia aculeata				2		1												7				
Cassinia arcuata																		4				
Cassinia aureonitens		2																				
Cassinia cunninghamii						3																
Cassinia longifolia		6																				
Cassinia trinerva		2									12			3								
Cassinia uncata						1											4	11				
Cassytha glabella forma *glabella*	43	21	24	19	14	24	8	2		5	25					22	4	46	14	58	50	
Cassytha pubescens	43	37	54	64	11	17		1									4	25	14	35	50	
Casuarina cunninghamiana subsp. *cunninghamiana*												8		5								
Casuarina cunninghamiana × *glauca*														3								
Casuarina glauca								1	3					32	50		8					33
Caustis flexuosa		21	51	10																		
Caustis pentandra	29	2	7																			
Cayratia clematidea							11	3	5	45	38	92	80	19		33						
Celastrus australis									3			31	30									
Centaurium spicatum								5	7					3			4					
Centella asiatica	14				16	4	11	20	15	23	12			49	50	11	16	4	86			
Centipeda cunninghamii														3								
Centipeda minima var. *minima*					3									11	50			4	43			
Centrolepis fascicularis					3																	
Centrolepis strigosa subsp. *strigosa*																				4		
Ceratopetalum apetalum	71	2																				
Ceratopetalum gummiferum	57	60	10	12							12											
Chamaesyce dallachyana									2													
Chamaesyce drummondii								1	3													
Cheilanthes distans		15				4	8	2	31			8	40	3								
Cheilanthes sieberi subsp. *sieberi*		24	2	37	54	81	87	87	69	9		15		51		11	92	89	86	58		
Chenopodium carinatum													10									
Chiloglottis formicifera										5												
Chloris divaricata var. *divaricata*									2													
Chloris truncata							3	5	20			8	30	3								

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Chloris ventricosa						1		18	41			15	20	8								
Chorizandra cymbaria	14			2																		
Chorizema parviflorum						3		8									28			4		
Christella dentata											12											
Chrysocephalum apiculatum					3	1		8	3								4			4		
Cissus antarctica					3					18		46	20									
Cissus hypoglauca	14			2						14	25											
Citriobatus pauciflorus										5		23										
Claoxylon australe												8										
Clematis aristata		13			11	10	5		3	32	62	15	10	8				4				
Clematis glycinoides var. *glycinoides*				2	27	10	18	9	31	59	12	31	40	49		33	4	4				
Clerodendrum tomentosum					5	6	16	5	3	36	50	62	70	11								
Comesperma defoliatum				3																		
Comesperma ericinum			7	3																		
Comesperma sphaerocarpum																		11		12		
Comesperma volubile		2		2	3	3																
Commelina cyanea					16	3	16	24	16	27		38	40	59	50	33	12	4				
Conospermum ellipticum			2																			
Conospermum ericifolium			2																			
Conospermum longifolium			34	2		1																
Conospermum taxifolium			2																		100	
Convolvulus erubescens								4	3			8		5								
Coopernookia barbata		3		2																		
Correa reflexa var. *reflexa*		21	2	3	19	3	3															
Corybas aconitiflorus				2																		
Corymbia eximia		2	2	8	5	7																
Corymbia gummifera		81	93	81	27	29	3				12									12		
Corymbia maculata						13	11	5	3			23	20	3			4					
Cotula australis								1					10	5								
Crassula sieberiana		11		2			5	2	13			8	30				4					
Croton verreauxii																11						
Crowea saligna		2	2																			
Cryptandra amara var. *amara*			10	2		4											4			23		
Cryptandra ericoides			2																			
Cryptandra propinqua				2																		
Cryptandra spinescens							11										4		14			
Cryptocarya glaucescens												8										
Cryptostylis erecta						1																

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Cryptostylis subulata											12											
Cupaniopsis anacardioides											12											
Cuscuta australis																		7				
Cyathea australis					3					5												
Cyathea cooperi										5												
Cyathea leichhardtiana	14																					
Cyathochaeta diandra		27	85	73	8	11											8	11		88	50	
Cymbidium suave		3		2	8																	
Cymbonotus lawsonianus								8	7													
Cymbopogon refractus				5	22	20	39	47	25	5		15	20	5		11	36	11		8		
Cynanchum elegans												15										
Cynodon dactylon	14			2	8	1	13	9	8	5				14	100	22		7		4		
Cynoglossum australe													10									
Cyperus enervis								2	3			23	10	5		22						
Cyperus exaltatus								1														
Cyperus flaccidus																			14			
Cyperus fulvus									2													
Cyperus gracilis					3	3	11	17	48	5		31	70	24			4					
Cyperus gunnii subsp. *gunnii*									2					3			4		14			
Cyperus haspan subsp. *haspan*																				4		
Cyperus imbecillis		3			3			1	2			31	20	3								
Cyperus laevis					5	3	8	4	2	14		8	10	3				4				
Cyperus sanguinolentus																			14			
Cyperus tetraphyllus										5												
Cyperus trinervis														3								
Dactyloctenium radulans									2													
Damasonium minus															100							
Dampiera purpurea		24	5	8		13												4				
Dampiera stricta		6	78	14																35		
Darwinia fascicularis	14																					
Daucus glochidiatus								9	5			8										
Davallia solida var. *pyxidata*		2												3								
Daviesia acicularis						3														4		
Daviesia corymbosa	57	2	10	5																		
Daviesia genistifolia								1	2													
Daviesia squarrosa			5	2	5	4													14	42		
Daviesia ulicifolia		3		3	14	21	11	39	2								68	50		54		
Deeringia amaranthoides												31	10									

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Dendrobium linguiforme	14	13									12											
Dendrobium speciosum		2																				
Dendrophthoe vitellina					5													11				
Desmodium brachypodum						4	5	18	46			15	70	22			12	4				
Desmodium rhytidophyllum					3	14	11	9	11	9			20	8			8					
Desmodium varians				2	16	23	63	84	82	41	25	54	100	57		22	68	14				
Deyeuxia quadriseta				3	5													4				
Dianella caerulea	29	89	22	34	78	44	16	2		73	75			14		11	4	4				
Dianella longifolia			2		8	9	29	60	33	18	12	8		30		11	52	11	43	8		
Dianella prunina			10																			
Dianella revoluta var. *revoluta*	29	52	22	85	43	54	11	32	8								56	82	14	77	50	
Dichanthium sericeum								4	16				20				8					
Dichelachne crinita																22		4				
Dichelachne inaequiglumis		2			14																	
Dichelachne micrantha		8		15	35	47	29	72	61	9	12	8	10	16		22	68	43	43	23		
Dichelachne parva						1	16	13	11	5							12					
Dichelachne rara		2		2	11			3	2										14			
Dichondra repens				2	57	33	79	98	97	77	25	69	100	97		78	68	32	71			
Dichopogon fimbriatus								5									12	4				
Dichopogon strictus								8														
Digitaria breviglumis				2														4		8		
Digitaria diffusa							5	5		9							4					
Digitaria parviflora		5			24	20	37	14	2	14	12		10	5			8	11		12		
Digitaria ramularis	14	6		12		39	13	6	2					3			4					
Dillwynia floribunda		5	7	3																8	50	
Dillwynia glaberrima								1									4			12		
Dillwynia parvifolia				8	3	6											4	14				
Dillwynia phylicoides						1																
Dillwynia retorta	14	39	71	53		13											4					
Dillwynia sericea			15	3														4		15	100	
Dillwynia sieberi						3		33	5								24	18				
Dillwynia tenuifolia						1		2									4	46	14	58		
Diospyros australis												15										
Dipodium punctatum		2			3			1														
Dipodium variegatum						1																
Dodonaea falcata																		21		4		
Dodonaea triquetra	43	58	20	17	38	23	5			9	25					22		7				
Dodonaea viscosa subsp. *angustifolia*						3	3	1														

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Dodonaea viscosa subsp. *cuneata*		2	5			1		12	11								4					
Doodia aspera					8		3			36	38	31		11								
Doodia caudata									2			15	10	14								
Doryanthes excelsa		8																				
Drosera auriculata						1											4			15		
Drosera peltata			5	2	3																	
Drosera spatulata	14	2																		4		
Duboisia myoporoides											12											
Echinopogon caespitosus var. *caespitosus*		11		20	32	73	24	46	5	32	12	8	10	19			48	29	29	23		
Echinopogon ovatus	14			5	51	19	87	38	48	55	38	46	50	84	50	67	52	25	29	23		
Eclipta platyglossa									5					8	50				14			
Ehretia acuminata var. *acuminata*												8										
Einadia hastata					8	11	18	26	15	23		23	50	30		22		14				
Einadia nutans						3	5	5	30			15	30	3		22	4					
Einadia polygonoides							5	2	13				30	3								
Einadia trigonos					3	4	13	12	23	9		15	10	19		22	4					
Elaeocarpus reticulatus		48	7	5	16	4				36	62			3								
Elatine gratioloides															50							
Eleocharis acuta									2					3								
Eleocharis cylindrostachys														3	50				14			
Eleocharis dietrichiana																			14			
Eleocharis philippinensis																				4		
Eleocharis sphacelata															50							
Elymus scaber var. *scaber*								4	20			8										
Entolasia marginata	14	3			54	29	76	26	11	82	88	23		89	50	44	12	11	14			
Entolasia stricta	86	94	80	100	78	90	32	18	2	45	50	8		5			80	96	57	96		
Epacris longiflora	14	3		2																		
Epacris microphylla var. *microphylla*		2	15	2																		
Epacris pulchella	29	19	37	8	8	1																
Epacris purpurascens var. *purpurascens*					3																	
Epaltes australis						1		1											43	12		
Epilobium billardierianum subsp. *cinereum*		2																	14			
Eragrostis benthamii		2		12		4										11						
Eragrostis brownii			2	17	22	39	18	31	10					3		11	36	54	57	77		
Eragrostis elongata						1		1											29	12		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Eragrostis leptostachya		3		5	11	21	71	68	34	14		8	10	38		11	32	4	43			
Eragrostis parviflora				2				2						3								
Eremophila debilis								35	31					8								
Eriochloa pseudoacrotricha								6	10						50				14			
Eriostemon australasius		29	61	41																		
Erodium crinitum						1																
Eucalyptus acmenoides					5					23												
Eucalyptus agglomerata		5	2	5		1																
Eucalyptus amplifolia								5	5					46	50				29			
Eucalyptus baueriana								1						5		11						
Eucalyptus benthamii																22						
Eucalyptus beyeriana						1														4		
Eucalyptus bosistoana								1														
Eucalyptus botryoides																33						
Eucalyptus capitellata				2																		
Eucalyptus consideniana			10																			
Eucalyptus crebra				5	11	57	39	31	31				30				36	4				
Eucalyptus deanei					8					5				3								
Eucalyptus elata														3		33						
Eucalyptus eugenioides				5	8	19	42	22	13	5				19			24	14	14	4		
Eucalyptus fibrosa				2	19	39	39	19	2								64	82	29	27		
Eucalyptus globoidea		3	10	3	41	17	13	1		9	25			8			12	4				
Eucalyptus haemastoma		3	22	3	3	1																
Eucalyptus longifolia						4		2										29		4		
Eucalyptus moluccana					3	1	24	69	70	5		8	60	14			40	7				
Eucalyptus notabilis				2	19	4																
Eucalyptus oblonga			32	44		16												4				
Eucalyptus paniculata				2	19	1		2		45	25											
Eucalyptus parramattensis subsp. *parramattensis*			2															7	57	77		
Eucalyptus pilularis	29	65	7	27	30	14	3			36	50	8										
Eucalyptus piperita	29	32	22	7	3									3								
Eucalyptus punctata	14	26	22	78	30	61	34	4		32	12			8			8					
Eucalyptus resinifera		6		10	32	7	5			5								4				
Eucalyptus saligna					5		3			50	50											
Eucalyptus saligna × *botryoides*	14															11						
Eucalyptus sclerophylla			32	19	8	6								3			8	7	14	69	100	
Eucalyptus sideroxylon							3											4	14	15		

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Eucalyptus sieberi			12	2																		
Eucalyptus sparsifolia			10	2	14												4					
Eucalyptus squamosa			2	7																		
Eucalyptus tereticornis					3	9	53	67	70	5	12	38	60	46		11	40	7	29			
Eucalyptus umbra		2			3																	
Euchiton gymnocephalus		2				1		1									4		29	8		
Euchiton involucratus					5		3	1	3									4				
Euchiton sphaericus		2			3	20	39	47	39			23	20	11			40	11	43	4		
Eustrephus latifolius	14	3			32		3			86	88	85	10	11				7				
Exocarpos cupressiformis		3		5	24	26	8	24	11	18	38	8		11			8	18		8		
Exocarpos strictus		19	15	49	8	30	5										8					
Ficus coronata											25	8										
Ficus rubiginosa												8										
Fimbristylis dichotoma						1	11	27	16								28	4	57	8		
Fimbristylis velata														3								
Gahnia aspera					14	20	29	5		9	12			8		22		4				
Gahnia clarkei					3						12											
Gahnia filifolia						1																
Gahnia melanocarpa										5												
Gahnia microstachya																				4		
Gahnia radula			2																	4		
Gahnia sieberiana	14	2	5				3															
Galium australe								1														
Galium binifolium	29	16		3	14	11	8				12	8										
Galium gaudichaudii						1		4	3								8					
Galium migrans									15			8	10	8								
Galium propinquum					3	3	39	10	23	9		46	70	35		11	4	4				
Geitonoplesium cymosum	14				11	3	16		3	14	25	92	20	24								
Geranium homeanum					5			4	15	14		46	30	3								
Geranium solanderi var. *solanderi*		2			3			1	15	23		8	10	11		11						
Gleichenia dicarpa	43	2		2																		
Gleichenia microphylla	14																					
Glochidion ferdinandi var. *ferdinandi*		6	2	2	16	3				9	38	8										
Glochidion ferdinandi var. *pubens*					3					5												
Glossogyne tannensis								10	3													
Glyceria australis															50							
Glycine clandestina		10		24	78	77	47	49	38	41	62	38	80	54		56	68	46	29	23		
Glycine microphylla		8		7	30	21	16	37	39	32				35		22	32	18	14	8		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Glycine species *A*						1	3	1	2			8				11	4					
Glycine tabacina		10		17	5	26	53	67	56	32		15	10	57		22	16	4		4		
Gompholobium glabratum			27	12		1			2											4		
Gompholobium grandiflorum		13	44	10																		
Gompholobium huegelii					3	6														8	50	
Gompholobium inconspicuum				3	3	10	3													19		
Gompholobium latifolium		3	17	7																		
Gompholobium minus		3	7	32	3	3											4			12		
Gompholobium pinnatum						3														27		
Gompholobium uncinatum				3			3															
Gonocarpus longifolius	14															22						
Gonocarpus micranthus																				4		
Gonocarpus tetragynus		10	10	46	49	44	18	3		23				3			20	39		81		
Gonocarpus teucrioides	57	40	17	15	3	3	3			5	12							7		4		
Goodenia bellidifolia subsp. *bellidifolia*		2	10	14		6												11		35		
Goodenia decurrens				2																		
Goodenia hederacea subsp. *hederacea*		24	24	61	49	49	39	48	8								68	61		35		
Goodenia heterophylla		3	2	5	5	1																
Goodenia ovata					3					9				3								33
Goodenia paniculata				5				1									4	4	100	27		
Gratiola pedunculata																			71			
Grevillea sphacelata		2	39	19																		
Grevillea arenaria							3															
Grevillea buxifolia subsp. *buxifolia*		15	44	2																		
Grevillea diffusa subsp. *diffusa*			24	15																		
Grevillea juniperina								2									12	18		4		
Grevillea linearifolia		16	5	7	3	1																
Grevillea longifolia		3		2																		
Grevillea mucronulata	43	37	29	34	3	23												14		73		
Grevillea oleoides	43	2	2																			
Grevillea sericea		16	27	8	3															4		
Grevillea speciosa		2	2																			
Guioa semiglauca											12	15										
Guringalia dimorpha	14																					
Haemodorum corymbosum	14	8	5															4		8	50	
Haemodorum planifolium		13	5	5					2								8			35		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Hakea dactyloides	14	31	73	46	3	3														77		
Hakea gibbosa			2																			
Hakea propinqua		2																				
Hakea salicifolia	29			2	8																	
Hakea sericea	29	35	71	54	22	14								3			24	32	29	81		
Hakea teretifolia			7																			
Haloragis heterophylla								1	5					8					29			
Hardenbergia violacea	29	48	10	31	49	47	13	45	28	27	12	8	30	5			48	21	14	35		
Helichrysum collinum				3																		
Helichrysum scorpioides			2	12	14	6	3										8			8		
Hemarthria uncinata var. *uncinata*				2										5					29	4		
Hibbertia acicularis		2				6																
Hibbertia aspera		11	10	19	51	40	42	4		23	38			5		11	20	32	29	4		
Hibbertia bracteata		3	15	3																		
Hibbertia circumdans		2																				
Hibbertia cistiflora subsp. *cistiflora*		2																				
Hibbertia dentata		2			5					14												
Hibbertia diffusa		2	5	24	24	36	29	17	5					11		22	28	14		8		
Hibbertia empetrifolia	14	2	10		5	1				5								7				
Hibbertia fasciculata																				4	50	
Hibbertia linearis		2	7				3															
Hibbertia monogyna		5	10																			
Hibbertia obtusifolia						3																
Hibbertia pedunculata						3											8	4				
Hibbertia riparia		2	20	5		1																
Hibbertia scandens										9	12											
Hibbertia serpyllifolia			22	17														4		8		
Hovea linearis		32	56	63		13												4		31		
Hovea longifolia		2																		8		
Hovea purpurea		2																				
Hybanthus monopetalus		10		7	3	3	5															
Hybanthus vernonii				2		1																
Hydrocotyle laxiflora					3	4				9	38			11		22		7				
Hydrocotyle peduncularis					19	9	21	13	2	18	12		10	8			44		71	8		
Hydrocotyle tripartita	14											8		3								
Hymenanthera dentata	14						8		3			54		5		67						
Hypericum gramineum				3	16	17	29	34	39				10	5			56	36	71	54		
Hypericum japonicum				2		3	3															

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Hypolepis muelleri					3					5				3								
Hypoxis hygrometrica			2			14	18	33	25					5			12	4	57	4		
Hypoxis pratensis var. *pratensis*						4		6		5				3			8		14			
Imperata cylindrica var. *major*		19		17	54	21	8	2		32	38	8		8			4	4	29	12		
Indigofera australis					11	4	8	17	16	14	25	8	30				4					
Isolepis inundata														8	50				43	4		
Isolepis nodosa	14													5					14			
Isopogon anemonifolius		19	85	47														4		38	50	
Isopogon anethifolius	14		7																		50	
Jacksonia scoparia		3		7		29	5	2	2								12	7		4		
Joycea pallida					3	1			2									4				
Juncus australis																			14			
Juncus continuus	14													8						8		
Juncus fockei																			14			
Juncus homalocaulis							3	1	8					5			4					
Juncus kraussii subsp. *australiensis*																						33
Juncus planifolius	14				3									5	50			4	43	8		
Juncus prismatocarpus	14													3				4	29			
Juncus remotiflorus								2									4	4	14			
Juncus subsecundus									2										14			
Juncus usitatus	14						5	28	18	5		15		35	100		20	7	86	4		
Juncus vaginatus					5																	
Kennedia rubicunda	14	21		3	22	13	3	2		23	25	8										
Kunzea ambigua	14	11	17	37	22	60	45	2	2	5				3		11	4	21	14	4		
Kunzea capitata			5	5																19	50	
Kunzea parvifolia																				4		
Lagenifera gracilis		6		24	3	40	42	15	8	5		8	30	5			12	7		12		
Lagenifera stipitata		2			3	6	11	3	7				10				24	36		4		
Lambertia formosa		37	78	31			3															
Lasiopetalum ferrugineum var. *cordatum*						4																
Lasiopetalum ferrugineum var. *ferrugineum*	29	10	7	3	3	1												11				
Lasiopetalum macrophyllum		2																				
Lasiopetalum parviflorum		3	7																			
Lasiopetalum rufum			10																			
Lastreopsis decomposita	14													3								
Laxmannia gracilis		5	7	14	5	39	13	28	3					3			52	61	14	50		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Legnephora moorei												8										
Leionema dentatum	43	3		2																		
Lemna disperma															50							
Lepidosperma concavum	14	5	5	3																		
Lepidosperma elatius	14										12											
Lepidosperma filiforme		13	10																	4		
Lepidosperma gunnii		2		5		7											8	7				
Lepidosperma laterale	71	71	49	76	62	90	63	6	2	18	38			3		22	56	93	29	23	50	
Lepidosperma urophorum						6														4	100	
Lepidosperma viscidium		5																				
Leptocarpus tenax			2	2																	50	
Leptochloa decipiens													10									
Leptomeria acida		23	10	17		4																
Leptospermum arachnoides		5	22	2																		
Leptospermum continentale																				4		
Leptospermum juniperinum	14																					
Leptospermum morrisonii	43																					
Leptospermum parvifolium			5	14		4														15		
Leptospermum polygalifolium subsp. *polygalifolium*	43	18	10	7	11	4	5							5				7	14	31	50	
Leptospermum trinervium		81	90	73	14	16	3										4	11		54	100	
Lepyrodia muelleri																			43	4		
Lepyrodia scariosa		8	54	12																50	50	
Leucopogon amplexicaulis		2																				
Leucopogon ericoides		10	7	12		1														4		
Leucopogon exolasius		3	5																			
Leucopogon juniperinus		10	2	5	49	47	50	12	7	32	75	15	10	11		22	24	18	14	4		
Leucopogon lanceolatus var. *lanceolatus*		19		3	19	4					25											
Leucopogon microphyllus var. *microphyllus*			29	2																		
Leucopogon muticus			2	3		13														4		
Leucopogon setiger				5		3																
Leucopogon virgatus			2	17																	50	
Lindsaea linearis	14	10	32	17	3	1														8		
Lindsaea microphylla	29	31	32	20	11	7																
Linum marginale							5	3	3								8					
Liparis reflexa	14	2																				

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Lipocarpha microcephala																			14			
Lissanthe sapida				5	11	1																
Lissanthe strigosa		15	24	59	11	34	26	4						3			52	68		42		
Livistona australis					3					14												
Lobelia alata	14													3								
Lobelia gracilis		6	7	5																		
Lobellia dentata		3		3																		
Logania albiflora	29	13		2		1																
Logania pusilla					3	1												4		4		
Lomandra brevis		2	7		5					9												
Lomandra confertifolia subsp. *pallida*						4	11	1	5								4					
Lomandra confertifolia subsp. *rubiginosa*		23		22	5	17	32	3	3								8	4		4		
Lomandra cylindrica		39	44	58	16	3				5							12	4		23		
Lomandra filiformis subsp. *coriacea*		23	15	44	16	34	16	8	2								12	11	14	4		
Lomandra filiformis subsp. *filiformis*		42	32	37	35	24	8	65	34	14				16			68	36	14	19		
Lomandra fluviatilis	29	2		2																		
Lomandra glauca		16	44	7	5	4	3										4	7		31	50	
Lomandra gracilis	29	55	29	10	3	4	8	3	5								12	21		4		
Lomandra longifolia	71	71	12	29	70	37	13	4	5	68	100			57		56	12	39	57	4		
Lomandra multiflora subsp. *multiflora*		53	54	76	57	87	39	55	25		12			8		11	92	71	71	81		
Lomandra obliqua		79	78	95	27	33	5			5												
Lomatia myricoides	100	3														33						
Lomatia silaifolia	14	68	59	46	5	9					12											
Lotus australis								1	2													
Lythrum hyssopifolia									2						50				43			
Macrozamia communis		6																14		4		
Macrozamia spiralis		3		3	3	1											8	7				
Marsdenia flavescens									2			31										
Marsdenia rostrata						1	3				38	31										
Marsdenia suaveolens	14	10						1		5	12											
Marsdenia viridiflora subsp. *viridiflora*								2	2			8										
Marsilea hirsuta															50							
Maundia triglochinoides															50							
Maytenus silvestris		2			11	1		4		55	62			3				7				
Melaleuca deanei			2	2																		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Melaleuca decora					3	4	3	20	2					5			64	89	86	58		
Melaleuca erubescens						1	3											7	14	31		
Melaleuca linariifolia	14			2		1		2						19					43			
Melaleuca nodosa			2	3		9		2		9				3			24	82	14	81		
Melaleuca styphelioides							3	3	5	5		77		14	50		4		14			
Melaleuca thymifolia				2		6	3												29	35		
Melia azedarach			2		8			1	2	14	12	15		3		11	4					
Melichrus urceolatus																				4		
Melicope micrococca										9		38										
Mentha diemenica							3	8	5													
Mentha satureioides							5		5		12	8	10	3								
Micrantheum ericoides	14	18	37	10	11	1														4		
Micrantheum hexandrum	29																					
Microlaena stipoides var. *stipoides*	14	37	17	47	86	83	87	92	79	95	25	69	70	97	50	100	100	93	86	69		33
Micromyrtus ciliata																				35		
Micromyrtus minutiflora																				27		
Microtis parviflora					8												4					
Microtis unifolia																	4	4	14	8		
Mirbelia rubiifolia			2	5		1														19		
Mirbelia speciosa subsp. *speciosa*			12	3																		
Mitrasacme polymorpha			20	5	3															23	100	
Monotoca elliptica	14	11	2																	4		
Monotoca ledifolia							3															
Monotoca scoparia	14	27	68	58	5	3												4		4	100	
Morinda jasminoides	29	2			3	3	3			9	50	8		8								
Morus alba										5												
Muellerina eucalyptoides					3						12											
Murdannia graminea								4											14			
Myoporum acuminatum											12											
Myoporum montanum									3				60									
Myriophyllum simulans														3	50							
Myriophyllum variifolium														3								
Notelaea longifolia forma *longifolia*	29	34	2	14	41	31	16	6	3	50	50	77	10	5		22	4	14				
Notelaea ovata										9		8										
Notelaea venosa												15										
Notodanthonia longifolia	14					11	3	1					20			11						
Nymphoides geminata																			14			
Nyssanthes diffusa									2			15	60									

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Nyssanthes erecta									2			15		3								
Olax stricta		2																			50	
Olearia elliptica						1																
Olearia microphylla		10	5	17	8	17	3										12	43		8		
Olearia tomentosa		2																				
Olearia viscidula						7	24		2			8	50	8								
Omalanthus populifolius										9	12	15						4				
Omalanthus stillingiifolius												8										
Omphacomeria acerba		3	2	3		1																
Opercularia aspera	29	27		5	3	6		3	3		12						4					
Opercularia diphylla		6	10	17	16	54	53	75	25		12			24			96	79	86	73		
Opercularia hispida		2			24		5							3								
Opercularia varia		2		3	22			1										4				
Oplismenus aemulus					14	9	32	14	25	82	50	31	40	95		89	8	4	14			
Oplismenus imbecillis	29	6		2	38	3	24	1	16	41	62	77	10	11								
Oxalis exilis		3			41	7	3	13	2	14				3				7	14			
Oxalis perennans		2		2	8	31	66	53	52	23	50	23	50	57		44	56	29	14	4		
Oxalis radicosa						3	3	2											14			
Oxalis rubens									2													
Ozothamnus diosmifolius		18	15	12	51	63	39	35	2	59	38		10	24			28	68		15		
Pandorea pandorana		27		2	51	1	8	2	15	86	75	85	40	11			4					
Panicum effusum				2	3	3	13	19	18								8		29	23		
Panicum simile		10	5	31	49	79	42	32	15	9			10	8			56	61	43	62		
Parsonsia lanceolata		2								5												
Parsonsia straminea		3		2	3	7	13	1	5	5		23		14	50							
Paspalidium albovillosum						1	5	1					10	3								
Paspalidium aversum								2						5					14			
Paspalidium criniforme								1	3	5		8	20	3		11	8					
Paspalidium distans		2		2	8	40	29	74	33	9				30			44	61	71	35		
Paspalidium gracile						1	3															
Paspalum distichum															50				14			
Paspalum orbiculare						1		1											43			
Passiflora cinnabarina							3															
Passiflora herbertiana subsp. *herbertiana*					3	4	11			41	25	15	10	3								
Patersonia fragilis		2																				
Patersonia glabrata		35	24	29		3																
Patersonia longifolia			2	2	3																	

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Patersonia sericea		24	37	37	3	3												7		50		
Pelargonium inodorum																22	4					
Pellaea falcata		2					3		11			85	40	11								
Pellaea paradoxa								1														
Persicaria decipiens	14							1						14	100							
Persicaria hydropiper														8					14			
Persicaria praetermissa														8								
Persicaria strigosa	14																					
Persicaria subsessilis														3								
Persoonia lanceolata		5	10	8	5	1																
Persoonia laurina		8	2	2	3	1														8		
Persoonia levis	29	82	98	69	14	7	3										8					
Persoonia linearis	29	76	22	69	38	84	42	1		9	50	8		3			16	11		15	50	
Persoonia mollis subsp. *mollis*				3																		
Persoonia mollis subsp. *nectens*						3																
Persoonia nutans																		4		35	100	
Persoonia oblongata						7																
Persoonia pinifolia	14	19	41	14		4				5												
Petrophile pedunculata			5	3																		
Petrophile pulchella	14	2	24	3				1												15	50	
Petrophile sessilis	14	6	54	19																4		
Phebalium diosmeum		2																				
Phebalium squamulosum subsp. *squamulosum*	14	2														33						
Philotheca hispidula				8																		
Philotheca salsolifolia				2														4		8	50	
Philotheca scabra subsp. *scabra*		13	7																			
Philydrum lanuginosum																			14	4		
Phragmites australis														3		11						
Phyllanthus gunnii					3		8	1	3	9	12	15		5		44						
Phyllanthus hirtellus	14	77	80	95	32	53	13										8	32		19		
Phyllanthus similis									3					30		11						
Phyllanthus virgatus								32	23					8		22	8					
Phyllota grandiflora			2																			
Phyllota phylicoides		3	15	2		1																
Pimelea curviflora var. *curviflora*								2														
Pimelea curviflora var. *subglabrata*								4														
Pimelea latifolia subsp. *hirsuta*						1				5												

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Pimelea linifolia subsp. *collina*																				4		
Pimelea linifolia subsp. *linifolia*		31	46	63	35	59	18		2									32		85	100	
Pimelea spicata								2	2			8										
Pittosporum revolutum		5		3	32	3	11	1		73	75	92		5		11						
Pittosporum undulatum	14	27	7	10	84	10				86	75	8						11				
Plantago debilis					3	6	13	24	16	5		31	60	22								
Plantago gaudichaudii								6	8								4					
Plantago hispida							3	1											14			
Plantago varia						1			2													
Platycerium bifurcatum var. *bifurcatum*										5												
Platylobium formosum		2			11					5	50											
Platysace ericoides		13	39	34		7												4		50	100	
Platysace lanceolata		19	10	2	3																	
Platysace linearifolia	29	52	61	20	3															4		
Plectorrhiza tridentata	14																					
Plectranthus graveolens								1					10									
Plectranthus parviflorus					8		8	9	26	27	12	62	60	38		11			14			
Poa affinis	29	15			27	4		1	2	68	62	15		8		44						
Poa labillardieri var. *labillardieri*		8		41	11	37	5	22	38	9		15		3		11	24	18	14	15		
Poa sieberiana var. *sieberiana*		2	2	2	22	6	3	5	8				40									
Podocarpus spinulosus		6																				
Podolobium ilicifolium		8		3	14	6																
Podolobium scandens var. *scandens*				3	3	4		3									4					
Polygala japonica							5	4	7													
Polymeria calycina						6	16	10	3					24			24	4	14			
Polyscias sambucifolia subsp. *A*	14	21		3	49	10	5	2		68	50	8		3		11		14				
Pomaderris discolor	14	6	2	2		4	3															
Pomaderris elliptica subsp. *elliptica*		6		2							12					11	4					
Pomaderris eriocephala							3															
Pomaderris ferruginea	29	6		3		1										11						
Pomaderris intermedia	14	3				3		1			12					11						
Pomaderris lanigera		6		5	5	10																
Pomaderris ligustrina						1																
Pomax umbellata		40	20	76	43	84	42	9	2					3			52	57		46		
Poranthera corymbosa			5																			
Poranthera ericifolia	14	6	17	8																		
Poranthera microphylla		3	2	7	22	34	42	35	23	9				41		56	72	39	71	15		

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Portulaca oleracea									3													
Potamogeton tricarinatus																			14			
Pratia purpurascens		19		14	76	74	76	44	5	64	62	23	30	68	50	56	84	79	86	23		
Pratia surrepens																			14			
Prostanthera scutellarioides																		18		8		
Pseudanthus pimeleoides	14																					
Pseuderanthemum variabile	14	10			46	4	3	3		91	75	69		24								
Pseudognaphalium luteoalbum								1						3								
Psilotum nudum		2																				
Psychotria loniceroides												8										
Pteridium esculentum	43	85	20	12	16	3		1		18	50	8		5		78		4				
Pteris tremula	14											15										
Pterostylis acuminata			2	3																		
Pterostylis concinna			2			9																
Pterostylis erecta		2	2																			
Pterostylis longifolia		5		10	3	1					12											
Pterostylis nutans		3			5																	
Ptilothrix deusta		2	27	15	3	6												4	14	23		
Pultenaea daphnoides		13	2																			
Pultenaea elliptica		6	46	12																54		
Pultenaea ferruginea						1														12		
Pultenaea flexilis	29	24	5	7	3	1																
Pultenaea hispidula		2																				
Pultenaea linophylla		5	5		5																	
Pultenaea microphylla				3		1		8	5													
Pultenaea parviflora																	4	39		8		
Pultenaea retusa		2			3	1														4		
Pultenaea scabra				8	11	1																
Pultenaea stipularis		3	15																			
Pultenaea villifera var. *villifera*																		4				
Pultenaea villosa		2		3	11	7		1		5							20	7	29	8		
Pyrrosia rupestris												23										
Ranunculus inundatus															50							
Ranunculus lappaceus								2														
Ranunculus plebeius									3					3								
Rapanea howittiana												8										
Rapanea variabilis		16		2	14	13	5	2	2	45	50	46	20	5				4				
Rhodamnia rubescens										5												

Typical Soil Type:	**Sandstone**				**Sandstone/Shale**			**Shale**						**Alluvium**			**Tertiary alluvium**				**Sand**	**Marine**
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Rhytidosporum procumbens		2	5	2		1												4				
Ricinocarpos pinifolius		24	10	2																4	50	
Ripogonum album												23										
Rorippa laciniata								1														
Rubus molluccanus var. *trilobus*											12											
Rubus parvifolius						1	3	2	18	41	12	46	30	35		22						
Rulingia dasyphylla					3													4				
Rumex brownii								3	11	23	12	23	50	16		33						
Samolus repens																						33
Samolus valerandi														5								
Santalum obtusifolium							5															
Sarcocornia quinqueflora subsp. *quinqueflora*																						67
Sarcomelicope simplicifolia subsp. *simplicifolia*												8										
Sarcopetalum harveyanum	14									32	12	23										
Scaevola aemula							3															
Scaevola albida var. *albida*								2	8				20									
Scaevola ramosissima		3	15	10		1														4		
Schelhammera undulata	14																					
Schizaea bifida		5	15	5																	50	
Schizaea dichotoma			7																			
Schoenus apogon						3	5	6									8	4	100	4		
Schoenus brevifolius		2	2	2																4		
Schoenus ericetorum		2	34	2																		
Schoenus imberbis		3	7	2														4			50	
Schoenus lepidosperma subsp. *pachylepis*	14																					
Schoenus maschalinus					3																	
Schoenus melanostachys	71	13		3		1					12			3								
Schoenus moorei							3													8		
Schoenus paludosus																				4		
Schoenus turbinatus			10																			
Schoenus villosus				2																		
Scleria mackaviensis								3	23			8	20	3								
Scutellaria humilis								5	13			8	10	14								
Scutellaria mollis														3								
Senecio bipinnatisectus		2																				

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Senecio biserratus					3																	
Senecio diaschides						3		2	13					14								
Senecio glomeratus								1	2													
Senecio hispidulus var. *dissectus*		2			3			3									4	4				
Senecio hispidulus var. *hispidulus*					5	4	3	4	15	9		15	30	11		22	8	4	14			33
Senecio lautus		2																				
Senecio linearifolius										5		15										
Senecio minimus						1								5								33
Senecio quadridentatus						1	3	6	10			8	50				12					
Senecio species *E*								1	2													
Sicyos australis												8										
Sida corrugata									39					3								
Sida spinosa								1	5													
Sigesbeckia orientalis subsp. *orientalis*						1	5	4	15	36		62	70	49		44		4				
Smilax australis	14				11					23	38	15										
Smilax glyciphylla	57	77	15	14	8	3	3	1	3	18	50	15		11		33	4					
Solanum aviculare										5												
Solanum brownii										5		8										
Solanum campanulatum								2									4					
Solanum cinereum									2								4					
Solanum opacum	14	2																				
Solanum prinophyllum				2	8	46	76	40	46	59	12	31	60	70		22	20					
Solanum stelligerum										5		38	10									
Solenogyne bellioides								4	2										14			
Solenogyne dominii								3	3													
Sorghum leiocladum								2	11					3			4					
Sphaerolobium vimineum																				4		
Sporobolus creber					3	4	18	17	36				20	5			4		14			
Sporobolus elongatus						3	3	17	21				10	5								
Sporobolus virginicus var. *minor*																						33
Stackhousia monogyna					3		3							3								
Stackhousia muricata							3	2	2								8					
Stackhousia nuda						1		1														
Stackhousia viminea		3	2		3	9	8	47	23	5				3			32	7	14	4		
Stellaria flaccida						1		1	3			54	10	16								
Stenocarpus salignus	57	5										8				22						
Stephania japonica var. *discolor*					3		3		2	14	25	54	10	11		22						

Typical Soil Type:	Sandstone				Sandstone/Shale			Shale						Alluvium			Tertiary alluvium				Sand	Marine
Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Sticherus flabellatus	57	3																				
Streblus brunonianus												23										
Stylidium graminifolium	14	15	15	34	5	4												4		69	100	
Stylidium laricifolium		16	2	7																		
Stylidium lineare			15	3																		
Stylidium productum	14	15	2	5																		
Stypandra glauca		8		2	8	30	5					8		3								
Styphelia laeta subsp. *laeta*			2	2		4												11		4		
Styphelia triflora			2	2																		
Styphelia tubiflora			2																			
Styphelia viridis subsp. *viridis*		2		3																		
Suaeda australis																						33
Symplocos thwaitesii												8										
Syncarpia glomulifera		32	2	29	76	27	5	1		77	12	8					4	7				
Telopea speciosissima	14	2	2	2																		
Tetragonia tetragonoides																						33
Tetraria capillaris					3																	
Tetrarrhena juncea		2																				
Tetrarrhena turfosa	14																					
Tetratheca ericifolia			5																			
Tetratheca glandulosa			12																			
Tetratheca neglecta		3	32	3																		
Tetratheca thymifolia		6	2																			
Thelymitra pauciflora					11																	
Themeda australis	14	26	10	68	84	80	76	89	77	23	38	8		22		22	84	54	86	85	50	
Thysanotus juncifolius			2																			
Thysanotus tuberosus subsp. *tuberosus*		2	2	3	3	10	3	1									28	29	14	27		
Todea barbara	43																					
Toona ciliata												8										
Trachymene incisa subsp. *incisa*			5	14	5	6	3											4		8	100	
Trema tomentosa var. *viridis*					3	3		1		36	12	8	20	14								
Tricoryne elatior					3	19	34	43	25					14			52	11	43	15		
Tricoryne simplex		3	5	7		1			2					3						4		
Tricostularia pauciflora			2	2																		
Triglochin microtuberosum															50							
Triglochin procerum	29													3								
Triglochin striatum															50							

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Map Unit:	**35**	**33**	**31**	**32**	**43**	**2**	**1**	**10**	**9**	**15**	**152**	**13**	**14**	**11**	**5**	**12**	**103**	**3**	**4**	**6**	**8**	**34**
Tristania neriifolia	29	2																				
Tristaniopsis collina										5												
Tristaniopsis laurina	86										12	8		3		11						
Trochocarpa laurina										5												
Tylophora barbata		2			16	3	3	1		55	100	31		8								
Typha orientalis								1							50							
Urtica incisa						1						38		3								
Vernonia cinerea var. *cinerea*				2	16	21	34	46	18	5			10	22		11	52	54	29	15		
Veronica brownii									2													
Veronica calycina	14				3					5												
Veronica plebeia		3			8	41	68	39	23	32		8	20	38		56	28	18	14			
Viola hederacea	29			3						9	25			8		11						
Vittadinia cuneata var. *cuneata*							3	4	3				10									
Vittadinia hispidula var. *hispidula*							3															
Vittadinia pustulata						1	3	3														
Wahlenbergia communis						1	13	4	5				10				8	4		4		
Wahlenbergia gracilis	14	18		14	14	21	24	71	49	18		15	50	49		56	76	36	43	19		
Wahlenbergia luteola						3			5													
Wahlenbergia stricta subsp. *stricta*				5			8	6	11	5							12	7				
Westringia longifolia	29	2				4	5															
Woollsia pungens		11	15	2																		
Wurmbea biglandulosa								1														
Wurmbea dioica subsp. *dioica*								11	2					3			4	11	29			
Xanthorrhoea arborea	29	34		5																		
Xanthorrhoea concava	14	21	37	44	8	13																
Xanthorrhoea media	14	19	56	29	3	1												4				
Xanthorrhoea minor subsp. *minor*		3				6											12	11		77	50	
Xanthorrhoea resinifera		5	17	8																		
Xanthosia pilosa	14	81	44	29	8	6																
Xanthosia tridentata	71	31	32	3		4																
Xylomelum pyriforme		42	15	24		3																
Xyris gracilis			5																			
Zieria cytisoides		2		2			3				12											
Zieria fraseri subsp. *compacta*		2																				
Zieria laevigata		2	2																			
Zieria pilosa	14	8																				
Zieria smithii		3	2		5	3				9	12											
Zornia dyctiocarpa var. *dyctiocarpa*								6	10								8					