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Flora assessment:
North Cooranbong

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1.0 Introduction

This document details the vegetation of land in North Cooranbong, within the Lake Macquarie Local Government Area (LGA).

The area surveyed consists of Lot 1 DP 595941, Lot 11 DP 129156, Lot 12 DP 129157, Lot 20 DP 129159, Lots 1-13, DP 7352, Lots 1-8, 10 DP 3533, Lot 1 DP 825266, Lot 1 DP 170378, Lot 2 DP 825266, Part Lot 1 DP 182756, Lot 1 DP 348173, Lot 212 DP 1037011 (the Site), plus land to the east, south-east and west (Figure 1).

This report has been prepared as part of a larger investigation of the potential future urban development of the Site.

This report identifies any flora constraints on the Site. Harper Somers / Harper Somers O'Sullivan separately investigated four parts (Area 1 to Area 4) of the surveyed area using variable sampling methods over a two year period and the reports are incomplete drafts only with:

Area	Lot and DP	Size
1.	Lot 1 DP 595941 Lot 11 DP 129156 Lot 12 DP 129157 Lot 20 DP 129159 Lots 1-13, DP 7352 Lots 1-8, 10 DP 3533	229.64 ha
2.	Lot 1 DP 825266	27.03 ha
3.	Lot 1 DP 170378 Lot 2 DP 825266 & Part Lot 1 DP 182756	17.19 ha
4.	Lot 1 DP 348173 & Lot 212 DP 1037011	4.32 ha

These drafts were reviewed as previous studies for the current assessment.

2.0 Environmental setting

Cooranbong is located within Lake Macquarie LGA, approximately:

- 38 km north of Gosford City;
- 34 km south-west of Newcastle City; and
- 2.6 km south of Olney State Forest.

The surveyed area drains to Dora Creek via a series of tributaries of Jigadee Creek in the east and Felled Timber Creek in the west (Figure 1). The creeklines mapped on the 1:25 000 topographic map (LPI 2002) have been overlain on the 2004 aerial photograph (Figure 2). The mapped creeklines were assessed by Patterson Britton (2004), given in Appendix 1.

2.1 Climate

Cooranbong is approximately 20 km inland and approximately 4 km west of Lake Macquarie. The Site has an elevation of 10 m.

The closest meteorological station to the Site is Olney State Forest (station number 061057), located approximately 5 km north-west of the Site and at a higher elevation than the Site of 153 m. Average annual rainfall recorded at Olney State Forest is 1589 mm, with the highest mean monthly rainfall of 213.5 mm recorded in February and the lowest mean monthly rainfall of 66.9 mm recorded in July. The mean annual daily maximum temperature recorded at Olney State Forest is 20.6 ^{o}C and the mean annual daily minimum temperature is 11.7 ^{o}C. The highest mean daily maximum temperature was recorded in December (26°C) and the lowest mean minimum temperature was recorded in July (6.5^{o}C) (Bureau of Meteorology website www.bom.gov.au/climate/averages/table accessed on 16 May 2003).

The nearest meteorological station at a similar elevation to the Site is at Norah Head Lighthouse (station number 061273, elevation 27 m), located on the coast, approximately 24 km south-east of the Site. The average annual rainfall recorded at the Norah Head station is 1246 mm, with the highest mean monthly rainfall of 140 mm recorded in June and the lowest mean monthly rainfall of 75 mm recorded in October. The mean annual daily maximum temperature recorded at Norah Head is 21.6 ^{o}C and the mean annual daily minimum temperature is 14.6 ^{o}C. The highest mean daily maximum temperature was recorded in February (25.2^{o}C) and the lowest mean minimum temperature was recorded in July (9.3^{o}C) (Bureau of Meteorology website www.bom.gov.au/climate/averages/table accessed on 16 May 2003).

2.2 Geology and Soil landscape

The geology of the Site was mapped at 1:250 000 scale by Bryan (1965) as map unit Rnc, part of the Narrabeen Group, described as "Claystone, sandstone and shale" (Figure 3). The Site is close to a boundary with map unit Qa, described as "Alluvium, gravel, sand, silt and clay."

Murphy and Tille (1993) mapped the soil landscape of the Site at a scale of 1:100 000 as Doyalson (map unit do) in the majority of the Site and Wyong (map unit wy) in the western section of Area 3 (Figure 4). These map units are described as:

- *Doyalson: Gently undulating rises on Mumnorah conglomerate. Slope gradients <10%; local relief to 30 m. Broad crests and ridges and long gently inclined slopes. Limitations – high erosion hazard, foundation hazard (localised), high run-on (localised), mine subsidence district, seasonal waterlogging (localised), hardsetting, stoniness, strongly acid soils of low fertility.*
- *Wyong: Broad poorly drained deltaic floodplains and alluvial flats of Quaternary sediments on the Central Coast Lowlands. Slope gradients <3%; local relief < 10 m. Meander scrolls, oxbows, and swamps are common. Limitations – flooding, seasonal waterlogging, foundation hazard, permanent waterlogging (localised), stream bank erosion (localised), acid sulphate potential (localised), strongly acid, poorly drained, impermeable soils of very low fertility with saline subsoils.*

2.3 Land use

The historical aerial photographs (2001, 1994, 1984, 1975, 1966, 1954) of the Site held by Land and Property Information was reviewed in term of Harper Somers / Harper Somers O'Sullivan investigation Areas 1 to 4. It appears that (Table 1):

- **Area 1:** the airstrip originally contained only a N-S runway, but was expanded to contain an additional SW-NE runway between 1975 and 1984. The vegetated areas on the majority of Area 1 have been densely vegetated with some tracks since at least 1954. The area to the north of the SW-NE runway was cleared between 1994 and 2001 and the area to the south of the SW-NE runway was cleared between 1984 and 1994. Avondale High School was constructed between 1975 and 1984.

- **Area 2:** has been vegetated in the south-west and cleared in the north-west with some areas of dense vegetation since at least 1975. Prior to 1975 the entire west of the area was vegetated. The east supported cleared paddocks since at least 1954, with crops visible until at least 1966. Buildings have been present in the east since at least 1954, with additional buildings constructed between 1984 and 1994.
- **Area 3:** has been vegetated along Felled Timber Creek in the west, with scattered trees in the east since at least 1954. The Poultry Farms in this area were built between 1954 and 1966.
- **Area 4:** was cleared with scattered trees between 1954 and 1984, regrowing to mostly cleared paddock with some vegetation along boundaries and in the centre between 1984 and 2001. Houses have been present in the north of the Site since at least 1954.

The current land uses adjoining the Site include:
- **To the north**: Agricultural land use, with:
  - extensive clearing in the western 1/3;
  - large block with fence line and patch clearing of the native vegetation; and
  - in the north-east corner of Area 1 is the upper tributary of a creek flowing west.
- **To the west**: Agricultural and forestry land use, with:
  - an approximately 500 m long common boundary with Olney State Forest to the south-west of the aerodrome (Area 1); and
  - about 875 m long common boundary with cleared agricultural land (Area 1).
- **To the south:** Agricultural and suburban development with:
  - a narrow band of treed vegetation adjoining the creek line in the south west;
  - an approximately 120 m wide treed vegetation in the centre of the south; and
  - a narrow band of treed vegetation adjoining the creek line in the south-east.
- **To the east:** Suburban development, Avondale College school, cleared farming land and relatively intact vegetation with:
  - a creek line in the north east flowing through the relative intact vegetation.

3.0 Flora

3.1 Previous surveys

Benson (1986) mapped vegetation of the Gosford and Lake Macquarie areas at a scale of 1:100 000. The Site was mapped as (Figure 5):

Map unit	Description	Location
Map unit 9g Open Forest: *Corymbia gummifera - Corymbia maculata - Eucalyptus pilularis*	Very widespread on claystones, sandstones and shales of the Clifton Sub-group, the Gosford Formation and the Newcastle Coal Measures. Species composition is very variable and changes from the coastal lowlands to the higher country to the west.	North-western
Map unit C Cleared	Native vegetation has been largely removed for agricultural or suburban development but remnant vegetation of varying size and condition may remain.	South-eastern

NPWS (2000) mapped the vegetation of the Lower Hunter and Central Coast region at a scale of at least 1:25 000. The surveyed area was mapped as containing five vegetation communities (Figure 6):

Map unit	Community	Canopy species	Habitat
5	Alluvial Tall Moist Forest	*Eucalyptus saligna, Syncarpia glomulifera, Glochidion ferdinandi*	Occurs in areas of higher rainfall on deep alluvial soils. Represents the gradient between well developed rainforest on alluvium and Swamp Mahogany – Paperbark Swamp Forest.
9	Coastal Ranges Open Forest	*Syncarpia glomulifera, Eucalyptus pilularis, Angophora floribunda, Eucalyptus deanei, Eucalyptus saligna*	Coastal Ranges Open Forest occurs extensively across the State Forests of the Watagan Range. It is present in Wyong, Olney and Ourimbah State Forests on ridges and upper slopes. Further west it occurs on protected slopes and gullies in McPherson State Forest.
30	Coastal Plains Smooth-barked Apple Woodland	*Angophora costata, Corymbia gummifera, Eucalyptus capitellata, Eucalyptus umbra*	It is distributed across a range of sedimentary geologies from the Narrabeen Group, Permian Coal Measures and Medowie sediments on low to undulating topography. Soil landscapes of Doyalson, Awaba and Medowie support typical examples of this assemblage.
31	Coastal Plains Scribbly Gum Woodland	*Eucalyptus haemastoma, Corymbia gummifera, Eucalyptus capitellata, Angophora inopina*	The core of the distribution of this assemblage occurs in the south west of Lake Macquarie, north of Wyong.
42	Riparian Melaleuca Swamp Woodland	*Melaleuca sieberi, Eucalyptus robusta*	Riparian Melaleuca Swamp Woodland occurs in deltaic floodplains and alluvial flats and drainage lines on the central coast lowlands from Wyong to Port Stephens. It is usually restricted to narrow creek lines, depressions and soaks.

Harper Somers / Harper Somers O'Sullivan separately investigated four parts (Area 1 to Area 4) of the surveyed area using variable sampling methods over a two year period and the reports are incomplete draft only.

Harper Somers (2002a), in the flora and fauna assessment for the 229.64 ha Area 1 (Lot 1 DP 595941, Lot 11 DP 129156, Lot 12 DP 129157, Lot 20 DP 129159, Lots 1-13 DP 7352, Lots 1-8, 10 DP 3533) reported two threatened plant species *Angophora inopina and Tetratheca juncea* with flora survey on 19, 20, 25 - 27 September 2001. The riparian forest dominated by *Eucalyptus robusta* in the north-eastern corner was correlated with the description of Sydney Coastal Estuary Swamp Forest Complex, an Endangered Ecological Community.

Harper Somers (2002b) is a flora and fauna assessment of the 4.32 ha Area 4 (Lot 1 DP 348173 and Lot 212 DP 1037011), with flora survey on 21 and 22 March 2002. It was stated: "survey methodology followed Lake Macquarie City Council Flora and Fauna Survey Guidelines". The vegetation survey used the 'random meander technique', two 20 m x 20 m plots and two transects (200 m and 350 m). A full list of

species recorded was included. Four vegetation communities were delineated in Area 4, namely:

Community	Description	Distribution
Eucalypt Woodland/Open Forest	Similar to NPWS (2000) Coastal Plains Smooth-barked Apple Woodland. Woodland to open forest with a canopy 15 - 25 metres high and 30 - 60% cover. Dominant canopy species *Eucalyptus capitellata, Corymbia gummifera, Angophora costata*.	North-west corner and along eastern boundary.
Melaleuca Scrub	Similar to NPWS (2000) Riparian Melaleuca Swamp Woodland / Melaleuca Scrub. Occurred as a closed scrub with a canopy height of 3 - 4 metres and 50 - 90% cover, although some emergent Eucalypts also occurred. Other lower-lying areas that are likely to have contained this community have been previously cleared. Dominant species *Melaleuca sieberi, M. linearifolia* and to a lesser extent *M. nodosa.* Emergent trees included *Eucalyptus capitellata and E. haemastoma.*	Two areas: Centre west and south.
Pasture/Cleared Areas	Dominated by native and introduced grasses although some trees and shrubs also occurred. A number of grass species were recorded including *Axonopus affinis, Paspalum dilatatum, Themeda australis, Imperata cylindrica* var. *major.*	Three areas: in the north, centre-west and south of Area 4.
Exotic Gardens	A large variety of ornamental and fruiting flora species have been planted in landscaped gardens in the vicinity of the residential dwelling, such as *Liquidambar styraciflua* and *Jacaranda mimosifolia*.	Surrounding existing dwelling in north of Area 4.

No threatened flora species were recorded in Area 4, but *Tetratheca juncea* and *Angophora inopina* were noted as having been recorded in the immediate vicinity. Two regionally significant plant species *Eucalyptus robusta* (Swamp Mahogany) and *Hakea bakerana* were recorded. This report states:

> *Both species appear to have been planted in a linear remnant along the road verge leading to the residential dwelling.*

Harper Somers O'Sullivan (2002) prepared a flora and fauna assessment of 17.19 ha Area 3 (Lot 1 DP 170378, Lot 2 DP 825266 and Part Lot 1 DP 182756) with flora survey on 21-25 April 2002. Flora survey techniques consisted of four transects (minimum length 200 m) and three vegetation plots (20 m x 20 m). The list of species recorded in each sampling location was provided.

Three vegetation communities were identified:

Vegetation community	Description	Distribution
Cleared Land	Generally the groundcover stratum throughout is dominated by exotic pasture grasses and herbs.	Majority of the centre and western portion of the Site.
Riparian Forest. Equivalent to NPWS (2000) Alluvial Tall Moist Forest (MU5)	Dominant canopy species included *Eucalyptus saligna* (Sydney Blue Gum) and *Syncarpia glomulifera* (Turpentine). Most ecologically intact part of the Site. Considered likely to be of conservation significance in the Lake Macquarie LGA.	Along Felled Timber Creek in the western portion of the Site.
Open Eucalypt Forest Equivalent to NPWS (2000) Coastal Plains Smooth-barked Apple Woodland (MU30)	Canopy dominated by *Eucalyptus capitellata* (Brown Stringybark), *Corymbia gummifera* (Red Bloodwood) and *Angophora costata* (Smooth-barked Apple). Highly modified, with the lower strata removed and/or regularly slashed.	Occurs over the majority of the eastern portion of the Site.

No threatened plant species were noted within the Site. Three species of regional conservation significance ("as listed in Forest Fauna Surveys Pty. Ltd and Eastcoast Flora Surveys, 2001") were recorded in Area 3, namely *Gompholobium pinnatum, Hakea bakerana* and *Eucalyptus robusta.*

Harper Somers O'Sullivan (2003) prepared a flora and fauna assessment of the 27.03 ha Area 2 (Lot 1 DP 825266), with flora survey on 9, 10, 17 April 2003. Flora survey techniques consisted of two transects (minimum length 200 m) and four vegetation plots (20 m x 20 m). A species list detailing which species were recorded in each sampling location was provided.

Three vegetation communities were identified:

Vegetation community	Description	Distribution
Swamp Mahogany – Paperbark Swamp Forest. Equivalent to Sydney Coastal Estuary Swamp Forest Complex.	Canopy consists primarily of *Eucalyptus robusta* (Swamp Mahogany), with the paperbark species *Melaleuca lineariifolia* being also present. Has suffered some disturbance and has been almost completely cleared in the north-western sections, however in the centre of Area 2, the upper stratum was intact although the lower stratum has been grazed.	Occurs in conjunction with a broad drainage line / low lying area which bisects Area 2 in a northwest-south-easterly direction.
Cleared Land	Predominantly composed of exotic pasture grass species.	Eastern half of Area 2.
Coastal Plains Smooth-barked Apple Woodland	Canopy dominated by *Eucalyptus capitellata* (Brown Stringybark), *Corymbia gummifera* (Red Bloodwood) and *Angophora costata*	Generally distributed throughout the

Vegetation community	Description	Distribution
	(Smooth-barked Apple). Includes a large patch of relatively intact forest in the south west corner as well as underscrubbed / thinned areas which have been grazed.	western half of Area 2.

Approximately 17 individuals of the Vulnerable species *Angophora inopina* were recorded at the ecotone between the Coastal Plains Smooth-barked Apple Woodland and the Swamp Mahogany - Paperbark Swamp Forest. It was also considered likely that the Vulnerable flora species *Tetratheca juncea* (Black-eyed Susan) does occur throughout the intact patch of Coastal Plains Smooth-barked Apple Woodland in the southwest corner of Area 2.

NPWS (2003) mapped the vegetation of the Lower Hunter and Central Coast region at a scale of 1:25 000. The Site was mapped as containing four vegetation communities (Figure 7):

Map unit	Community	Canopy species
5	Alluvial Tall Moist Forest	*Eucalyptus saligna, Syncarpia glomulifera, Glochidion ferdinandi*
30	Coastal Plains Smooth-barked Apple Woodland	*Angophora costata, Corymbia gummifera, Eucalyptus capitellata, Eucalyptus umbra*
31	Coastal Plains Scribbly Gum Woodland	*Eucalyptus haemastoma, Corymbia gummifera, Eucalyptus capitellata, Angophora inopina*
42	Riparian Melaleuca Swamp Woodland	*Melaleuca sieberi, Eucalyptus robusta*

The City of Lake Macquarie State of the Environment report (2004) lists regionally significant vegetation communities and habitat for the Lake Macquarie LGA. The communities mapped by NPWS (2003) as occurring on the Site were listed as:

Vegetation community	**Regional Significance** (City of Lake Macquarie 2004)
Alluvial Tall Moist Forest	Regionally Vulnerable Community
Coastal Plains Smooth-barked Apple Woodland	Regionally Significant Habitat
Coastal Plains Scribbly Gum Woodland	Regionally Significant Habitat
Riparian Melaleuca Swamp Woodland	Regionally Specialised Community

These categories of significance are defined as (City of Lake Macquarie 2004):

- Regionally Vulnerable Communities - All vegetation communities that have an extant distribution of less than or equal to 30% of their pre 1750 (original) distribution, or have a total extant distribution of less than or equal to 1000 hectares.
- Regionally Significant Habitat - The largest and best connected bushland. This has been undertaken to ensure that large contiguous and often pristine areas of bushland are protected.
- Regionally Specialised Communities - Communities that play a critical role in ecosystem processes or that provide specialised habitat for species.

Lake Macquarie Council (2004), the Lake Macquarie Local Environment Plan 2004, zoned the bulk of the Site as 10 Investigation Zone, with Area 1 part zoned 10 Investigation (urban / employment / recreation / conservation) and part zoned 7(2) Conservation (Secondary) Zone. Areas 2 and 4 are zoned 10 Investigation (urban/conservation) whilst Area 3 is part zoned 7(1) Conservation (Primary) Zone and part zoned 1(1) Rural (Production) Zone.

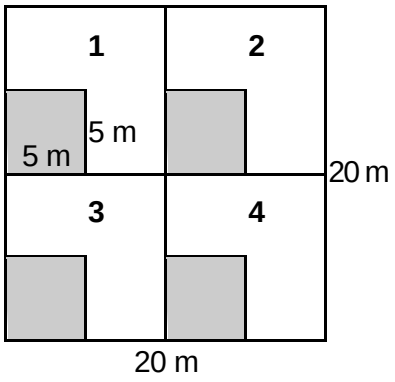
3.2 Current survey

The Site was surveyed by Dr AnneMarie Clements, Emma Gorrod, Jane Rodd, Tony Rodd, Rhiannon Ward and Sian Wilkins on 19 and 20 November 2003, 3 December 2003 and 23 and 24 February 2004.

On the Site, a total of 312 species (263 native and 49 exotic) were recorded from 40 quadrats and 30 spot locations (Tables 2, 3 and 4). Adjacent to the Site on land adjoining Site to the east and west, a total of 152 species (141 native, 11 exotic) were recorded from five quadrats and ten spot locations (Tables 2, 3 and 4).

3.2.1 Methods

Each of the quadrats (Figure 8) consisted of four contiguous 10 m x 10 m sub-quadrats. The relative frequency of plant species was assessed by recording the presence/absence of each species in the sub-quadrats with presence/absence of herb and shrub species recorded in 5 m x 5 m within the sub-quadrats (Table 3). In each 10 m x 10 m quadrat, the numbers of individuals and heights of all tree species were recorded (Table 5).



Supplementary data from the spot locations consisted of recording all species present in a 10 m radius (Table 4).

The sampling locations were photographed at the time of inspection (Appendix 2).

Nomenclature is consistent with Harden (1990-1993, 2002), Harden and Murray (2000) and subsequent taxonomic changes as published in *Telopea*, the Sydney Royal Botanic Gardens' journal of systematic botany, and in other Australian taxonomic literature.

3.2.2 Observations

3.2.2.1 On Site

The vegetation on the Site was recorded from 40 quadrats (Q1-Q10, Q12-Q39, Q45-Q47) and 30 spot locations (A-J, L-Z, AB-AF) (Tables 2, 3 and 4).

The vegetation recorded on the Site was tested against the characteristic species of the communities that NPWS (2003) mapped on the Site, namely Coastal Plains Smoothbarked Apple Woodland (map unit 30), Coastal Plains Scribbly Gum Woodland (map unit 31), Riparian Melaleuca Swamp Woodland (map unit 42) and Alluvial Tall Moist Forest (map unit 5) (Table 6).

Coastal Plains Smoothbarked Apple Woodland (map unit 30)

Coastal Plains Smoothbarked Apple Woodland was the dominant woodland vegetation recorded on the Site (Q5, Q6, Q8, Q12, Q14, Q15, Q16, Q17, Q19, Q26, Q34, Q36, C, D, E, G, L, O, P, S, X, Z, AD, AE, AF, Figure 8). Coastal Plains Smoothbarked Apple Woodland consisted of:

- Canopy dominated by *Angophora costata* (Angophora), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark) and *E. haemastoma* (Broad-leaved Scribbly Gum), with *A. inopina* and *E. resinifera* subsp. *resinifera* (Red Mahogany) less dominant.
- Midstorey dominated by *Allocasuarina littoralis* (Black She-Oak), *Melaleuca sieberi* with *Banksia spinulosa* var. *collina* (Hill Banksia), *Dillwynia retorta* (Eggs-and-bacon Pea), *Lambertia formosa* (Mountain Devil), *Leptospermum polygalifolium* subsp. *cismontanum* (Yellow Tea-tree), *Leptospermum trinervium* (Paperbark Tea-tree), *Melaleuca nodosa* (Ball Honey-myrtle), *Persoonia levis* (Broad-leaved Geebung) and *Pimelea linifolia* (Rice Flower).
- Understorey species including *Austrostipa pubescens* (Tall Speargrass), *Bossiaea obcordata* (Spiny Bossiaea), *Brunoniella pumilio* (Dwarf Blue Trumpet), *Cassytha glabella* (Devil's Twine), *Dampiera stricta* (Blue Dampiera), *Entolasia stricta* (Wiry Panic), *Epacris pulchella, Gonocarpus tetragynus* (Raspwort), *Hibbertia vestita, Lepidosperma viscidum* (Sticky Sword-sedge), *Lomandra multiflora* (Many-flowered Mat-rush), *Lomandra obliqua, Patersonia glabrata* (Native Iris), *Ptilothrix deusta, Themeda australis* (Kangaroo Grass) and *Xanthorrhoea latifolia* subsp. *latifolia* (Grass-tree).

Areas with moist soils close to drainage lines contained Melaleuca species such as *Melaleuca linariifolia* (Flax-leaved Paperbark), *M. nodosa* (Ball Honey-myrtle), *M. sieberi* and *M. thymifolia* (Thyme Honey-myrtle).

The Coastal Plains Smoothbarked Apple Woodland recorded on the Site was in relatively good condition, with few exotic species recorded. In some areas the understorey had been subject to mowing (Spot location AE and AF). Yet, even in these disturbed areas, the understorey contained sufficient native species diversity to re-establish the characteristic structure of the community (Tables 3 and 4).

Coastal Plains Smoothbarked Apple Woodland was also recorded on the Site in Olney State Forest (Q40).

Rare species recorded in Coastal Plains Smoothbarked Apple Woodland on the Site include *Angophora inopina, Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea* (Black-eyed Susan) (Figure 9).

Coastal Plains Scribbly Gum Woodland (map unit 31)

Coastal Plains Scribbly Gum Woodland was recorded in sampling locations Q1, Q2, Q3, Q4, Q7, Q9, Q10, Q13, Q20, Q21, Q23, Q24, Q28, Q29, Q31, Q35, Q38, Q45, Q46, Q47, A, B, I, J, N, R and Y (Figure 9). Coastal Plains Scribbly Gum Woodland consisted of:

- Canopy species *Angophora inopina, Corymbia gummifera, Eucalyptus capitellata* and *E. haemastoma* with *A. costata* less dominant.
- Midstorey species *Banksia oblongifolia, Banksia spinulosa* var. *collina, Hakea laevipes* subsp. *laevipes, Isopogon anemonifolius* (Broad-leaf Drumsticks), *Lambertia formosa, Leptospermum trinervium, Persoonia levis* and *Pultenaea paleacea*.
- Understorey species including *Austrostipa pubescens, Bossiaea obcordata, Brunoniella pumilio, Cassytha glabella, Cyathochaeta diandra, Dampiera stricta, Entolasia stricta, Epacris pulchella, Gompholobium pinnatum* (Pinnate Wedge Pea), *Goodenia bellidifolia, Lepidosperma viscidum, Leucopogon juniperinus* (Prickly Tea-tree), *Lindsaea linearis* (Screw Fern), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *L. multiflora, L. obliqua, Patersonia sericea* (Native Iris), *Ptilothrix deusta, Themeda australis, Xanthorrhoea latifolia* subsp. *latifolia* and *Xanthosia tridentata*.

Wetter areas close to creeks and drainage lines contained Melaleuca species such as *Melaleuca linariifolia, M. nodosa, M. sieberi* and *M. thymifolia*.

The Coastal Plains Scribbly Gum Woodland was in relatively good condition, with few weed species recorded. Some areas were disturbed by grazing (Q23, I, J) and clearing for the airstrip (A, B, N), yet these areas were relatively weed free and contained good native species diversity (Tables 3 and 4).

Rare species recorded in Coastal Plains Scribbly Gum Woodland on the Site include *Angophora inopina, Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea* (Figure 9).

Riparian Melaleuca Swamp Woodland (map unit 42)

Riparian Melaleuca Swamp Woodland was recorded along tributaries of Jigadee Creek in the north of the Site (Q30, Q32, Q33, Q37, Q39 and Q, Figure 9) and along tributaries of Dora Creek in the south of the Site (Q18, Q22, Q27, F, H and M, Figure 9). Riparian Melaleuca Swamp Woodland consisted of:

- Canopy species *Eucalyptus robusta* (Swamp Mahogany), with *Angophora costata, A. inopina, E. capitellata* and *E. resinifera* subsp. *resinifera* less dominant.
- Midstorey dominated by Melaleucas such as *M. linariifolia, M. nodosa, M. sieberi* and *M. thymifolia*, with *Banksia oblongifolia, Banksia spinulosa var. collina, Leptospermum polygalifolium* subsp. *cismontanum, Leptospermum trinervium* and *Lepyrodia scariosa* (Scale-rush).
- The dominant understorey species was *Gahnia clarkei*, with *Baumea rubiginosa* (Soft Twig-rush), *Cassytha glabella, Dampiera stricta, Drosera spatulata* (Common Sundew), *Entolasia stricta, Gonocarpus tetragynus, Goodenia heterophylla* subsp. *eglandulosa, Hemarthria uncinata* (Mat Grass) and *Imperata cylindrica* var. *major* (Blady Grass) less dominant.

Exotic species recorded in the Riparian Melaleuca Swamp Woodland on the Site included *Andropogon virginicus* (Whisky Grass), *Axonopus affinis* (Narrow-leaved Carpet Grass), *Cinnamomum camphora* (Camphor-laurel), *Paspalum dilatatum* (Paspalum) and *Rubus bellobatus* (Kittatinny Blackberry).

Some areas of Riparian Melaleuca Swamp Woodland on the Site had been cleared and were regenerating (Quadrat 22 and Spot location M). There was also evidence of recent fires in some areas including Spot location M.

Rare species recorded in Riparian Melaleuca Swamp Woodland on the Site were *Angophora inopina* and *Grevillea parviflora* subsp. *parviflora* (Figure 9)

Alluvial Tall Moist Forest (map unit 5)

Alluvial Tall Moist Forest was recorded along Felled Timber Creek in Area 3 of the Site (U and V, Figure 9).

Alluvial Tall Moist Forest on the Site was dominated by canopy species *Eucalyptus pilularis* (Blackbutt), *E. saligna* (Sydney Blue Gum) and *Syncarpia glomulifera* (Turpentine), with *Acmena smithii* (Lilly-pilly) and *Breynia oblongifolia* (Coffee Bush) in the midstrorey. Species recorded in the understorey included *Adiantum aethiopicum* (Common Maidenhair Fern), *Aneilema biflorum, Carex longebrachiata* (Drooping Sedge), *Commelina cyanea* (Blue Spiderwort), *Dichondra repens* (Kidney-weed), *Duboisia myoporoides* (Corkwood), *Entolasia stricta, Geranium homeanum* (Native Geranium), *Hydrocotyle peduncularis* (Pennywort), *Lomandra longifolia, Microlaena stipoides, Oplismenus aemulus, Oxalis exilis* and *Pratia purpurascens.*

Exotic species recorded in Alluvial Tall Moist Forest on the Site included *Ehrharta erecta* (Annual Veld Grass), *Ligustrum sinense* (Small-Leaved Privet), *Senecio madagascariensis* (Fireweed) and *Sida rhombifolia* (Paddy's Lucerne).

Areas of Alluvial Tall Moist Forest on the Site were generally relatively degraded, with frequent cattle grazing evident. Cattle movements across the creek beds have resulted in erosion of the creek banks in this area (Spot location V).

Disturbed areas

Some areas on the Site were highly disturbed by grazing (Spot locations W, AB, AC) and clearing (Spot location T). These areas contained a higher number of exotic species than other areas of the Site. Dominant exotic species recorded included *Andropogon virginicus, Axonopus affinis, Cinnamomum camphora, Ehrharta erecta, Hypochoeris radicata* (Cat's-ears), *Phytolacca octandra* (Inkweed), *Plantago lanceolata* (Plantain), *Protasparagus aethiopicus* (Asparagus Fern), *Senecio madagascariensis* and *Sida rhombifolia*.

Native canopy species recorded in these disturbed areas include *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus capitellata, Eucalyptus haemastoma*, and *E. pilularis*, with *Centella asiatica* (Heart-leaved Pennywort), *Commelina cyanea, Dianella caerulea, Dichelachne micrantha* (Short-haired Plume Grass), *Dichondra repens, Eragrostis brownii* (Brown's Lovegrass) and *Microlaena stipoides* in the understorey.

3.2.2.2 Adjacent to the Site

The vegetation adjacent to the Site to the east and west was recorded from 5 quadrats (Q40-Q44) and 10 spot locations (AG-AP) (Tables 2, 3 and 4).

Coastal Plains Smoothbarked Apple Woodland (map unit 30) was sampled adjacent to the Site in sampling locations Q40, Q43, Q44, AG, AJ, AL and AG and AP (Table 6).

Riparian Melaleuca Swamp Woodland (map unit 42) was sampled adjacent to the Site in sampling locations AH and AI (Table 6).

Alluvial Tall Moist Forest (map unit 5) was sampled adjacent to the Site in sampling locations AN and AO (Table 6).

The threatened species that were recorded on the Site were also recorded in adjacent vegetation (Figures 9 and 10):

Species	Sampling location
Angophora inopina	Q43, AM, AN, AP
Grevillea parviflora subsp. *parviflora*	Q40, AL, AM
Tetratheca juncea	AL

4.0 Conservation significance

The conservation significance of the communities and species recorded on the Site were assessed at a:

- National level against the schedules of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EP&BC Act);
- State level against the schedules of the Threatened Species Conservation Act 1995 (TSC Act); and
- Regional level (species only) against Benson (1986).

4.1 Communities

4.1.1 National

A search of the Environment Australia website (accessed 13 August 2003) revealed that there are no endangered ecological communities listed on the EP&BC Act occurring within 10 km of the Site.

4.1.2 State

A search of the Final Determinations listed on the NPWS Website (www.nationalparks.nsw.gov.au, searched 15 February 2003) indicated that four endangered ecological communities have been recorded in the Lake Macquarie LGA, namely:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Of these communities, one is likely to occur on site, namely Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, gazetted 17 December 2004 (Appendix 3).

The data collected on the Site are tested against the Final Determination for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

4.1.2.1 Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

In the Final Determination (Appendix 3), gazetted on 17 December 2004, the NSW Scientific Committee found that:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The Soil landscape of the Site is mapped as Doyalson over the majority of the Site and Wyong (map unit wy) in the western section of Area 3 (Figure 4). Doyalson occurs on gently undulating rises on Munmorah conglomerate and Wyong occurs on broad poorly drained deltaic floodplains and alluvial flats of Quaternary sediments on the Central Coast Lowlands.

The Site is within the Sydney Basin Bioregion. The Site has an elevation of 10 m.

Numerous creeklines were mapped on the 1:25 000 topographic map as occurring across the Site. Sampling locations located within approximately 40 m of a mapped creekline were:

Sampling location	**Approximate distance from mapped creekline**
Q1	0 m
Q2	0 m
Q3	14 m
Q5	0 m
Q9	23 m
Q12	38 m
Q18	0 m
Q22	0 m
Q27	0 m
Q30	6 m
Q32	0 m
Q33	0 m
Q34	19 m
Q36	8 m
Q37	0 m
Q39	0 m
A	36 m

Sampling location	Approximate distance from mapped creekline
D	6 m
I	0 m
L	22 m
M	4 m
O	11 m
Q	22 m
U	0 m
V	34 m
Y	39 m
AG	18 m
AI	0 m
AK	30 m
AN	34 m
AO	0 m
AP	0 m

The structure of the vegetation sampled close to the creeklines on the Site was found to be mainly open forest.

The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity, nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species (Appendix 3):

Of the 60 characteristic species listed, 39 of the species (65%) were recorded in the 70 sampling locations on the Site. The sampling locations located within 40 m of mapped creeklines and that recorded either 20% of the characteristic species or in which 20% of all species in the quadrat were characteristic species are as follows:

Sampling Location	Number of Species	Number of SSF Species	% characteristic SSF spp. in quadrat*	% characteristic SSF spp.^
Q5	56	14	25	23
Q12	46	14	30	23
Q18	34	13	38	22
Q22	40	9	23	15
Q27	52	11	21	18
Q30	32	10	31	17
Q32	19	14	74	23
Q33	43	14	33	23
Q37	29	8	28	13
Q39	35	8	23	13
A	34	7	21	12
D	25	13	52	22
M	30	7	23	12
O	26	7	27	12
Q	18	4	22	7
R	18	4	22	7
S	19	5	26	8
U	38	15	39	25
V	31	8	26	13

Sampling Location	Number of Species	Number of SSF Species	% characteristic SSF spp. in quadrat*	% characteristic SSF spp.^
Y	23	5	22	8
AG	20	8	40	13
AI	26	11	42	18
AK	8	6	75	10
AN	24	6	25	10
AO	14	9	64	15
AP	15	8	53	13
Total Site	313	39	12	65

* Number of characteristic SSF species recorded / Number of species recorded
^ Number of SSF species recorded / Number of characteristic SSF species

2. *The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.*

No additional comments.

3. *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.*

The Site is located in Lake Macquarie Local Government Area.

4. *Swamp Sclerophyll Forest on Coastal Floodplains has an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. The most widespread and abundant dominant trees include* Eucalyptus robusta *(swamp mahogany),* Melaleuca quinquenervia *(paperbark) and, south from Sydney,* Eucalyptus botryoides *(bangalay) and* Eucalyptus longifolia *(woollybut). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including* Callistemon salignus *(sweet willow bottlebrush),* Casuarina glauca *(swamp oak) and* Eucalyptus resinifera *subsp.* hemilampra *(red mahogany),* Livistona australis *(cabbage palm) and* Lophostemon suaveolens *(swamp turpentine). A layer of small trees may be present, including* Acacia irrorata *(green wattle),* Acmena smithii *(lilly pilly),*

Elaeocarpus reticulatus *(blueberry ash),* Glochidion ferdinandi *(cheese tree),* Melaleuca linariifolia *and* M. styphelioides *(paperbarks*). *Shrubs include* Acacia longifolia *(Sydney golden wattle),* Dodonaea triquetra (*a hopbush),* Ficus coronata *(sandpaper fig),* Leptospermum polygalifolium *subsp.* polygalifolium *(lemon-scented tea tree) and* Melaleuca *spp. (paperbarks). Occasional vines include* Parsonsia straminea *(common silkpod),* Morinda jasminoides *and* Stephania japonica *var.* discolor *(snake vine). The groundcover is composed of abundant sedges, ferns, forbs, and grasses including* Gahnia clarkei*,* Pteridium esculentum *(bracken),* Hypolepis muelleri *(batswing fern),* Calochlaena dubia *(false bracken),* Dianella caerulea *(blue flax lily),* Viola hederacea*,* Lomandra longifolia *(spiny-headed mat-rush) and* Entolasia marginata *(bordered panic) and* Imperata cylindrica *var.* major *(blady grass). The endangered swamp orchids* Phaius australis *and* P. tankervillei *are found in this community. On sites downslope of lithic substrates or with soils of clay-loam texture, species such as* Allocasuarina littoralis *(black she-oak),* Banksia oblongifolia*,* B. spinulosa *(var.* collina *or var.* spinulosa*) (hairpin banksia),* Ptilothrix deusta *and* Themeda australis *(kangaroo grass), may also be present in the understorey. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.*

Of the species listed above, the following were recorded in the sampling locations within 40 m of mapped creeklines and with greater than 20% of characteristic species:

Canopy Species	**Sampling locations**
Eucalyptus robusta	Q18, Q22, Q27, Q32, Q33, Spot locations D, AK and AO
Callistemon salignus	Q12, Q18, Q22, Q27, Spot locations A, D and U

Canopy Species	Sampling locations
Small trees	
Acacia irrorata	Q32, Spot location U
Acmena smithii	Spot locations U and V
Glochidion ferdinandi	Spot location AD
Melaleuca linariifolia	Q5, Q18, Q22, Q27, Q30, Q32, Q37, Spot locations A and D
Shrubs	
Dodonaea triquetra	Q12
Melaleuca spp.	Q5, Q18, Q22, Q27, Q32, Q33, Q39, Spot locations A, D, M, O and Y
Vines	
Parsonsia straminea	Q12, Q18, Q27, Q32, Q33, Spot location AD
Morinda jasminoides	Spot location V
Stephania japonica var. *discolor*	Spot location U
Groundcover	
Gahnia clarkei	Q5, Q12, Q18, Q22, Q27, Q30, Q32, Q33, Q37, Q39, Spot locations D, M, O, Q, U and Y
Pteridium esculentum	Q5, Q12, Q30, Q32, Q33, Q37, Spot locations A, D, M and U
Hypolepis muelleri	Q33
Calochlaena dubia	Q5, Q27, Q32, Q33, Spot location M
Dianella caerulea	Q5, Q12 and Q18
Viola hederacea	Q18, Q22, Q27, Spot location V
Lomandra longifolia	Q5, Spot locations D, U and V
Entolasia marginata	Q32, Q33, Spot location U
Imperata cylindrica var. *major*	Q5, Q12, Q18, Q30, Q33, Q37 and Q39

Species typical of soils of clay-loam texture

Allocasuarina littoralis	Q12, Spot locations D, R, S and Y
Banksia oblongifolia	Q30, Q37, Q39, Spot locations M, Q, R, S and AP
Banksia spinulosa	Q5, Q12, Q30, Q39, Spot locations A, Q, R, S and AP
Themeda australis	Q5, Q12, Q30, Q39, Spot locations A, D, O, S and AN

*5. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law et al. 2000). The blossoms of Eucalyptus robusta and Melaleuca quinquenervia are also an important food source for the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Common Blossom Bat (*Sycoyncteris australis*) (Law 1994), as well as the Yellow-bellied Glider (*Petaurus australis*), Sugar Glider (*Petaurus breviceps*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*). Other animals found in this community include the Osprey (*Pandion haliaetus*), Australasian Bittern (*Botaurus poiciloptilus*), Large-footed myotis (*Myotis adversus*), Litoria olongburensis and Wallum Froglet (*Crinia tinnula*).*

No additional comments.

6. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested and

treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Sclerophyll Forest on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include: its relatively dense tree canopy dominated by Eucalyptus robusta, Melaleuca quinquenervia *or* E. botryoides*, the relatively infrequent occurrence of other eucalypts,* Casuarina glauca *or* Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover. It generally occupies small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains. The soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water.*

Of the Quadrats within 40 m of mapped creeklines and with greater than 20% of characteristic species, *Eucalyptus robusta* was the dominant or co-dominant canopy species in Q18, Q22, Q27, Q32, Q33 and Spot locations D, AK and AO. Of these sampling locations, all contained no other eucalypts apart from Q33 and Spot location AO, in which *Eucalyptus resinifera* subsp. *resinifera* was also recorded.

7. *Swamp Sclerophyll Forest on Coastal Floodplains includes and replaces Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Subtropical Floodplain Forest, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, as soils become less waterlogged, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. As soil salinity increases Swamp Sclerophyll Forest on Coastal Floodplains may intergrade with, and be replaced by, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston et al. 2003, Stevenson 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.*

No additional comments.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes the Eucalyptus robusta *(Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), those areas on floodplains mapped as 'Forest Ecosystem 112, Paperbark', and those areas on floodplains mapped as 'Forest Ecosystem 142, Swamp Mahogany' are included within this community. On the Tweed lowlands, this community includes* 'Eucalyptus robusta *mid-high to very tall closed*

forest' (F7), 'Archontophoenix cunninghamiana-Melaleuca quinquenervia *very tall feather palm swamp forest' (F9), those parts of* Melaleuca quinquenervia *tall to very tall open to closed forest' (F8) on alluvial soils and parts of 'Floodplain Wetland Complex' (FL) dominated by* Eucalyptus robusta *or* Melaleuca quinquenervia *(Pressey and Griffith 1992). In the lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a) of NPWS (2000). In the Sydney-Gosford region, this community includes those parts of 'Freshwater Swamp complex' (map unit 27a) dominated by* Eucalyptus robusta *or* E. botryoides *(Benson 1986, Benson and Howell 1994) and parts of the 'Freshwater wetlands – on the floodplains' of Benson and Howell (1990) and Benson et al. (1996). In the Illawarra, this community includes 'Alluvial swamp mahogany forest' (map unit 35) of NPWS (2002). On the south coast, this community includes 'Northern Coastal Lowlands Swamp Forest' (forest ecosystem 175) of Thomas et al. (2000) and 'Coastal Sand Swamp Forest' (map unit 45) of Tindall et al. (2004). Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' and 'Coastal Swamp Forest' vegetation classes of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Sclerophyll Forest on Coastal Floodplains within and beyond these surveyed areas.*

NPWS (2003) mapped nine fragmented patches of Riparian Melaleuca Swamp Woodland (MU 42) on the Site, totalling approximately 7.74 ha in area (Figure 7).

9. *The extent of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forest on Floodplains, currently cover 800-1400 km2, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Sclerophyll Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. For example, there were less than 350 ha of native vegetation attributable to this community on the Tweed lowlands in 1985 (Pressey and Griffith 1992), less than 2500 ha on the Clarence floodplain in 1982 (Pressey 1989a), less than 700 ha on the Macleay floodplain in 1983 (Pressey 1989b), up to 7000 ha in the lower Hunter – central coast district during the 1990s (NPWS 2000), and less than 1000 ha in the Sydney – South Coast region in the mid 1990s (Tindall et al. 2004), including less than 40 ha on the Illawarra plain in 2001 (NPWS 2002) and about 450 ha on the South Coast in the 1990s (Thomas et al. 2000).*

No additional comments.

10. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Sclerophyll Forest on Coastal Floodplains in other parts of the NSW North Coast bioregion (Goodrick 1970, Pressey 1989a, 1989b). In the lower Hunter – central coast district, about 30 % of the original area of Swamp mahogany – paperbark forest was estimated to remain in the 1990s (NPWS 2000).

No additional comments.

11. Land clearing continues to threaten Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey and Griffith 1992, NPWS 2000), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnston et al. 2003). Anthropogenic climate change may also threaten Swamp Sclerophyll Forest on Coastal Floodplains if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire and Removal of dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Act (1995).

No additional comments.

12. *Large areas of habitat formerly occupied by Swamp Sclerophyll Forest on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, Boulton and Brock 1999). While much of the early drainage works were associated with agricultural development, more recently they are associated with urban expansion. Additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith 1992). On the north coast of NSW, expansion of Melaleuca quinquenervia into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston et al. 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston et al. 2003).*

No additional comments.

13. *Relatively few examples of Swamp Sclerophyll Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Sclerophyll Forest on Coastal Floodplains include* Andropogon virginicus *(whiskey grass),* Anredera cordifolia *(Madeira vine),* Ageratina adenophora *(crofton weed),* Baccharis halimifolia *(groundsel bush),* Cinnamomum camphora *(camphor laurel*), Lantana camara *(lantana),* Ligustrum sinense *(small-leaved privet),* Lonicera japonica *(Japanese honeysuckle) and* Ludwigia peruviana *(Keith and Scott 2005).*

Of the species listed above, three were recorded on or recorded on or adjacent to the Site.

Exotic Species	Sampling Locations
Ageratina adenophora	Q33
Cinnamomum camphora	Q33, Q42
Ligustrum sinense	U, 42

14. *Small areas of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.*

No additional comments.

15. *Given the dynamic hydrological relationship between Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of* water *and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.*

No additional comments.

16. *In view of the above the Scientific Committee is of the opinion that Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.*

No additional comments.

In conclusion, the vegetation recorded in sampling locations Q18, Q22, Q27, Q32, Q33 and Q37 and Spot locations D, M, O, AK and AO appear to meet the criteria for the endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as:

- They are all located in the riparian zone (within approximately 40 m of a mapped creekline);
- They either contain the dominant canopy species *Eucalyptus robusta* (Q18, Q22, Q27, Q32, Q33, Spot locations D, AK and AO) or *E. resinifera* subsp. *resinifera* (Q37, Spot location M) with few or no other eucalypt species present and a midstorey dominated by *Melaleuca* spp.

Of the sampling locations fitting the criteria for Swamp Sclerophyll Forest on Coastal Floodplains, all except for Spot locations AK and AO occur on the Site.

4.2 Species

4.2.1 National

A search of the Environment Australia website (www.deh.gov.au accessed 2 December 2004) revealed that there are 5 threatened species listed on the EP&BC Act occurring within 10 km of the Site, namely:

Species	Status
Acacia bynoeana	V
Angophora inopina	V
Cryptostylis hunteriana	V
Grevillea parviflora subsp. *parviflora*	V
Tetratheca juncea	V

Three of the listed species were recorded on and adjacent to the Site (Figures 9 and 10), namely:

Species	Sampling locations on Site	Sampling locations adjacent to Site
Angophora inopina	Q1, Q2, Q3, Q8, Q10, Q13, Q19, Q20, Q21, Q24, Q25, Q31, Q37, Q38, Q39, Q45, Q46, Q47, I, L, M, N, Y	Q43, AM, AN, AP
Grevillea parviflora subsp. *parviflora*	Q1, Q5, Q12, Q15, Q30, Q39, A, B, L,	Q40, AL, AM
Tetratheca juncea	Q12, Q19, Q20, C, E, P	AL

The identification of the three species was confirmed by the Royal Botanic Gardens (Appendix 4).

4.2.2 State

Twelve species listed on the TSC Act have been recorded in the Lake Macquarie LGA (NPWS 2000b, NPWS Wildlife Atlas website accessed on 2 December 2004 http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlasSpecies.jsp), namely:

Species	Status
Acacia bynoeana	E1
Angophora inopina	V
Chamaesyce psammogeton	E1
Cryptostylis hunteriana	V
Cynanchum elegans	E1
Diuris praecox	V
Eucalyptus camfieldii	V
Grevillea parviflora subsp. *parviflora*	V
Melaleuca biconvexa	V
Syzygium paniculatum	V
Tetratheca glandulosa	V
Tetratheca juncea	

E1: Endangered V: Vulnerable

Three of the listed species were recorded on and adjacent to the Site (Figures 9 and 10), namely:

Species	Sampling location on Site	Sampling locations adjacent to Site
Angophora inopina	Q1, Q2, Q3, Q8, Q10, Q13, Q19, Q20, Q21, Q24, Q25, Q31, Q37, Q38, Q39, Q45, Q46, Q47, I, L, M, N, Y,	Q43, AM, AN, AP
Grevillea parviflora subsp. *parviflora*	Q1, Q5, Q12, Q15, Q30, Q39, A, B, L,	Q40, AL, AM
Tetratheca juncea	Q12, Q19, Q20, C, E, P	AL

4.2.3 Regional

Benson (1986) list 50 species of particular conservation significance in the Gosford and Lake Macquarie vegetation map sheet. Three of the species listed were recorded on the Site, namely (Figure 9):

Species	Sampling locations on Site	Sampling locations adjacent to Site
Blandfordia grandiflora	Q31, Q37	Not recorded
Hakea bakeriana	Q2, Q6, Q9, Q20, Q21, Q29, Q30, Q31, Q36, Q38, Q39, L, N, Q	AM
Tetratheca juncea	Q12, Q19, Q20, C, E, P	AL

5.0 Noxious weeds

The NSW Agriculture *Noxious Weeds List* (website accessed 2 December 2004 http://www.agric.nsw.gov.au/noxweed, Appendix 5) identifies 38 noxious weeds for the Lake Macquarie LGA. One of the 49 exotic species recorded in the current survey is declared noxious in the Lake Macquarie LGA, namely:

Species	Control Category	Sampling location
Ageratina adenophora	W2 - The weed must be fully and continuously suppressed and destroyed.	Q33

6.0 Conclusions

From the flora assessment of the Site, there were:

- A total of 312 species (263 native and 49 exotic) recorded from 42 Quadrats and 31 Spot locations;
- Four vegetation communities identified on the Site, namely Coastal Plains Smoothbarked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Riparian Melaleuca Swamp Woodland and Alluvial Tall Moist Forest;
- One endangered ecological community listed under the TSC Act was recorded on the Site, namely Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Three species listed on the EP&BC Act and the TSC Act were recorded on the Site, namely:

Species	Vegetation community recorded
Angophora inopina	Coastal Plains Smoothbarked Apple Woodland, Coastal Plains

Species	Vegetation community recorded
	Scribbly Gum Woodland, Riparian Melaleuca Swamp Woodland
Grevillea parviflora subsp. *parviflora*	Coastal Plains Smoothbarked Apple Woodland, Coastal Plains Scribbly Gum Woodland, Riparian Melaleuca Swamp Woodland
Tetratheca juncea	Coastal Plains Smoothbarked Apple Woodland, Coastal Plains Scribbly Gum Woodland

- Three species of regional conservation significance recorded on the Site, namely *Blandfordia grandiflora, Hakea bakeriana* and *Tetratheca juncea*; and
- One noxious weed for the Lake Macquarie LGA recorded on the Site, namely *Ageratina adenophora.*

7.0 Recommendations

Conservation areas are required to conserve the identified vegetation of conservation significance in the long term. The adjoining land uses are important in determining the long-term viability of the conservation corridors. The other issue of concern is ensuring the long term water quality of the creeks flowing to Lake Macquarie.

It is recommended that:

- A wide corridor from Olney State Forest land be extended to join with the south flowing creek line adjoining the southern boundary of the Avondale land. Sections of this proposed corridor will require some re-creation using bush regeneration techniques. The south-western section of the airport runway should be allowed to continue to naturally regenerate.
- A second wide corridor be established linking the north east vegetated area (north of Avondale College school) with its associated south east flowing creekline to the creekline in the north west of Avondale land and extending along the associated west flowing creekline.
- The noxious weed *Ageratina adenophora* recorded near the eastern boundary of Area 1 (Quadrat 33) be removed from the Site in accordance with NSW Agriculture directions that the weed be “fully and continuously suppressed and destroyed”

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Figures

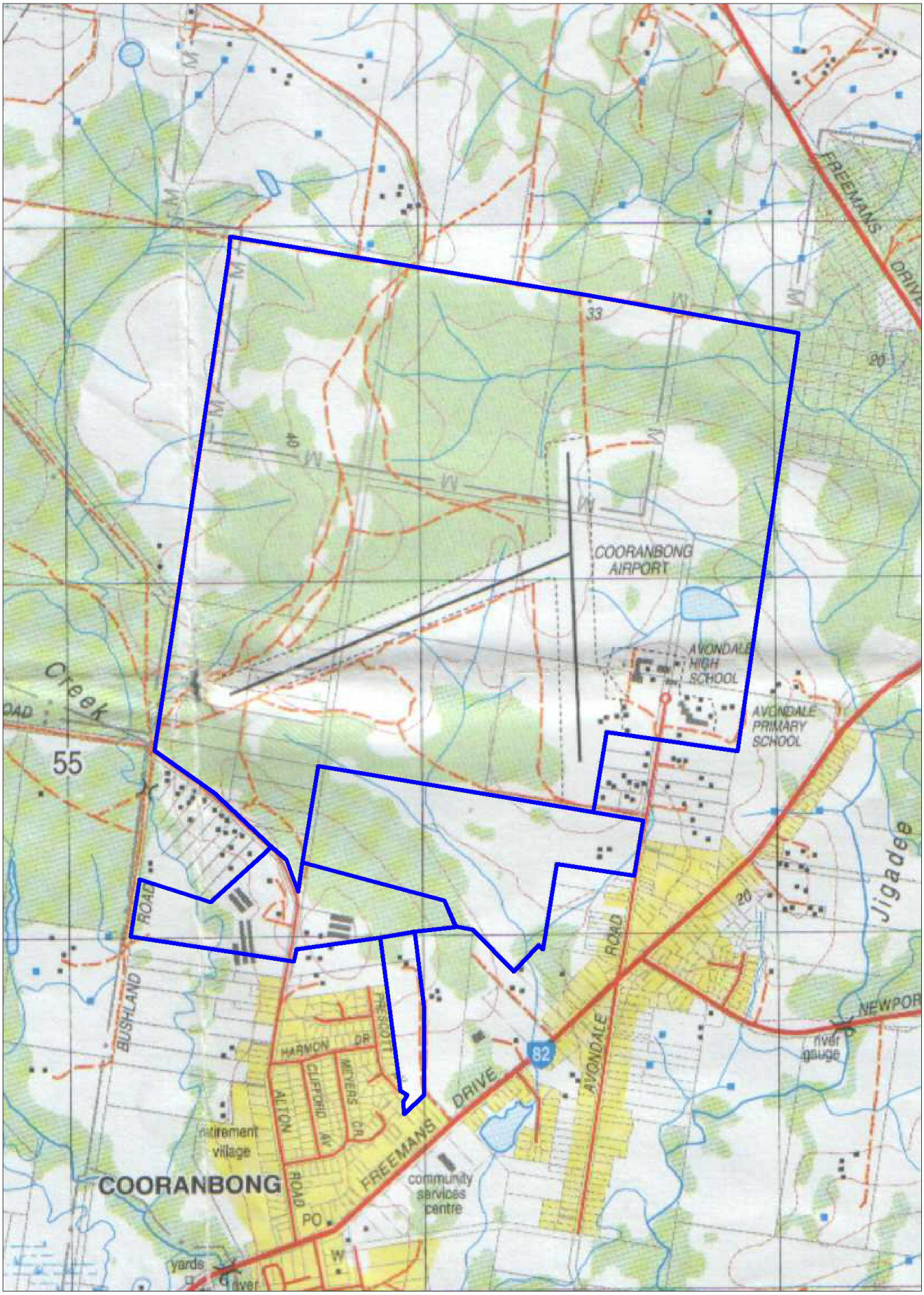


Figure 1.
Site location

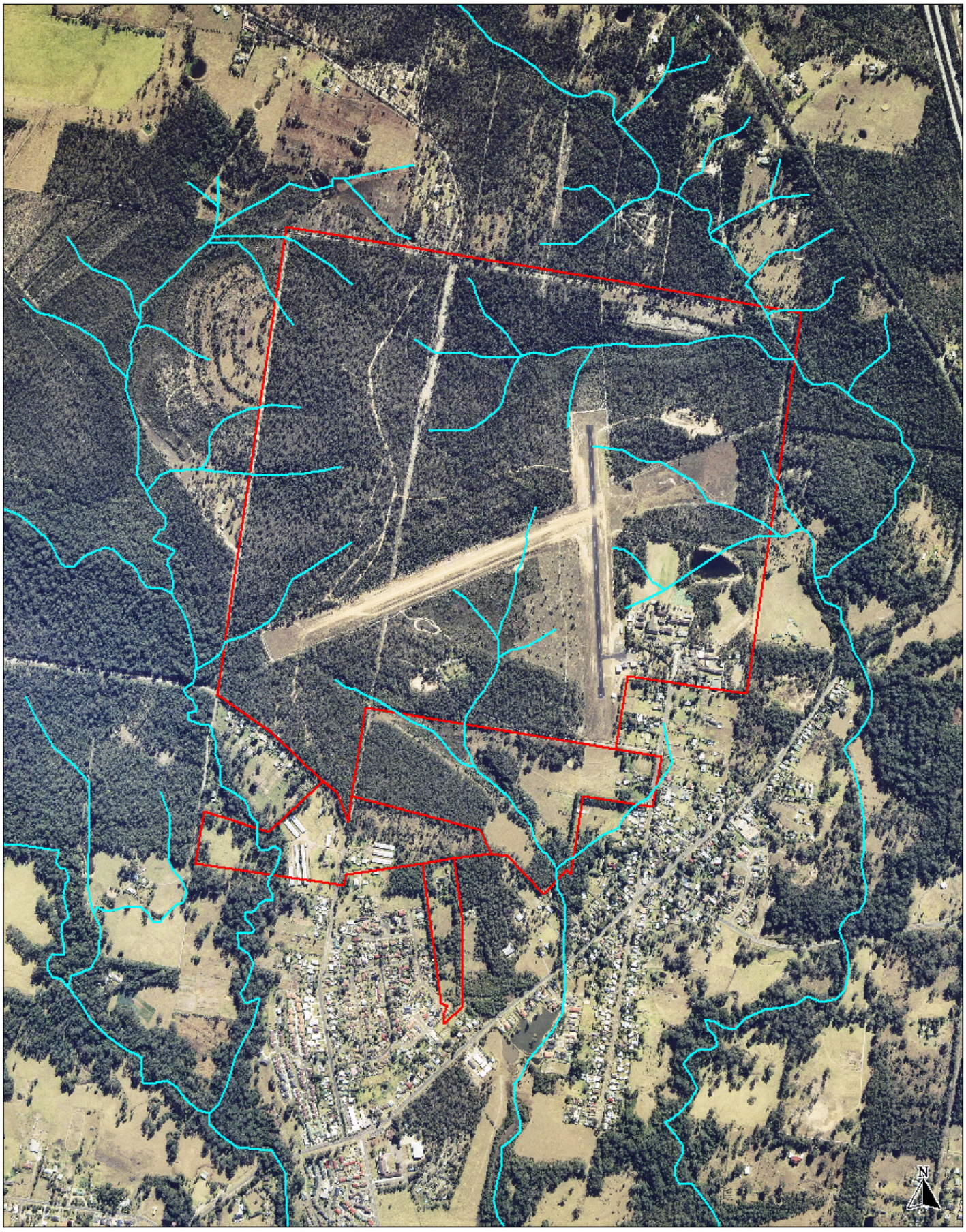


Figure 2.
Creeklines mapped on the 1:25 000 topographic map (LPI 2002)

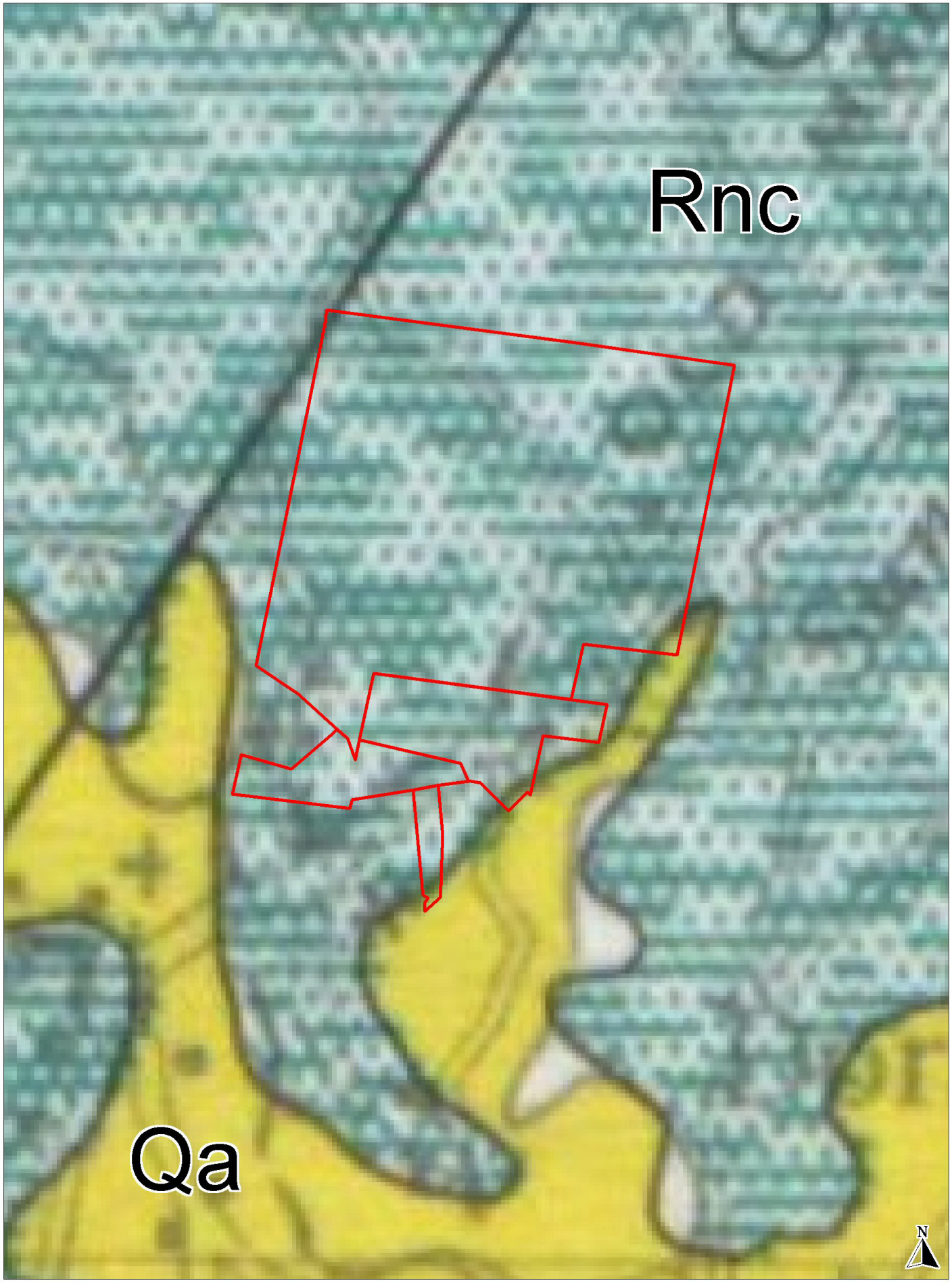


Figure 3.
Geology mapping (Bryan 1965)

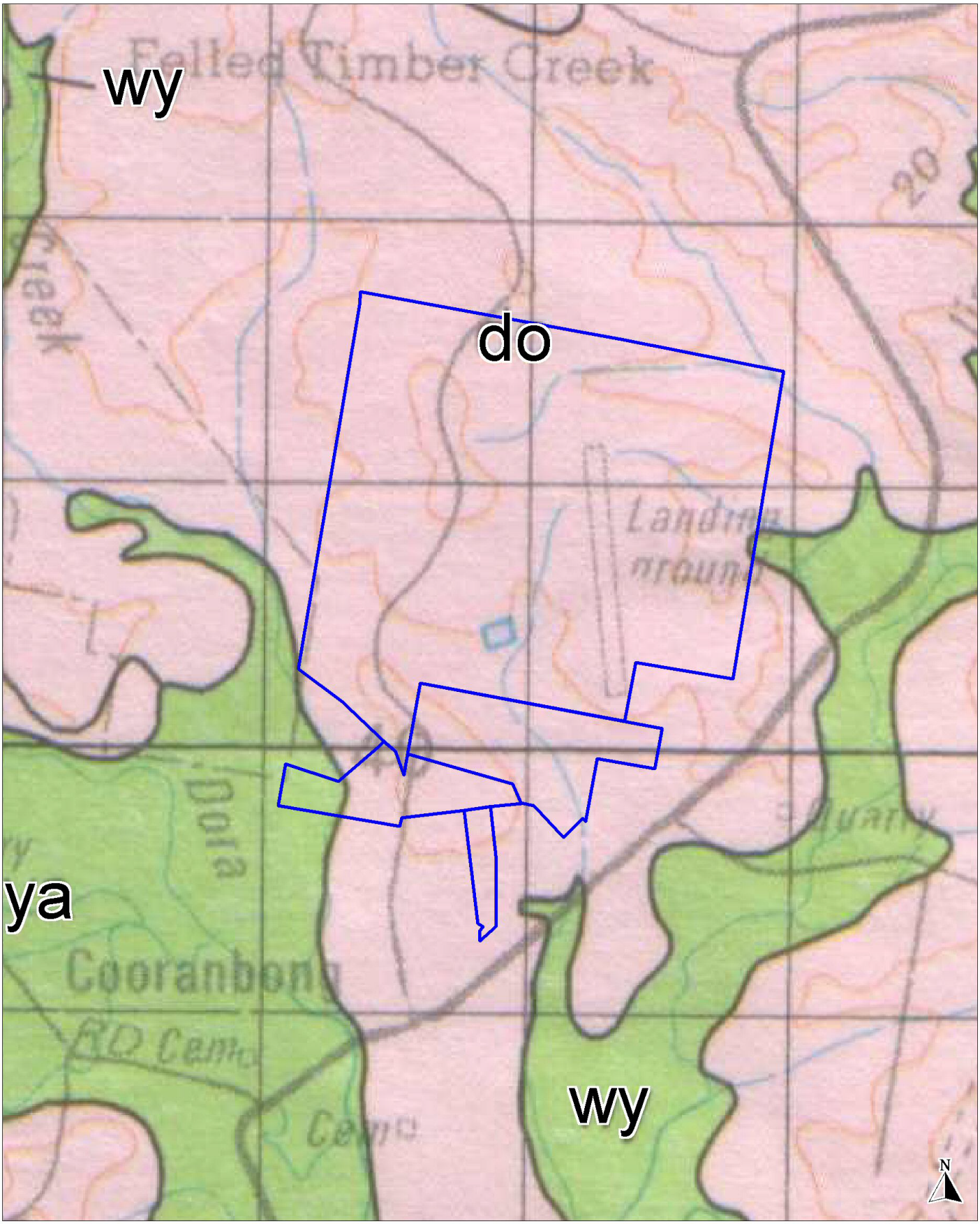
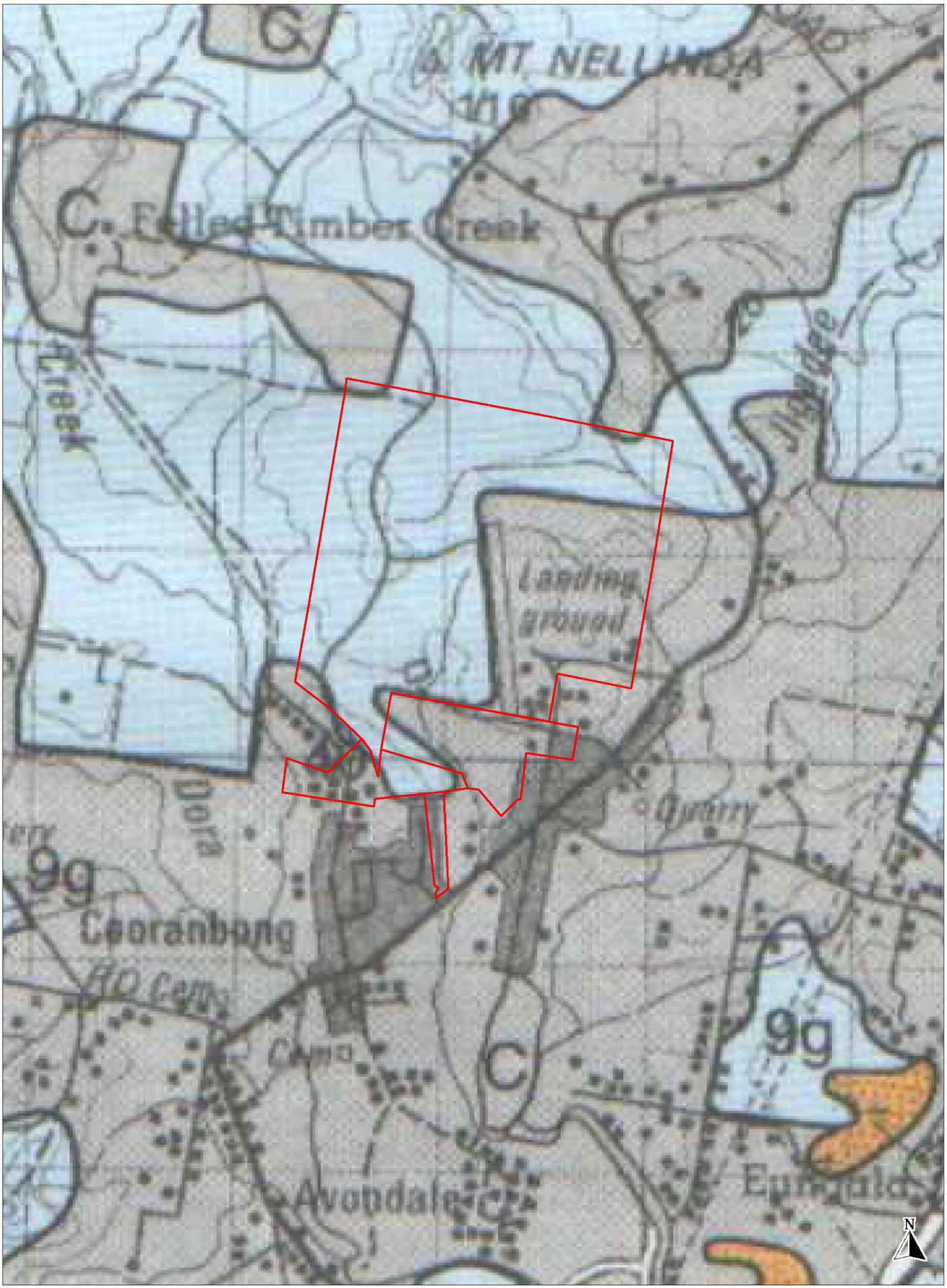


Figure 4.
Soil landscape mapping (Murphy and Tille 1993)

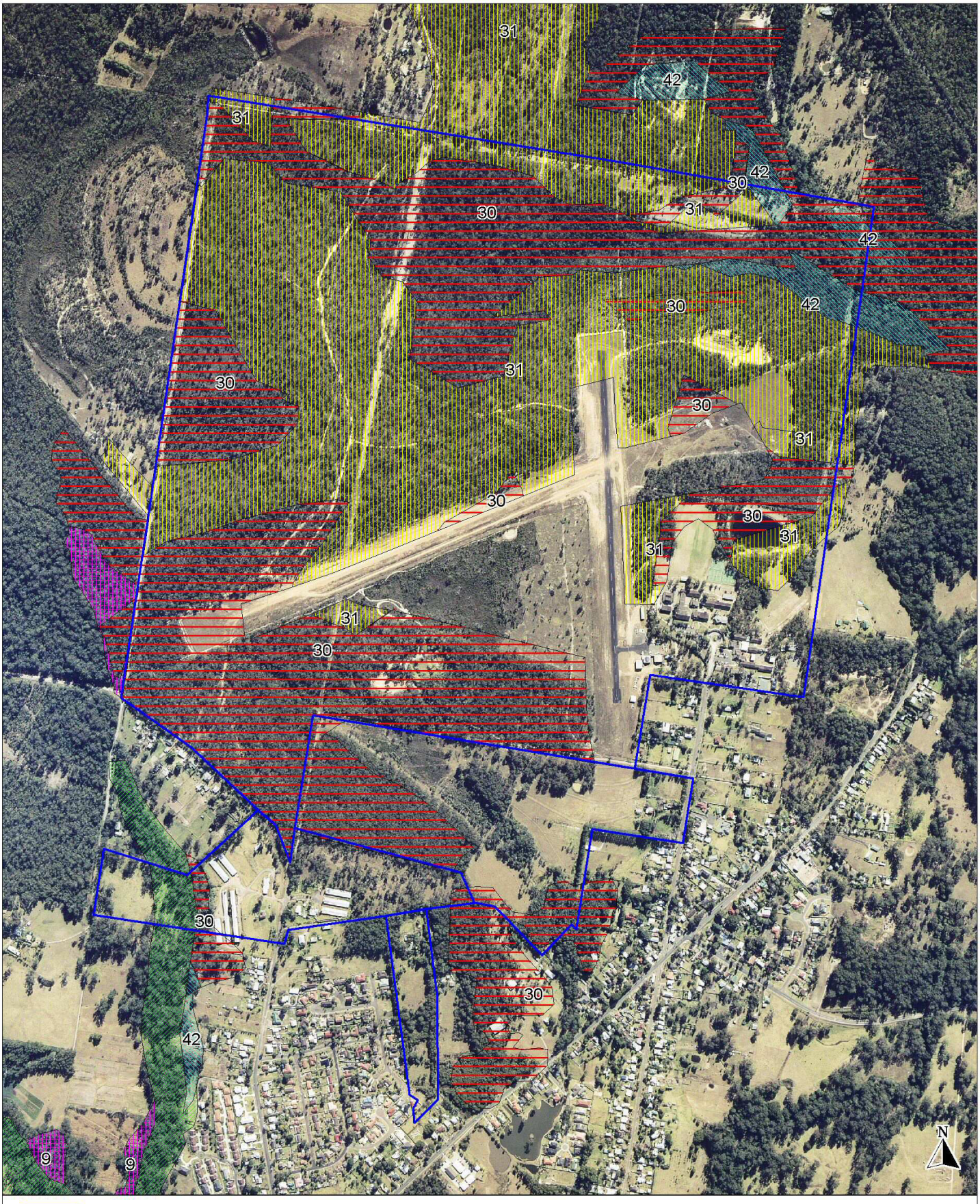


Site boundary

9g: Open Forest: Corymbia gummifera - C. maculata - Eucalyptus pilularis

C: Cleared

Figure 5.
Benson (1986) vegetation mapping



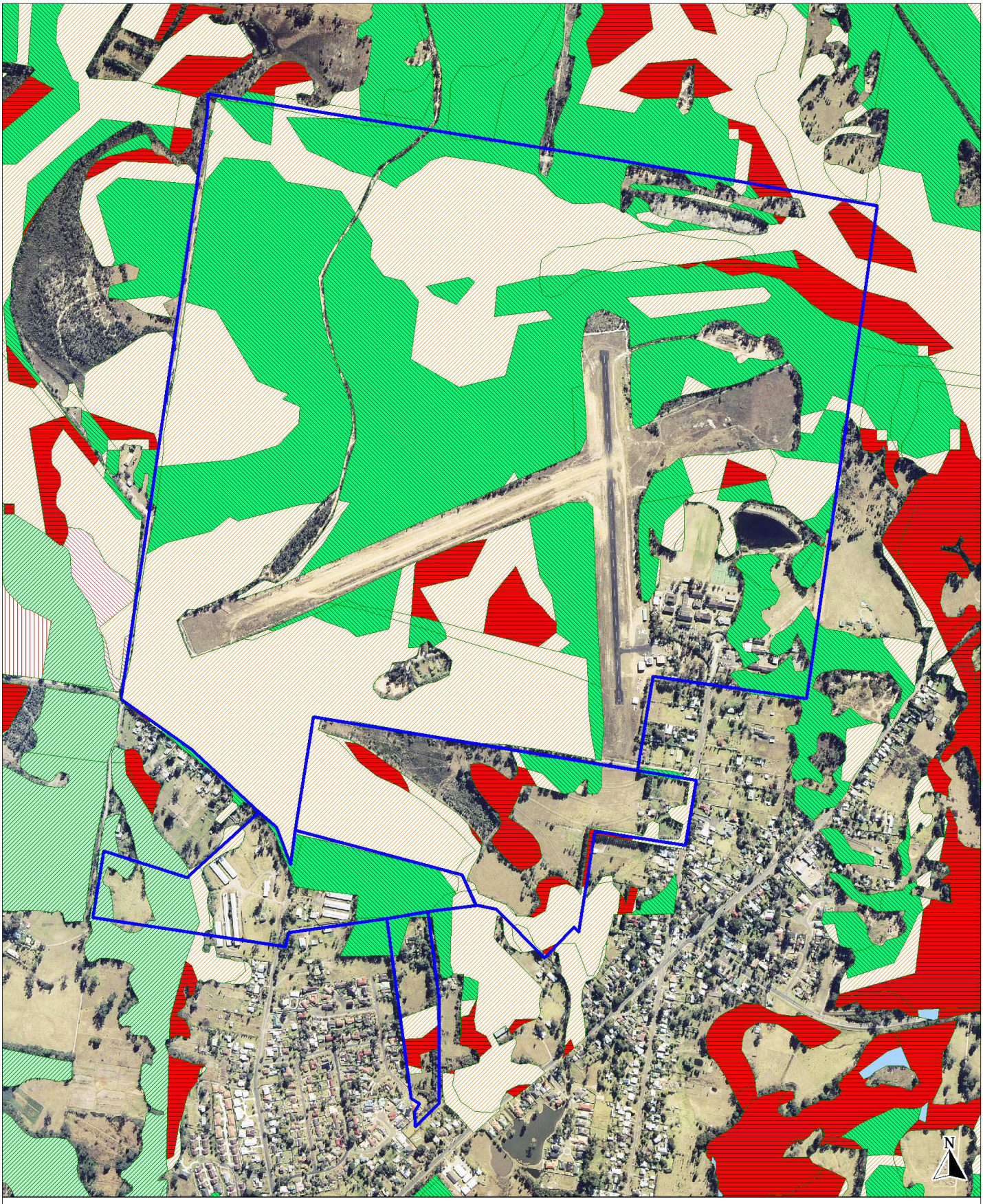
Site boundary

LHCCREMS vegetation communities

- 31 Coastal Plains Scribbly Gum Woodland
- 30 Coastal Plains Smooth-barked Apple Woodland
- 42 Riparian Melaleuca Swamp Woodland
- 5 Alluvial Tall Moist Forest
- 9 Coastal Ranges Open Forest

0 250 500
metres

Figure 6.
LHCCREMS (2000) vegetation mapping



Legend

- Site boundary
- Coastal Plains Scribbly gum Woodland
- Coastal Plains Smooth-barked Apple Woodland
- Alluvial Tall Moist Forest
- Riparian Melaleuca Swamp Woodland

0 250 500
metres

Figure 7.
LHCCREMS (2003) vegetation mapping

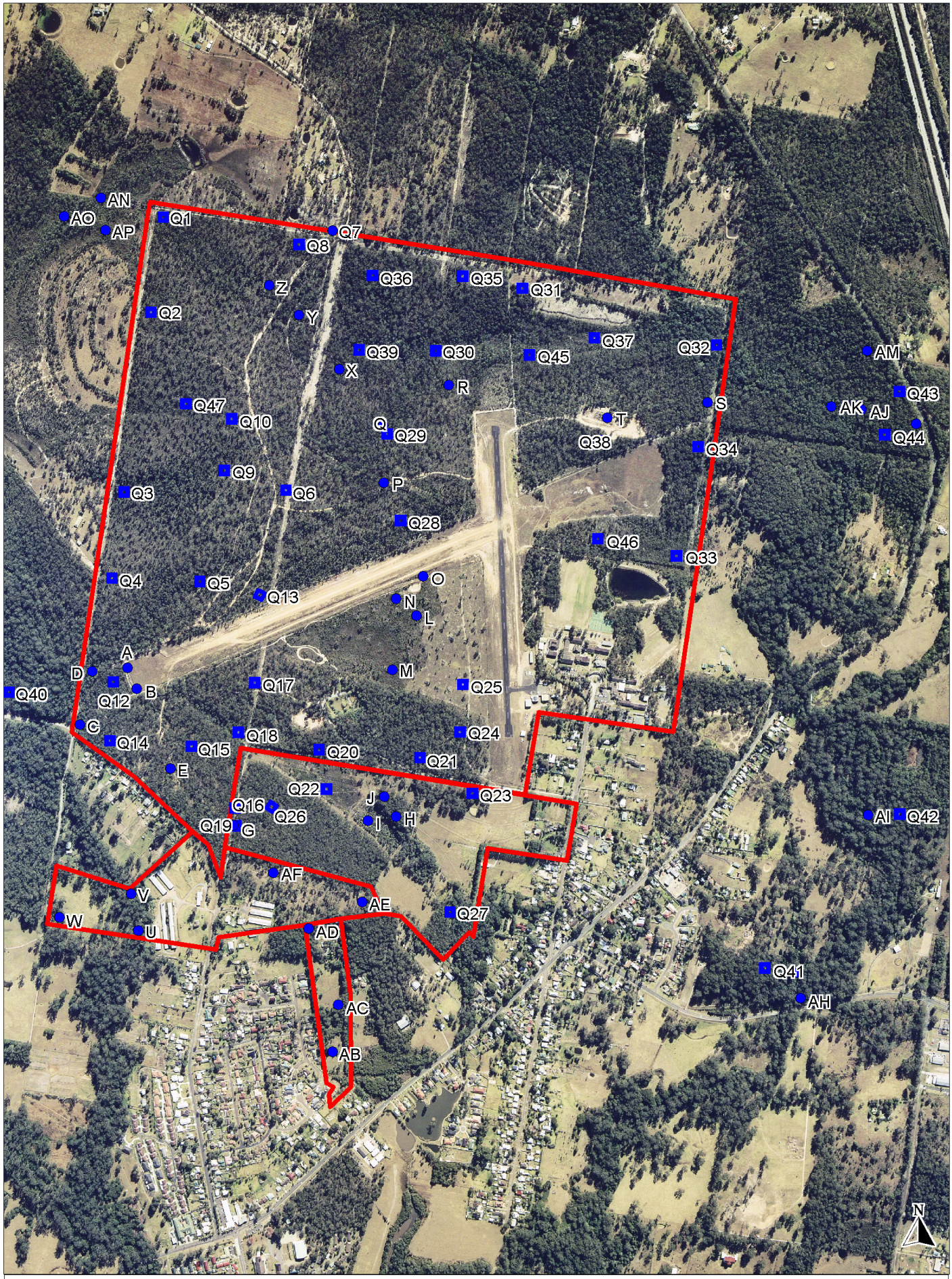


Figure 8.
Sampling locations

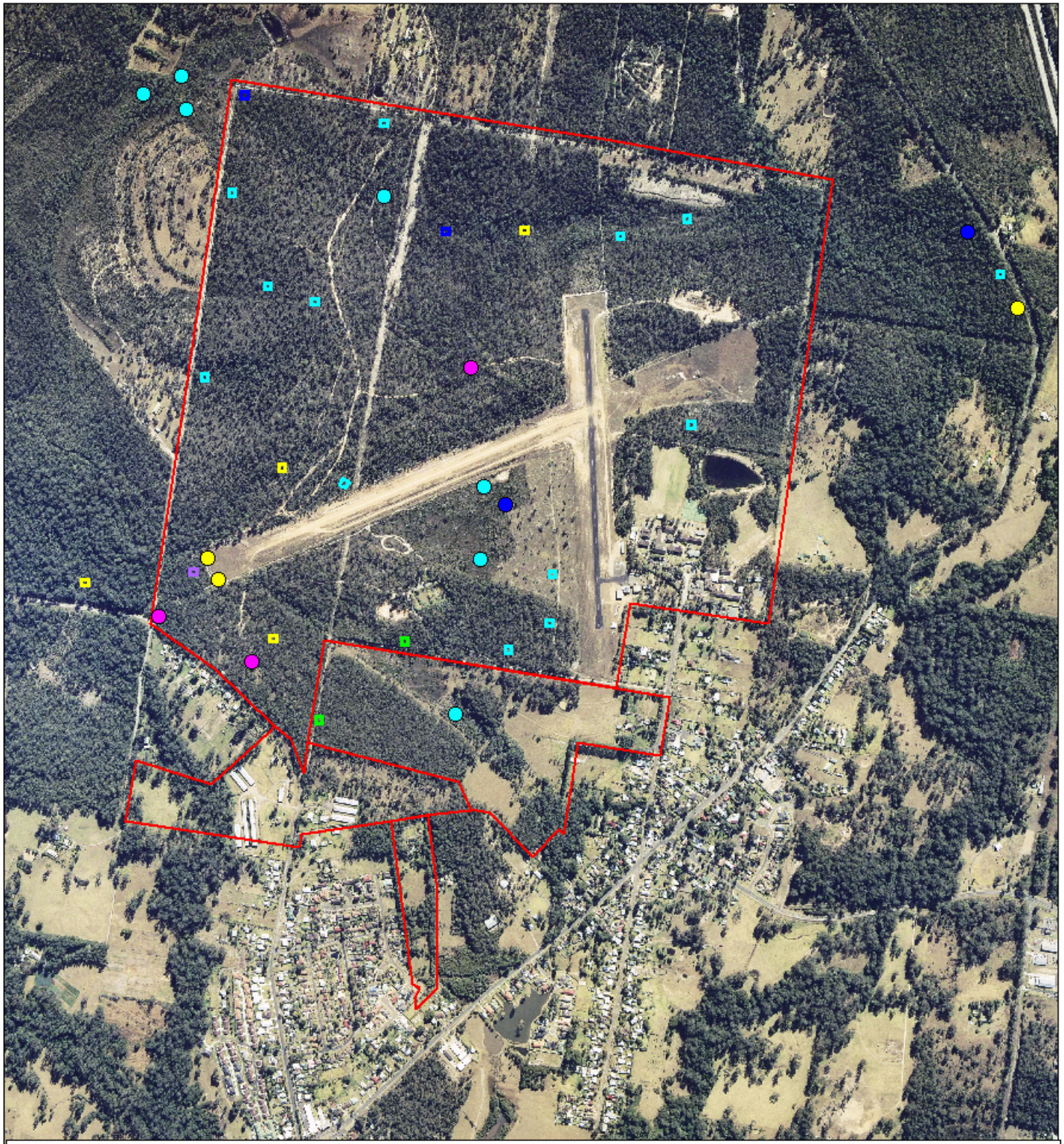


Figure 9.
Sampling locations on and adjacent to the Site in which threatened species were recorded

Tables

Table 1. Review of historical aerial photographs

Date	Observations	
	Site	**Surrounds**
23 October 2001	Area 1: Cooranbong Airstrip with south-west to north-east and north to south runways. Dense vegetation in the majority of the rest of the area, with tracks throughout and vegetation to the north and south of the centre of the SW-NE runway cleared. Area in south-east cleared with a large dam and buildings (Avondale High School). Patch of exotic vegetation visible in south. Area 2: Vegetated in south-west. Cleared in north-west with some areas of dense vegetation. Buildings in cleared paddocks in the east. Area 3: Scattered trees in the east. Dense vegetation along Felled Timber Creek in the west. Large buildings in the south (Poultry Farms). Area 4: Mostly cleared paddock with some vegetation along boundaries and in the middle. Houses in the north.	N: Dense vegetation along creeklines contiguous with vegetation on the Site. Dense vegetation to the north-east with some tracks and cleared patches. Cleared paddocks to the north-west. E: Vegetation along major creeklines with cleared paddocks and some densely vegetated areas. Pacific Highway to far west. Some residential development along major roads. S: Vegetated along major creeklines and cleared paddocks with some treed areas. Residential development to the centre south. W: Mostly dense vegetation (State Forest) with cleared areas in the north-west.
15 September 1994	Area 1: As in 2001 with vegetation to the north of SW-NE runway vegetated. Patch of exotic vegetation in the south absent. Area 2: Similar to 2001 aerial photo, but patches of dense vegetation in paddocks less extensive. Area 3: Similar to 2001 aerial photo. Area 4: Similar to 2001 aerial photo, but the vegetation across the centre of the Site less dense.	Similar to 2001 aerial photo.
27 April 1984	Area 1: Airstrip present. Mostly densely vegetated, area to the south of the SW-NE runway vegetated. Some tracks and cleared patches. Mostly cleared in south-east corner, dam absent and buildings present. Area 2: NE appears to be mostly cleared with some regrowth. Fewer buildings in the east. Otherwise similar to 1994 aerial photo. Area 3: Similar to 1994 aerial photo. Area 4: Site cleared with scattered trees. Buildings in north present.	N: Not visible. E: Similar to 1994 aerial photo. S: Similar to 1994 aerial photo. W: Dense vegetation, no cleared area to NW and some tracks.
27 May 1975	Area 1: Only N-S runway of airstrip present. Rest of area densely vegetated	N: Vegetation to north more dense than in 1994.

Date	Observations	
	Site	**Surrounds**
	with some tracks. Buildings and cleared areas in south-east absent. Area 2: Similar to 1984 aerial photo. Area 3: Similar to 1984 aerial photo, with vegetation more extensive in west. Area 4: Similar to 1984 aerial photo, with fewer scattered trees.	E: Similar to 1984 aerial photo. S: Similar to 1984 aerial photo. W: Similar to 1984 aerial photo with fewer tracks.
14 August 1966	Area 1: Dense vegetation with some tracks. N-S runway area cleared but not bituminised. Area 2: Dense vegetation in west. Cleared paddocks in east, with crops visible. Area 3: Similar to 1975 aerial photo, with vegetation along creekline in west and scattered trees. Area 4: Similar to 1975 aerial photo, with more scattered trees.	N: Dense vegetation with some tracks. E: Vegetation more extensive, otherwise similar to 1975 aerial photo. S: Similar to 1975 aerial photo. W: Similar to 1975 aerial photo, but vegetation more extensive.
7 March 1954	Area 1: Similar to 1966 aerial photo. Area 2: Similar to 1966 aerial photo. Area 3: Poultry Farms absent. Dense vegetation in some areas and cleared in others. Area 4: Similar to 1966 with fewer scattered trees.	N: Similar to 1966 aerial photo. E: Similar to 1966 aerial photo with fewer houses along main roads and vegetation more extensive. S: Similar to 1966 aerial photo with areas of vegetation more extensive. W: Similar to 1966 aerial photo.

Table 2 - Botanical and common names of species recorded in Cooranbong

Note: * preceding botanical name signifies exotic species

Botanical name	Common name
1. Pteridophytes	
Adiantaceae	
Adiantum aethiopicum	Common Maidenhair Fern
Blechnaceae	
Blechnum cartilagineum	Gristle Fern
Blechnum indicum	Swamp Water Fern
Doodia aspera	Prickly Rasp Fern
Doodia caudata	Small Rasp Fern
Dennstaedtiaceae	
Histiopteris incisa	Batswing Fern, Oak Fern
Hypolepis muelleri	
Pteridium esculentum	Bracken
Dicksoniaceae	
Calochlaena dubia	Rainbow Fern, False Bracken
Gleicheniaceae	
Gleichenia dicarpa	Pouched Coral-fern
Lindsaeaceae	
Lindsaea linearis	Screw Fern
Lindsaea microphylla	Lacy Wedge-fern
Schizaeaceae	
Schizaea bifida	Forked Comb Fern
Selaginellaceae	
Selaginella uliginosa	
Sinopteridaceae	
Cheilanthes sieberi subsp. sieberi	Rock Fern
2. Gymnosperms	
Pinaceae	
* Pinus patula	Mexican Pine, Spreading-leaved Pine
3. Dicotyledons	
Acanthaceae	
Brunoniella pumilio	Dwarf Blue Trumpet
Pseuderanthemum variabile	
Anacardiaceae	
* Anacardium occidentale	Cashew
Apiaceae	
Centella asiatica	Pennywort
Centella cordifolia	Heart-leaved Pennywort
Hydrocotyle geraniifolia	Forest Pennywort
Hydrocotyle peduncularis	Pennywort
Platysace ericoides	
Xanthosia tridentata	
Apocynaceae	
Parsonsia straminea	Common Silkpod, Monkey Rope
Araliaceae	
Polyscias sambucifolia	Elderberry Panax
Asteraceae	
* Ageratina adenophora	Crofton Weed
* Ambrosia sp.	
* Bidens pilosa	Cobbler's Pegs, Pitchforks

Botanical name	Common name
Cassinia leptocephala	
* Cirsium vulgare	Spear Thistle
* Conyza albida	Tall Fleabane
Epaltes australis	Spreading Nut-heads
* Erechtites valerianifolia	Brazilian Fireweed
* Gnaphalium coarctatum	Cudweed
* Hypochoeris radicata	Cat's-ears, False Dandelion
Lagenifera gracilis	
Ozothamnus diosmifolius	White Dogwood
* Senecio madagascariensis	Fireweed, Madagascar Ragwort
Sigesbeckia orientalis	Indian Weed
* Sonchus oleraceus	Common Sow-thistle, Milk-thistle
Vernonia cinerea	
Caprifoliaceae	
* Lonicera japonica	Japanese Honeysuckle
Casuarinaceae	
Allocasuarina littoralis	Black She-Oak
Allocasuarina torulosa	Forest She-oak
Celastraceae	
Maytenus silvestris	
Clusiaceae	
Hypericum gramineum	Small St Johns-wort
Convolvulaceae	
Convolvulus erubescens	Native Bindweed, Blushing Bindweed, Pink Bindweed,
Dichondra repens	Kidney-weed, Mercury Bay Weed
Polymeria calycina	Polymeria
Cunoniaceae	
Ceratopetalum gummiferum	NSW Christmas Bush
Dilleniaceae	
Hibbertia aspera	Rough Guinea-flower
Hibbertia empetrifolia	Trailing Guinea-flower
Hibbertia scandens	Twining Guinea-flower
Hibbertia vestita	
Droseraceae	
Drosera spatulata	Common Sundew
Epacridaceae	
Astroloma humifusum	Cranberry Heath
Epacris pulchella	
Leucopogon juniperinus	Long-flowered Beard-heath
Leucopogon lanceolatus	Lance-leaf Beard-heath
Leucopogon microphyllus	
Melichrus procumbens	
Monotoca scoparia	Prickly Broom-heath
Euphorbiaceae	
Breynia oblongifolia	Coffee Bush
Glochidion ferdinandi	Cheese Tree
Phyllanthus hirtellus	Thyme Spurge
Poranthera ericifolia	Heath-leaved Poranthera
Fabaceae Caesalpinioideae	
* Senna pendula var. glabrata	
Fabaceae Faboideae	
Bossiaea heterophylla	
Bossiaea obcordata	Spiny Bossiaea
Daviesia ulicifolia	Gorse Bitter-pea

Botanical name	Common name
Dillwynia retorta	Eggs-and-bacon Pea, Parrot Pea
Glycine clandestina	Twining Glycine
Gompholobium glabratum	Dainty Wedge Pea
Gompholobium latifolium	Golden Glory Pea
Gompholobium pinnatum	Pinnate Wedge Pea
Gompholobium uncinatum	Red Wedge Pea
Hardenbergia violacea	False Sarsaparilla
Hovea heterophylla	
Mirbelia rubiifolia	
Podolobium ilicifolium	Native Holly, Prickly Shaggy-pea
Podolobium scandens	Netted Shaggy Pea
Pultenaea paleacea	
Pultenaea polifolia	
Pultenaea retusa	
Pultenaea tuberculata	
Pultenaea villosa	
Sphaerolobium minus	
Sphaerolobium vimineum	Leafless Globe-pea
Fabaceae Mimosoideae	
Acacia irrorata subsp. irrorata	Green Wattle
Acacia longifolia	Sydney Golden Wattle
Acacia myrtifolia	Red Stemmed Wattle
# Acacia podalyriifolia	Queensland Wattle
Acacia suaveolens	Sweet Wattle
Acacia terminalis	Sunshine Wattle
Acacia ulicifolia	Prickly Moses, Prickly Wattle
Gentianaceae	
Centaurium spicatum	Spike Centaury
* Centaurium tenuiflorum	Centaury
Geraniaceae	
Geranium homeanum	Native Geranium
* Pelargonium (Zonal hybrid)	Zonal Geranium
Goodeniaceae	
Dampiera stricta	Blue Dampiera
Goodenia bellidifolia	
Goodenia heterophylla subsp. eglandulosa	
Goodenia ovata	
Goodenia paniculata	
Scaevola ramosissima	Purple Fan-flower
Haloragaceae	
Gonocarpus micranthus subsp. micranthus	Creeping Raspwort
Gonocarpus tetragynus	
Lauraceae	
Cassytha glabella	Devil's Twine, Dodder-laurel
Cassytha pubescens	Devil's Twine, Dodder-laurel
* Cinnamomum camphora	Camphor-laurel
Lobeliaceae	
Isotoma fluviatilis subsp. fluviatilis	Swamp Isotome
Lobelia alata	Angled Lobelia
Pratia purpurascens	Whiteroot
Loganiaceae	
Logania pusilla	Tiny Logania
Mitrasacme alsinoides	
Mitrasacme polymorpha	Mitre Weed

Botanical name	Common name
Loranthaceae	
Dendrophthoe vitellina	Long-flowered Mistletoe
Malvaceae	
* Modiola caroliniana	Red-flower Mallow
* Sida rhombifolia	Paddy's Lucerne
Menispermaceae	
Stephania japonica	Snake Vine
Menyanthaceae	
Villarsia exaltata	Erect Marsh-flower
Myrtaceae	
Acmena smithii	Lilly-pilly
Angophora costata	Angophora, Sydney Red Gum
Angophora floribunda	Rough-barked Apple
Angophora inopina	
Babingtonia pluriflora	
Babingtonia similis	
Callistemon citrinus	Scarlet Bottlebrush
Callistemon linearis	Narrow-leaved Bottlebrush
Callistemon salignus	White Bottlebrush, Pink-tips
Corymbia gummifera	Red Bloodwood
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus capitellata	Brown Stringybark
Eucalyptus globoidea	White Stringybark
Eucalyptus haemastoma	Broad-leaved Scribbly Gum
Eucalyptus pilularis	Blackbutt
Eucalyptus resinifera subsp. resinifera	Red Mahogany
Eucalyptus robusta	Swamp Mahogany
Eucalyptus saligna	Sydney Blue Gum
Leptospermum juniperinum	Prickly Tea-tree
Leptospermum polygalifolium subsp. cismontanum	Yellow Tea-tree, Tantoon Tea-Tree
Leptospermum trinervium	Paperbark Tea-tree
Melaleuca linariifolia	Flax-leaved Paperbark, Snow-in-summer
Melaleuca nodosa	Ball Honey-myrtle
Melaleuca sieberi	
Melaleuca thymifolia	Thyme Honey-myrtle
Syncarpia glomulifera	Turpentine
Ochnaceae	
* Ochna serrulata	Micky Mouse Plant
Oleaceae	
* Ligustrum lucidum	Broad-leaved Privet
* Ligustrum sinense	Small-Leaved Privet, Chinese Privet
Notelaea longifolia	Mock-olive
Oxalidaceae	
Oxalis exilis	Creeping Oxalis
Passifloraceae	
* Passiflora edulis	Passionfruit
Phytolaccaceae	
* Phytolacca octandra	Inkweed
Pittosporaceae	
Billardiera scandens	Appleberry, Snotberry, Apple Dumplings
Pittosporum revolutum	Yellow Pittosporum
Rhytidosporum procumbens	
Plantaginaceae	
* Plantago lanceolata	Plantain, Ribwort

Botanical name	Common name
Polygalaceae	
Comesperma ericinum	Heath Milkwort
Comesperma sphaerocarpum	Broom Milkwort
Polygonaceae	
Persicaria decipiens	Slender Knotweed
Proteaceae	
Banksia oblongifolia	
Banksia robur	Swamp Banksia, Large-leaf Banksia
Banksia serrata	Saw Banksia, Old Man Banksia
Banksia spinulosa var. collina	Hill Banksia
Grevillea linearifolia	
Grevillea parviflora subsp. parviflora	
# Grevillea robusta	Silky Oak
Grevillea sericea	
Hakea bakeriana	
Hakea gibbosa	Needlebush
Hakea laevipes subsp. laevipes	
Hakea sericea	Needlebush, Silky Hakea
Isopogon anemonifolius	Broad-leaf Drumsticks
Lambertia formosa	Mountain Devil, Honey-flower
Lomatia silaifolia	Native Parsley, Crinklebush
Persoonia levis	Broad-leaved Geebung
Persoonia linearis	Narrow-leaf Geebung
Petrophile pulchella	Conesticks
Ranunculaceae	
Clematis aristata	Traveller's Joy, Old Man's Beard
Clematis glycinoides	Headache Vine, Traveller's Joy, Old Man's Beard
Rhamnaceae	
Alphitonia excelsa	Red Ash
Pomaderris elliptica	
Rosaceae	
* Rubus bellobatus	Kittatinny Blackberry
Rubiaceae	
Morinda jasminoides	Morinda
Opercularia diphylla	Stinkweed
Opercularia hispida	Stinkweed
Opercularia varia	Stinkweed
Pomax umbellata	Pomax
* Richardia humistrata	
* Richardia stellaris	Field Madder
Rutaceae	
Boronia polygalifolia	
Melicope micrococca	Hairy-leaved Doughwood
Sapindaceae	
Dodonaea triquetra	Hopbush
Scrophulariaceae	
Veronica plebeia	Creeping Speedwell
Solanaceae	
Duboisia myoporoides	Corkwood, Duboisia
* Solanum mauritianum	Tree Tobacco, Wild Tobacco
* Solanum nigrum	Blackberry Nightshade
* Solanum pseudocapsicum	Jerusalem Cherry
Stylidiaceae	
Stylidium graminifolium	Grass-leaf Triggerplant

Botanical name	Common name
Thymelaeaceae	
Pimelea linifolia	Rice Flower
Tremandraceae	
Tetratheca juncea	Black-eyed Susan
Urticaceae	
Urtica incisa	Stinging Nettle, Scrub Nettle
Verbenaceae	
Clerodendrum tomentosum	Hairy Clerodendrum
* Lantana camara	Lantana
Violaceae	
Hybanthus enneaspermus subsp. enneaspermus	Spade Flower
Hybanthus monopetalus	Slender Violet-bush
Viola hederacea	Native Violet, Ivy-leaved Violet
4. Monocotyledons	
Anthericaceae	
Arthropodium milleflorum	Vanilla Lily
Caesia parviflora	Pale Grass Lily
Caesia parviflora var. parviflora	Pale Grass Lily
Thysanotus juncifolius	
Tricoryne elatior	Yellow Rush Lily
Tricoryne simplex	
Araceae	
* Alocasia odora	
Gymnostachys anceps	Settlers' Flax, Settlers' Twine
Asparagaceae	
* Asparagus aethiopicus	
Blandfordiaceae	
Blandfordia grandiflora	Christmas Bells
Cannaceae	
* Canna indica	Indian Shot
Colchicaceae	
Burchardia umbellata	Milkmaids
Commelinaceae	
Aneilema biflorum	
Commelina cyanea	Blue Spiderwort
* Tradescantia albiflora	Wandering Jew
Cyperaceae	
Baumea articulata	Jointed Twig-rush
Baumea rubiginosa	Soft Twig-rush
Baumea tetragona	
Carex breviculmis	
Carex gaudichaudiana	Tufted Sedge
Carex longebrachiata	Drooping Sedge
Chorizandra cymbaria	
Cyathochaeta diandra	
* Cyperus aggregatus	
Cyperus brevifolius	Mullumbimby Couch
* Cyperus eragrostis	Drain Flat-sedge, Umbrella Sedge
Cyperus polystachyos	
Cyperus sphaeroideus	
Eleocharis gracilis	
Fimbristylis dichotoma	
Gahnia clarkei	Saw-sedge
Gahnia radula	

Botanical name	Common name
Isolepis inundata	
* Isolepis prolifera	
Lepidosperma laterale (narrow leaved form)	Variable Sword-sedge
Lepidosperma quadrangulatum	
Lepidosperma viscidum	Sticky Sword-sedge
Ptilothrix deusta	
Schoenus apogon	Fluke Bog-rush, Common Bog-rush
Schoenus brevifolius	Zigzag Bog-rush
Schoenus villosus	Hairy Bog-rush
Dioscoreaceae	
Dioscorea transversa	Native Yam
Haemodoraceae	
Haemodorum corymbosum	
Haemodorum planifolium	Strapleaf Bloodroot
Iridaceae	
Patersonia glabrata	Native Iris, Leafy Purple-flag
Patersonia sericea	Native Iris, Silky Purple-flag
Juncaceae	
* Juncus cognatus	
Juncus continuus	
Juncus homalocaulis	
Juncus planifolius	
Juncus prismatocarpus	Branching Rush
Juncus usitatus	
Lomandraceae	
Lomandra cylindrica	Needle Mat-rush
Lomandra filiformis subsp. filiformis	Wattle Mat-rush
Lomandra glauca	Pale Mat-rush
Lomandra longifolia	Honey Reed, Spike Mat-rush
Lomandra multiflora	Many-flowered Mat-rush
Lomandra obliqua	
Orchidaceae	
Calochilus sp.	
Cryptostylis erecta	Tartan Tongue Orchid
Cryptostylis subulata	Large Tongue-orchid, Cow Orchid
Cymbidium suave	Native Cymbidium
Dipodium variegatum	Hyacinth Orchid
Orthoceras strictum	Bird's-mouth Orchid, Horned Orchid
Thelymitra pauciflora	Slender Sun Orchid
Philesiaceae	
Eustrephus latifolius	Wombat Berry
Geitonoplesium cymosum	Scrambling Lily
Philydraceae	
Philydrum lanuginosum	Woolly Waterlily, Frogmouth
Phormiaceae	
Dianella caerulea	Blue Flax-lily
Dianella revoluta	Blue Flax-lily, Spreading Flax-lily
Poaceae	
* Andropogon virginicus	Whisky Grass, Broomsedge
Anisopogon avenaceus	Oat Spear Grass
Aristida ramosa var. ramosa	Wiregrass
Aristida vagans	Wiregrass
Aristida warburgii	Wiregrass
Austrodanthonia tenuior	Wallaby Grass
Austrostipa pubescens	Speargrass

Botanical name	Common name
* Axonopus affinis	Narrow-leaved Carpet Grass
* Briza maxima	Quaking Grass
* Briza minor	Shivery Grass
Cynodon dactylon	Couch, Bermuda Grass
Deyeuxia microseta	
Deyeuxia parviseta	
Deyeuxia quadriseta	Reed Bent-grass
Dichelachne inaequiglumis	
Dichelachne micrantha	Short-haired Plume Grass
Digitaria diffusa	
Echinopogon ovatus	Forest Hedgehog Grass
* Ehrharta erecta	Annual Veld Grass
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Eragrostis brownii	Brown's Lovegrass
Hemarthria uncinata	Mat Grass
Imperata cylindrica var. major	Blady Grass
Ischaemum australe var. australe	
Lachnagrostis filiformis	
* Lolium perenne	Perennial Ryegrass
Microlaena stipoides	Weeping Grass
Oplismenus aemulus	Broad-leaved Basket Grass
Oplismenus imbecillis	Narrow-leaved Basket Grass
Panicum simile	Two-colour Panic
Paspalidium distans	
* Paspalum dilatatum	Paspalum
Paspalum orbiculare	Ditch Millet
* Paspalum urvillei	Vasey Grass
* Pennisetum clandestinum	Kikuyu
* Setaria gracilis	Slender Pigeon Grass
* Stenotaphrum secundatum	Buffalo Grass
Tetrarrhena juncea	Wiry Ricegrass
Themeda australis	Kangaroo Grass
Restionaceae	
Baloskion pallens	
Empodisma minus	Tanglefoot
Lepyrodia muelleri	
Lepyrodia scariosa	Scale-rush
Smilacaceae	
Smilax australis	Lawyer Vine, Native Sarsaparilla
Smilax glyciphylla	Sweet Sarsaparilla
Xanthorrhoeaceae	
Xanthorrhoea fulva	Swamp Grasstree
Xanthorrhoea latifolia subsp. latifolia	Grass-tree
Zingiberaceae	
* Hedychium gardnerianum	Yellow Ginger, Ginger Lily

Table 3 - Species recorded in quadrats

Notes: 1. asterisk before botanical name signifies non-native species

2. for common names see Table 2

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Pteridophytes																									
Adiantaceae																									
Adiantum aethiopicum																									
Blechnaceae																									
Blechnum cartilagineum																									
Blechnum indicum																									
Doodia aspera																									
Doodia caudata																									
Dennstaedtiaceae																									
Histiopteris incisa																									
Hypolepis muelleri																									
Pteridium esculentum					3							3							1	1					
Dicksoniaceae																									
Calochlaena dubia					2																				
Gleicheniaceae																									
Gleichenia dicarpa																									
Lindsaeaceae																									
Lindsaea linearis	3	4	1	1	1					2			1	2	1					4	1				
Lindsaea microphylla																									
Schizaeaceae																									
Schizaea bifida		1												1											
Selaginellaceae																									
Selaginella uliginosa																		1				3			
Sinopteridaceae																									
Cheilanthes sieberi subsp. sieberi																									
2. Gymnosperms																									
Pinaceae																									
* Pinus patula																									

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
3. Dicotyledons																									
Acanthaceae																									
Brunoniella pumilio		1	3	4	3	1	2	2	3			1			1	3	2	4	3	3	1		1		
Pseuderanthemum variabile																									
Anacardiaceae																									
* Anacardium occidentale																									
Apiaceae																									
Centella asiatica					1																				
Centella cordifolia																						2			
Hydrocotyle geraniifolia																									
Hydrocotyle peduncularis																		3				2			
Platysace ericoides				2		3							3	1											
Xanthosia tridentata	4	2	1		4		2	2		2									1					2	
Apocynaceae																									
Parsonsia straminea												1				1		1					1		
Araliaceae																									
Polyscias sambucifolia												2													
Asteraceae																									
* Ageratina adenophora																									
* Ambrosia sp.																									
* Bidens pilosa																									
Cassinia leptocephala																									
* Cirsium vulgare																									
* Conyza albida																									
Epaltes australis																						2			
* Erechtites valerianifolia																									
* Gnaphalium coarctatum																							1		
* Hypochoeris radicata																		1					3		
Lagenifera gracilis			2		2													1							
Ozothamnus diosmifolius																									
* Senecio madagascariensis																									
Sigesbeckia orientalis																									
* Sonchus oleraceus																									
Vernonia cinerea																									

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Caprifoliaceae																									
* Lonicera japonica																									
Casuarinaceae																									
Allocasuarina littoralis						1		4				1	3	3	1					1					
Allocasuarina torulosa					1																				
Celastraceae																									
Maytenus silvestris												1													
Clusiaceae																									
Hypericum gramineum			1																			1			
Convolvulaceae																									
Convolvulus erubescens																		1	1						
Dichondra repens																		3				3			
Polymeria calycina								2								1		1	1						
Cunoniaceae																									
Ceratopetalum gummiferum														1											
Dilleniaceae																									
Hibbertia aspera																									
Hibbertia empetrifolia																1			1						
Hibbertia scandens																									
Hibbertia vestita			3	2	1							2	1	1	4	1	1			3	2			3	1
Droseraceae																									
Drosera spatulata	1	1	2																			1			
Epacridaceae																									
Astroloma humifusum						1																			
Epacris pulchella	3	2	1	1		1	3	3	2	4		2	4	3	3	2	3		1	3	4		1	3	4
Leucopogon juniperinus	2	1	3	4	1		3		3						2		1								
Leucopogon lanceolatus																									
Leucopogon microphyllus																									
Melichrus procumbens		2							1																
Monotoca scoparia						2				1															
Euphorbiaceae																									
Breynia oblongifolia					1																				
Glochidion ferdinandi																									
Phyllanthus hirtellus					1							4		1	2	3			4						
Poranthera ericifolia		1																						3	

Botanical name	Quadrats																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Fabaceae Caesalpinioideae																										
* Senna pendula var. glabrata																										
Fabaceae Faboideae																										
Bossiaea heterophylla		3											1													
Bossiaea obcordata	1	2			2	4		1				4		1	3	4			4	4	3			3	1	
Daviesia ulicifolia																			1							
Dillwynia retorta				4	1								2	2	2	3	4		1							
Glycine clandestina												2											2			
Gompholobium glabratum																										
Gompholobium latifolium																			1							
Gompholobium pinnatum	4	4	4	2	1		4	1	4	2			3		2				1					1	1	
Gompholobium uncinatum																										
Hardenbergia violacea					1														2							
Hovea heterophylla		2				3		2		1		1							3	1						
Mirbelia rubiifolia		3					4						1	4	4	2			2		3			3	3	
Podolobium ilicifolium																										
Podolobium scandens																										
Pultenaea paleacea	4	2	4		4			1					1		1		3	1		1	4			1		
Pultenaea polifolia																										
Pultenaea retusa																										
Pultenaea tuberculata				1		2	1						4								2			2	3	
Pultenaea villosa																						1				
Sphaerolobium minus	1																									
Sphaerolobium vimineum			2			1																				
Fabaceae Mimosoideae																										
Acacia irrorata subsp. irrorata																										
Acacia longifolia										1																
Acacia myrtifolia					1																			2	2	
# Acacia podalyriifolia																										
Acacia suaveolens		2	1		1	1													1	1						
Acacia terminalis												1														
Acacia ulicifolia								3					1													
Gentianaceae																										
Centaurium spicatum																										
* Centaurium tenuiflorum																										
Geraniaceae																										
Geranium homeanum																										

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
* Pelargonium (Zonal hybrid)																									
Goodeniaceae																									
Dampiera stricta	4	4	3	2	1	1	2		3	2		4		4	4	1			1	3				1	2
Goodenia bellidifolia	1		4	2		3	2		3	4			2			1	2		1		1	1		1	2
Goodenia heterophylla subsp. eglandulosa				1					1	1		1	4		2	1	2	1	2			1			
Goodenia ovata																									
Goodenia paniculata																						3			
Scaevola ramosissima		1				1													1	1					2
Haloragaceae																									
Gonocarpus micranthus subsp. micranthus																						4			
Gonocarpus tetragynus	2		4	2	4		4	1	4			1		2	3	2	3	1				4			
Lauraceae																									
Cassytha glabella	4	3	3	1	1	2	3	2	4			2	1	3	4	3	1	2	4	4	3			1	
Cassytha pubescens												2		2		1	1								
* Cinnamomum camphora																1			1				2		
Lobeliaceae																									
Isotoma fluviatilis subsp. fluviatilis																									
Lobelia alata																						1			
Pratia purpurascens					4											1		3	2						
Loganiaceae																									
Logania pusilla				2			1							1			1							1	
Mitrasacme alsinoides																									
Mitrasacme polymorpha	3	2	2			1								1											
Loranthaceae																									
Dendrophthoe vitellina						1																			
Malvaceae																									
* Modiola caroliniana																									
* Sida rhombifolia																									
Menispermaceae																									
Stephania japonica																									
Menyanthaceae																									
Villarsia exaltata																									
Myrtaceae																									
Acmena smithii																									
Angophora costata				1	4	1		3	1			1		3	3	4	2	1							

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Angophora floribunda																									
Angophora inopina	4	2	4					3		2			3						1	4	3			3	1
Babingtonia pluriflora						1																			
Babingtonia similis																									
Callistemon citrinus																									
Callistemon linearis								1														4			
Callistemon salignus												2		1				1				1			
Corymbia gummifera	1	4		4	2	4	4	4	3	1			4	4	4	4	3		4	1	4		4	4	3
Eucalyptus amplifolia																									
Eucalyptus capitellata		2	4	3	3	2	2	3	1	1		1	1	3	1	4	4		4	4	4		3	2	2
Eucalyptus globoidea														2											
Eucalyptus haemastoma	4	3	2	3		3	3	2	1	4		1	3	4	3	2	3		3	3	3		3	3	1
Eucalyptus pilularis																									
Eucalyptus resinifera subsp. resinifera			2		4			4	1			1		2											
Eucalyptus robusta																		1				3			
Eucalyptus saligna																									
Leptospermum juniperinum																						4			
Leptospermum polygalifolium subsp. cismont	3	3	3		4	1						1		2	1		1			3	2	2			2
Leptospermum trinervium	4	4	4		3	3	4	3	4	4		1	4	4	1	1	2		1	4	3			1	2
Melaleuca linariifolia			1		3													4				4			
Melaleuca nodosa			3		2															3		2			
Melaleuca sieberi	1		4					1	1									1				3			
Melaleuca thymifolia			3																			4			
Syncarpia glomulifera																									
Ochnaceae																									
* Ochna serrulata																									
Oleaceae																									
* Ligustrum lucidum																									
* Ligustrum sinense																									
Notelaea longifolia																									
Oxalidaceae																									
Oxalis exilis					2													3							
Passifloraceae																									
* Passiflora edulis																									
Phytolaccaceae																									
* Phytolacca octandra																									

Botanical name	Quadrats																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Pittosporaceae																										
Billardiera scandens					1							4		2		1			1	2						
Pittosporum revolutum												1														
Rhytidosporum procumbens														1												
Plantaginaceae																										
* Plantago lanceolata																										
Polygalaceae																										
Comesperma ericinum								2		2									1							
Comesperma sphaerocarpum				2									1													
Polygonaceae																										
Persicaria decipiens																										
Proteaceae																										
Banksia oblongifolia	4	4	4	2						2			2				2			2	1				1	
Banksia robur																										
Banksia serrata																										
Banksia spinulosa var. collina			4	3	4		2	2	4	1		1	1	4	3	3	4		1	4	4			1	1	
Grevillea linearifolia		2	4						3					1												
Grevillea parviflora subsp. parviflora	3				3							4			3											
# Grevillea robusta																										
Grevillea sericea		3								1			2			4	2		2	1				1	4	
Hakea bakeriana		4				1			2											1	4					
Hakea gibbosa																				4						
Hakea laevipes subsp. laevipes	1	3				1	1		2	4			2		1				1	1	3			1	3	
Hakea sericea																										
Isopogon anemonifolius		4		2		4		1		3			4											1		
Lambertia formosa	1	4		3		4	4	1	1	4			2		3	4	1		4	1	4			3	2	
Lomatia silaifolia					1	1						2		1												
Persoonia levis	2	1		1		1				2		1	1	1	2	2	2		4	1	3			1		
Persoonia linearis																									1	
Petrophile pulchella																										
Ranunculaceae																										
Clematis aristata																			2							
Clematis glycinoides																										
Rhamnaceae																										
Alphitonia excelsa																										
Pomaderris elliptica																										

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Rosaceae																									
* Rubus bellobatus																									
Rubiaceae																									
Morinda jasminoides																									
Opercularia diphylla																									
Opercularia hispida				1			1																		
Opercularia varia			3		1		3		2									1							
Pomax umbellata																									
* Richardia humistrata																									
* Richardia stellaris																							1		
Rutaceae																									
Boronia polygalifolia														2		2									
Melicope micrococca																									
Sapindaceae																									
Dodonaea triquetra								2				1							1						
Scrophulariaceae																									
Veronica plebeia																									
Solanaceae																									
Duboisia myoporoides																									
* Solanum mauritianum																									
* Solanum nigrum																									
* Solanum pseudocapsicum																									
Stylidiaceae																									
Stylidium graminifolium																									
Thymelaeaceae																									
Pimelea linifolia	3	2	2	2		1	4		2								1		1		4			4	4
Tremandraceae																									
Tetratheca juncea												X2							X2	1					
Urticaceae																									
Urtica incisa																									
Verbenaceae																									
Clerodendrum tomentosum																									
* Lantana camara																									

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Violaceae																									
Hybanthus enneaspermus subsp. enneasper																									
Hybanthus monopetalus						3			2						3	3			4		1				
Viola hederacea																		1				1			
4. Monocotyledons																									
Anthericaceae																									
Arthropodium milleflorum																									
Caesia parviflora			1														1		1			1			
Caesia parviflora var. parviflora				1			1							1									1		
Thysanotus juncifolius	2	1	1						1				1	1											
Tricoryne elatior																									
Tricoryne simplex		1														1					1			1	
Araceae																									
* Alocasia odora																									
Gymnostachys anceps																									
Asparagaceae																									
* Asparagus aethiopicus																									
Blandfordiaceae																									
Blandfordia grandiflora																									
Cannaceae																									
* Canna indica																									
Colchicaceae																									
Burchardia umbellata																									
Commelinaceae																									
Aneilema biflorum																									
Commelina cyanea																									
* Tradescantia albiflora																									
Cyperaceae																									
Baumea articulata																									
Baumea rubiginosa																		1				4			
Baumea tetragona																									
Carex breviculmis																									
Carex gaudichaudiana																									
Carex longebrachiata																									

Botanical name	Quadrats																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Chorizandra cymbaria					2																	1				
Cyathochaeta diandra	4	4	3	2		4	1		2	2			3			1	3	1		1	2		1	4	4	
* Cyperus aggregatus																										
Cyperus brevifolius																										
* Cyperus eragrostis																										
Cyperus polystachyos																										
Cyperus sphaeroideus																										
Eleocharis gracilis																										
Fimbristylis dichotoma																										
Gahnia clarkei			1		1				1			1						4				3				
Gahnia radula								4																		
Isolepis inundata																										
* Isolepis prolifera																										
Lepidosperma laterale (narrow leaved form)					2									4												
Lepidosperma quadrangulatum																						4				
Lepidosperma viscidum	3	4				2	3		2	4		3	4		4	3	3		4	2	3			2	4	
Ptilothrix deusta	4	3	4	4		4	4	4	4	4		2	4	3	3	4	4		2	3	4			4	4	
Schoenus apogon					2																		2			
Schoenus brevifolius																										
Schoenus villosus	?																									
Dioscoreaceae																										
Dioscorea transversa																										
Haemodoraceae																										
Haemodorum corymbosum	2																									
Haemodorum planifolium			1						1																2	
Iridaceae																										
Patersonia glabrata		1		3					1	3		1	2	3	4	4	4		4	4	2					
Patersonia sericea	1	3		4		3		1	1	4			2			2			2		1		1	3	1	
Juncaceae																										
* Juncus cognatus																			1							
Juncus continuus																										
Juncus homalocaulis																										
Juncus planifolius																										
Juncus prismatocarpus																										
Juncus usitatus																										
Lomandraceae																										
Lomandra cylindrica		2	1		1									1												

Botanical name	Quadrats																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Lomandra filiformis subsp. filiformis	2	1	2	4			1		1	1			3				1				1		4	1	2	
Lomandra glauca	1		2	1			2																		1	
Lomandra longifolia			1		3																					
Lomandra multiflora	2	2		1			2		4	2				1	1	1	1		1	1	2		1	3	3	
Lomandra obliqua	2	4	2	4		2	4		3	4		4	4	4	4	3	2		4	3	4		1	4	4	
Orchidaceae																										
Calochilus sp.													1													
Cryptostylis erecta														2												
Cryptostylis subulata																										
Cymbidium suave																	1									
Dipodium variegatum							1																			
Orthoceras strictum						1										2										
Thelymitra pauciflora																										
Philesiaceae																										
Eustrephus latifolius																										
Geitonoplesium cymosum																										
Philydraceae																										
Philydrum lanuginosum																										
Phormiaceae																										
Dianella caerulea					2							1			1	1		2	1							
Dianella revoluta																	1									
Poaceae																										
* Andropogon virginicus																								1	2	
Anisopogon avenaceus																										
Aristida ramosa var. ramosa																							2			
Aristida vagans				1			2	1	1												1		3			
Aristida warburgii		1		1						3														1		
Austrodanthonia tenuior												1		1		1							3		1	
Austrostipa pubescens	3	4		4		3	4	3	4	4		3	4	3	1	3	3		4	3	4			4	4	
* Axonopus affinis																			1			1	1		2	
* Briza maxima																										
* Briza minor																										
Cynodon dactylon																										
Deyeuxia microseta																										
Deyeuxia parviseta					1													1								
Deyeuxia quadriseta																						3				
Dichelachne inaequiglumis					1																	1				

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Dichelachne micrantha																									
Digitaria diffusa					1													3							
Echinopogon ovatus																							1		
* Ehrharta erecta																									
Entolasia marginata																									
Entolasia stricta	3	4	3	4	3	4	4	4	4	4		4	4	4	4	4	4	4	4	4	4	2	4	4	4
Eragrostis brownii																		1							2
Hemarthria uncinata					3													1				4			
Imperata cylindrica var. major					4							4			1			3							
Ischaemum australe var. australe					2																	4			
Lachnagrostis filiformis																						1	1		
* Lolium perenne																									1
Microlaena stipoides					1		3		1			1		1		3	1	4		1			2	1	3
Oplismenus aemulus																									
Oplismenus imbecillis																									
Panicum simile	3	2	4		1					1				1	1	1	1	1	1			2	1		2
Paspalidium distans																							1		
* Paspalum dilatatum																						1			
Paspalum orbiculare																									
* Paspalum urvillei																									
* Pennisetum clandestinum																									
* Setaria gracilis																									
* Stenotaphrum secundatum																							4		
Tetrarrhena juncea																									
Themeda australis			4	2	3		4	2	4	1		3		4	4	4			4	2	3		1		4
Restionaceae																									
Baloskion pallens																						2			
Empodisma minus																									
Lepyrodia muelleri																						2			
Lepyrodia scariosa	4	1	4		1									1						2	3				
Smilacaceae																									
Smilax australis																									
Smilax glyciphylla												1													
Xanthorrhoeaceae																									
Xanthorrhoea fulva																									
Xanthorrhoea latifolia subsp. latifolia	3	4	4	4	1	4	4	3	4	3		3	4	4	3		4		2	4				3	4

Botanical name	Quadrats																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Zingiberaceae																									
* Hedychium gardnerianum																									

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
1. Pteridophytes																									
Adiantaceae																									
Adiantum aethiopicum																2	2								
Blechnaceae																									
Blechnum cartilagineum																									
Blechnum indicum							3																		
Doodia aspera															1										
Doodia caudata																									
Dennstaedtiaceae																									
Histiopteris incisa																									
Hypolepis muelleri								4																	
Pteridium esculentum					2		4	2				1				3	1		3						
Dicksoniaceae																									
Calochlaena dubia		1					1	2																	
Gleicheniaceae																									
Gleichenia dicarpa		4										3													
Lindsaeaceae																									
Lindsaea linearis	3		1	1	4				3	3	4		4	3				1	4	3					
Lindsaea microphylla						1																			
Schizaeaceae																									
Schizaea bifida						1																			
Selaginellaceae																									
Selaginella uliginosa		3																							
Sinopteridaceae																									
Cheilanthes sieberi subsp. sieberi																									
2. Gymnosperms																									
Pinaceae																									
* Pinus patula																									
3. Dicotyledons																									
Acanthaceae																									
Brunoniella pumilio	3			2	3				3		4			3	4		3		2						

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
Pseuderanthemum variabile																4	2								
Anacardiaceae																									
* Anacardium occidentale																									
Apiaceae																									
Centella asiatica		3					1										3								
Centella cordifolia																									
Hydrocotyle geraniifolia																									
Hydrocotyle peduncularis		4						2																	
Platysace ericoides			1																						
Xanthosia tridentata																		2							
Apocynaceae																									
Parsonsia straminea	3	1					2	2											1						
Araliaceae																									
Polyscias sambucifolia																4	1	1							
Asteraceae																									
* Ageratina adenophora								1																	
* Ambrosia sp.																									
* Bidens pilosa																									
Cassinia leptocephala																									
* Cirsium vulgare																									
* Conyza albida		1																							
Epaltes australis		1						1																	
* Erechtites valerianifolia		1						3																	
* Gnaphalium coarctatum																									
* Hypochoeris radicata																									
Lagenifera gracilis											1														
Ozothamnus diosmifolius																3		1							
* Senecio madagascariensis		1																							
Sigesbeckia orientalis																									
* Sonchus oleraceus																									
Vernonia cinerea								1								1									
Caprifoliaceae																									
* Lonicera japonica																									
Casuarinaceae																									
Allocasuarina littoralis						1			4		4					3			4						
Allocasuarina torulosa																	1								

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
Celastraceae																									
Maytenus silvestris																1	1								
Clusiaceae																									
Hypericum gramineum	1	1																				1			
Convolvulaceae																									
Convolvulus erubescens																	3								
Dichondra repens																	3								
Polymeria calycina															1										
Cunoniaceae																									
Ceratopetalum gummiferum																									
Dilleniaceae																									
Hibbertia aspera																									
Hibbertia empetrifolia	3																								
Hibbertia scandens		1															2								
Hibbertia vestita			1																						
Droseraceae																									
Drosera spatulata		3										3													
Epacridaceae																									
Astroloma humifusum																									
Epacris pulchella	1		4	3		4			1	4	2		3	3	4			4	4	3	3	2			
Leucopogon juniperinus	1																								
Leucopogon lanceolatus																1									
Leucopogon microphyllus																									
Melichrus procumbens						1																			
Monotoca scoparia						2																			
Euphorbiaceae																									
Breynia oblongifolia																2	3								
Glochidion ferdinandi																	3								
Phyllanthus hirtellus	3								1										1						
Poranthera ericifolia						1																			
Fabaceae Caesalpinioideae																									
* Senna pendula var. glabrata																	1								
Fabaceae Faboideae																									
Bossiaea heterophylla			1	1									2	2						2	1				
Bossiaea obcordata			1	3		4				3						3	3	3	2	1	3				

Botanical name	Quadrats																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47				
Daviesia ulicifolia																										
Dillwynia retorta	1					1							1						3		2					
Glycine clandestina																3	3									
Gompholobium glabratum										1																
Gompholobium latifolium																1		2			1					
Gompholobium pinnatum	1		1	2							1				1						1	4				
Gompholobium uncinatum						1																				
Hardenbergia violacea																1		2								
Hovea heterophylla						1				1								3								
Mirbelia rubiifolia	4		2			3					4								2							
Podolobium ilicifolium																1				1						
Podolobium scandens																										
Pultenaea paleacea			2	2	2							1		4	1					4	4					
Pultenaea polifolia																										
Pultenaea retusa		2													1											
Pultenaea tuberculata			3																		2					
Pultenaea villosa		1						1								1										
Sphaerolobium minus																										
Sphaerolobium vimineum																										
Fabaceae Mimosoideae																										
Acacia irrorata subsp. irrorata							1									4	2									
Acacia longifolia															1											
Acacia myrtifolia																										
# Acacia podalyriifolia																										
Acacia suaveolens																										
Acacia terminalis																1										
Acacia ulicifolia																										
Gentianaceae																										
Centaurium spicatum																										
* Centaurium tenuiflorum																										
Geraniaceae																										
Geranium homeanum																										
* Pelargonium (Zonal hybrid)																										
Goodeniaceae																										
Dampiera stricta	2			4	2			4	1	1	4			2	1			1		4						
Goodenia bellidifolia	2		2	2						1	1											1				
Goodenia heterophylla subsp. eglandulosa					3			2	1		2	2		2	3					1						

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
Goodenia ovata																									
Goodenia paniculata																									
Scaevola ramosissima													2												
Haloragaceae																									
Gonocarpus micranthus subsp. micranthus		3						1																	
Gonocarpus tetragynus					4			2	2		1	4		2	4				4	1					
Lauraceae																									
Cassytha glabella	4			2	4	1			3		3	3	3	3	1			1		3	2	4			
Cassytha pubescens													1			1									
* Cinnamomum camphora		4						1									2								
Lobeliaceae																									
Isotoma fluviatilis subsp. fluviatilis		1																							
Lobelia alata		1																							
Pratia purpurascens	3							1							1		3								
Loganiaceae																									
Logania pusilla	2										2								2						
Mitrasacme alsinoides		1																							
Mitrasacme polymorpha									1	2															
Loranthaceae																									
Dendrophthoe vitellina																									
Malvaceae																									
* Modiola caroliniana																									
* Sida rhombifolia																									
Menispermaceae																									
Stephania japonica																									
Menyanthaceae																									
Villarsia exaltata		2					1																		
Myrtaceae																									
Acmena smithii																									
Angophora costata	3		1	1	3				2		3	1			4	1		4	4	2					
Angophora floribunda																	1								
Angophora inopina						1						2	4	1				2		3	4	2			
Babingtonia pluriflora																									
Babingtonia similis				1																					
Callistemon citrinus												4													

Botanical name	Quadrats																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47				
Callistemon linearis												1							1							
Callistemon salignus		1														3	4									
Corymbia gummifera	4		3	4		2			3	2	3		4	3	1			3	1	3	4	3				
Eucalyptus amplifolia																										
Eucalyptus capitellata	3		2	4	4	4			2	2	2		1	2	2			1	4		3					
Eucalyptus globoidea																					2					
Eucalyptus haemastoma	1		3	3		4				4	3		4				1	2	2	4	1	4				
Eucalyptus pilularis																4	2									
Eucalyptus resinifera subsp. resinifera								4				4														
Eucalyptus robusta		2					4	1																		
Eucalyptus saligna																	2									
Leptospermum juniperinum		3						1				4														
Leptospermum polygalifolium subsp. cismont	4			4	4			2	3		3	4		4	2		1		4	4						
Leptospermum trinervium			4	3	4	1			3	4	4	1	4	4	1			2	2	2		4				
Melaleuca linariifolia		1			1		4					2							2							
Melaleuca nodosa								4							3	2	3									
Melaleuca sieberi		4			3		1	2			1	4		4	2					1						
Melaleuca thymifolia		1			1			1				4		4												
Syncarpia glomulifera																										
Ochnaceae																										
* Ochna serrulata																										
Oleaceae																										
* Ligustrum lucidum		1																								
* Ligustrum sinense																	3									
Notelaea longifolia																	1									
Oxalidaceae																										
Oxalis exilis																	1									
Passifloraceae																										
* Passiflora edulis																										
Phytolaccaceae																										
* Phytolacca octandra																										
Pittosporaceae																										
Billardiera scandens	2		1	2		2							1			4		2	4		2					
Pittosporum revolutum																3	1									
Rhytidosporum procumbens									1																	

Botanical name	Quadrats																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47				
Plantaginaceae																										
* Plantago lanceolata																										
Polygalaceae																										
Comesperma ericinum																		1								
Comesperma sphaerocarpum																										
Polygonaceae																										
Persicaria decipiens								1																		
Proteaceae																										
Banksia oblongifolia			2		3					4	3	3	3	3					1	4	3	4				
Banksia robur																										
Banksia serrata																		2								
Banksia spinulosa var. collina	3			4	4				4		4		2	4	4			1	4	1	2	3				
Grevillea linearifolia																										
Grevillea parviflora subsp. parviflora					1									1	2											
# Grevillea robusta																										
Grevillea sericea	1													2												
Hakea bakeriana				1	2	1					1		2	1												
Hakea gibbosa																										
Hakea laevipes subsp. laevipes	2		3	3						3	4		3							1	1	4				
Hakea sericea																			4							
Isopogon anemonifolius			4	1						4	1		4								1	1				
Lambertia formosa	4		4		1	1				3			4					1		1	2	3				
Lomatia silaifolia																										
Persoonia levis	4			1									1													
Persoonia linearis																		1								
Petrophile pulchella																		1		2	2					
Ranunculaceae																										
Clematis aristata																										
Clematis glycinoides																										
Rhamnaceae																										
Alphitonia excelsa																										
Pomaderris elliptica																?4										
Rosaceae																										
* Rubus bellobatus		3					1									1	1									

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
Rubiaceae																									
Morinda jasminoides																1	2								
Opercularia diphylla																	1								
Opercularia hispida																									
Opercularia varia																									
Pomax umbellata																		2							
* Richardia humistrata																									
* Richardia stellaris																									
Rutaceae																									
Boronia polygalifolia																									
Melicope micrococca																									
Sapindaceae																									
Dodonaea triquetra																4									
Scrophulariaceae																									
Veronica plebeia						1																			
Solanaceae																									
Duboisia myoporoides																									
* Solanum mauritianum																									
* Solanum nigrum																									
* Solanum pseudocapsicum																									
Stylidiaceae																									
Stylidium graminifolium																									
Thymelaeaceae																									
Pimelea linifolia						1												1		1	1				
Tremandraceae																									
Tetratheca juncea																									
Urticaceae																									
Urtica incisa																									
Verbenaceae																									
Clerodendrum tomentosum																									
* Lantana camara																									
Violaceae																									
Hybanthus enneaspermus subsp. enneasper																									
Hybanthus monopetalus	1																								

Botanical name	Quadrats																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47				
Viola hederacea		3																								
4. Monocotyledons																										
Anthericaceae																										
Arthropodium milleflorum																	1									
Caesia parviflora		1				1							1													
Caesia parviflora var. parviflora																										
Thysanotus juncifolius														1												
Tricoryne elatior														1												
Tricoryne simplex	1																									
Araceae																										
* Alocasia odora																										
Gymnostachys anceps																										
Asparagaceae																										
* Asparagus aethiopicus																										
Blandfordiaceae																										
Blandfordia grandiflora						1						1														
Cannaceae																										
* Canna indica																										
Colchicaceae																										
Burchardia umbellata																										
Commelinaceae																										
Aneilema biflorum																										
Commelina cyanea																										
* Tradescantia albiflora																										
Cyperaceae																										
Baumea articulata							1	1																		
Baumea rubiginosa		1						4				4														
Baumea tetragona																										
Carex breviculmis															1											
Carex gaudichaudiana							2	1																		
Carex longebrachiata																	1									
Chorizandra cymbaria							2					2														
Cyathochaeta diandra			1	2		2				4	2		4	1	4			2		2	2	3				
* Cyperus aggregatus																										
Cyperus brevifolius		1						1																		

Botanical name	Quadrats																										
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47					
* Cyperus eragrostis																											
Cyperus polystachyos								2																			
Cyperus sphaeroideus								1																			
Eleocharis gracilis		4																									
Fimbristylis dichotoma																											
Gahnia clarkei		4			1		4	4				4		2	1	2	3		2								
Gahnia radula															1												
Isolepis inundata								3																			
* Isolepis prolifera		1?																									
Lepidosperma laterale (narrow leaved form)											1						1		4			1					
Lepidosperma quadrangulatum																											
Lepidosperma viscidum	1		4	4		2			3	4	1		4	1	3	3		1	3	4	4	3					
Ptilothrix deusta	4		4	4	2						4		3							4	4	4					
Schoenus apogon		3						1																			
Schoenus brevifolius												1															
Schoenus villosus																											
Dioscoreaceae																											
Dioscorea transversa																											
Haemodoraceae																											
Haemodorum corymbosum																											
Haemodorum planifolium																											
Iridaceae																											
Patersonia glabrata	1		3	3		3			1	1	3		3							1		1					
Patersonia sericea			1			3				4			2					3		1	1	1					
Juncaceae																											
* Juncus cognatus		1																									
Juncus continuus																											
Juncus homalocaulis																											
Juncus planifolius		3						3																			
Juncus prismatocarpus		2																									
Juncus usitatus								1																			
Lomandraceae																											
Lomandra cylindrica															1												
Lomandra filiformis subsp. filiformis			1			3		1							1	3			2		1						
Lomandra glauca																				3	1						
Lomandra longifolia															1	4	2										
Lomandra multiflora	1		1						1												1						

Botanical name	Quadrats																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47				
Lomandra obliqua	4		4		1	3			3	2	3		3	2	1	1		2	4	3	4	4				
Orchidaceae																										
Calochilus sp.																										
Cryptostylis erecta											4															
Cryptostylis subulata	2													2							1					
Cymbidium suave																										
Dipodium variegatum													1													
Orthoceras strictum																										
Thelymitra pauciflora		2																								
Philesiaceae																										
Eustrephus latifolius																4	1									
Geitonoplesium cymosum																										
Philydraceae																										
Philydrum lanuginosum		1																								
Phormiaceae																										
Dianella caerulea	1					1			1						3	3	2	1	3							
Dianella revoluta					1																					
Poaceae																										
* Andropogon virginicus		4				4															1					
Anisopogon avenaceus													1													
Aristida ramosa var. ramosa																					1					
Aristida vagans						2									1			1			3					
Aristida warburgii						1															2					
Austrodanthonia tenuior	1																									
Austrostipa pubescens	4		4	4	2	2			2	4	3		3	1							4	4				
* Axonopus affinis		4																								
* Briza maxima																										
* Briza minor																										
Cynodon dactylon							1																			
Deyeuxia microseta																										
Deyeuxia parviseta		1																								
Deyeuxia quadriseta								1							?1											
Dichelachne inaequiglumis		4																								
Dichelachne micrantha																										
Digitaria diffusa																										
Echinopogon ovatus																	3									
* Ehrharta erecta																										

Botanical name	Quadrats																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
Entolasia marginata							2	1	2																
Entolasia stricta	4		4	4	4	4		4	4	4	4	4	4	4	4	4	4	4	4	3	4	3			
Eragrostis brownii				1		2										1		1							
Hemarthria uncinata		3					1	4	1			2													
Imperata cylindrica var. major	1				1	1		3				1		1	4	4	4		1						
Ischaemum australe var. australe		1						1																	
Lachnagrostis filiformis		1						2																	
* Lolium perenne																									
Microlaena stipoides		1			1	2			1		1			3		1					1				
Oplismenus aemulus																	2								
Oplismenus imbecillis							1																		
Panicum simile	1					1														1	1	1			
Paspalidium distans		1														1	1								
* Paspalum dilatatum		4																							
Paspalum orbiculare		1																							
* Paspalum urvillei																									
* Pennisetum clandestinum																									
* Setaria gracilis																									
* Stenotaphrum secundatum																									
Tetrarrhena juncea						1																			
Themeda australis	4			4	2				2					4	3	1		4			1				
Restionaceae																									
Baloskion pallens																									
Empodisma minus					1							2													
Lepyrodia muelleri																									
Lepyrodia scariosa				1	3						4	1	2	4						4		4			
Smilacaceae																									
Smilax australis																									
Smilax glyciphylla																2									
Xanthorrhoeaceae																									
Xanthorrhoea fulva																									
Xanthorrhoea latifolia subsp. latifolia	4		4	4	2	4			4	4	4		4	4				4	4	4	4	4			
Zingiberaceae																									
* Hedychium gardnerianum																									

Table 4 - Species recorded in spot locations

Notes: 1. asterisk before botanical name signifies non-native species

2. for common names see Table 2

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1. Pteridophytes																										
Adiantaceae																										
Adiantum aethiopicum																					X	X				
Blechnaceae																										
Blechnum cartilagineum																										
Blechnum indicum																										
Doodia aspera																										
Doodia caudata																						X				
Dennstaedtiaceae																										
Histiopteris incisa													X													
Hypolepis muelleri																										
Pteridium esculentum	X		X	X									X								X					
Dicksoniaceae																										
Calochlaena dubia													X													
Gleicheniaceae																										
Gleichenia dicarpa								X					X		X											
Lindsaeaceae																										
Lindsaea linearis	X		X											X			X							X	X	
Lindsaea microphylla															X											
Schizaeaceae																										
Schizaea bifida			X																							
Selaginellaceae																										
Selaginella uliginosa						X		X																		
Sinopteridaceae																										
Cheilanthes sieberi subsp. sieberi																										
2. Gymnosperms																										
Pinaceae																										
* Pinus patula																										

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
3. Dicotyledons																									
Acanthaceae																									
Brunoniella pumilio				X					X	X														X	X	
Pseuderanthemum variabile																						X				
Anacardiaceae																									
* Anacardium occidentale																									
Apiaceae																									
Centella asiatica		X													X					X						
Centella cordifolia								X					X													
Hydrocotyle geraniifolia																									
Hydrocotyle peduncularis				X		X		X													X		X		
Platysace ericoides					X?																				
Xanthosia tridentata	X																							X	X
Apocynaceae																									
Parsonsia straminea								X																	
Araliaceae																									
Polyscias sambucifolia			X																						
Asteraceae																									
* Ageratina adenophora																									
* Ambrosia sp.																				X					
* Bidens pilosa																				X					
Cassinia leptocephala												X													
* Cirsium vulgare																				X					
* Conyza albida																									
Epaltes australis						X														X					
* Erechtites valerianifolia																									
* Gnaphalium coarctatum																									
* Hypochoeris radicata	X	X							X	X										X		X			
Lagenifera gracilis						X																			
Ozothamnus diosmifolius															X						X				
* Senecio madagascariensis																				X	X		X		
Sigesbeckia orientalis																					X				
* Sonchus oleraceus																					X				
Vernonia cinerea										X															

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Caprifoliaceae																										
* Lonicera japonica																										
Casuarinaceae																										
Allocasuarina littoralis			X	X												X		X	X						X	X
Allocasuarina torulosa																										
Celastraceae																										
Maytenus silvestris																										
Clusiaceae																										
Hypericum gramineum																				X						
Convolvulaceae																										
Convolvulus erubescens																										
Dichondra repens				X											X						X	X	X			
Polymeria calycina																										
Cunoniaceae																										
Ceratopetalum gummiferum																										
Dilleniaceae																										
Hibbertia aspera																										
Hibbertia empetrifolia																										
Hibbertia scandens																										
Hibbertia vestita		X	X												X											
Droseraceae																										
Drosera spatulata												X	X													
Epacridaceae																										
Astroloma humifusum																										
Epacris pulchella	X	X	X		X				X			X	X	X	X	X			X					X	X	X
Leucopogon juniperinus					X									X												
Leucopogon lanceolatus																										
Leucopogon microphyllus																										
Melichrus procumbens															X											
Monotoca scoparia																										
Euphorbiaceae																										
Breynia oblongifolia																					X	X				
Glochidion ferdinandi																										
Phyllanthus hirtellus			X																							
Poranthera ericifolia																										

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Fabaceae Caesalpinioideae																										
* Senna pendula var. glabrata																										
Fabaceae Faboideae																										
Bossiaea heterophylla																								X		
Bossiaea obcordata		X	X		X		X			X		X				X	X									X
Daviesia ulicifolia																										X
Dillwynia retorta					X																					
Glycine clandestina				X																	X					X
Gompholobium glabratum																										
Gompholobium latifolium																								X		
Gompholobium pinnatum		X												X												X
Gompholobium uncinatum																										
Hardenbergia violacea					X		X																			
Hovea heterophylla																		X								
Mirbelia rubiifolia					X		X												X					X	X	
Podolobium ilicifolium																										
Podolobium scandens																	X									
Pultenaea paleacea												X	X	X										X		
Pultenaea polifolia				X																						
Pultenaea retusa																										
Pultenaea tuberculata																										
Pultenaea villosa																										
Sphaerolobium minus																										
Sphaerolobium vimineum																										
Fabaceae Mimosoideae																										
Acacia irrorata subsp. irrorata																					X					
Acacia longifolia														X	X											
Acacia myrtifolia																										
# Acacia podalyriifolia															X											
Acacia suaveolens														X	X											
Acacia terminalis																										
Acacia ulicifolia												X														
Gentianaceae																										
Centaurium spicatum						X																				
* Centaurium tenuiflorum																				X						
Geraniaceae																										
Geranium homeanum																					X		X			

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
* Pelargonium (Zonal hybrid)																										
Goodeniaceae																										
Dampiera stricta	X	X	X									X	X	X					X					X	X	X
Goodenia bellidifolia		X																						X		X
Goodenia heterophylla subsp. eglandulosa																										
Goodenia ovata																					X					
Goodenia paniculata						X							X													
Scaevola ramosissima																								X		
Haloragaceae																										
Gonocarpus micranthus subsp. micranthus								X																		
Gonocarpus tetragynus			X	X				X					X													X
Lauraceae																										
Cassytha glabella	X	X	X		X					X		X					X							X	X	
Cassytha pubescens	X														X											
* Cinnamomum camphora									X	X												X				
Lobeliaceae																										
Isotoma fluviatilis subsp. fluviatilis																										
Lobelia alata																										
Pratia purpurascens			X																			X	X			
Loganiaceae																										
Logania pusilla																								X		
Mitrasacme alsinoides																										
Mitrasacme polymorpha																								X		
Loranthaceae																										
Dendrophthoe vitellina																										
Malvaceae																										
* Modiola caroliniana																				X						
* Sida rhombifolia																				X	X		X			
Menispermaceae																										
Stephania japonica																					X					
Menyanthaceae																										
Villarsia exaltata																										
Myrtaceae																										
Acmena smithii																					X	X				
Angophora costata			X	X	X		X												X							X

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Angophora floribunda																										
Angophora inopina									X			X	X	X											X	
Babingtonia pluriflora																										
Babingtonia similis																										
Callistemon citrinus													X													
Callistemon linearis																									X	
Callistemon salignus	X			X																	X					
Corymbia gummifera	X			X	X		X		X	X						X		X	X					X		X
Eucalyptus amplifolia																										
Eucalyptus capitellata	X		X						X	X				X			X		X					X	X	X
Eucalyptus globoidea																										
Eucalyptus haemastoma	X				X				X	X		X		X		X	X	X	X					X	X	X
Eucalyptus pilularis																					X		X			
Eucalyptus resinifera subsp. resinifera													X													
Eucalyptus robusta				X																						
Eucalyptus saligna																					X	X	X			
Leptospermum juniperinum				X									X													
Leptospermum polygalifolium subsp. cismont		X	X	X	X							X	X	X	X		X	X	X					X	X	X
Leptospermum trinervium	X		X						X			X		X				X	X						X	
Melaleuca linariifolia	X			X				X																		
Melaleuca nodosa						X		X																X		
Melaleuca sieberi								X				X	X	X	X										X	X
Melaleuca thymifolia								X					X													
Syncarpia glomulifera							X														X	X				
Ochnaceae																										
* Ochna serrulata																										
Oleaceae																										
* Ligustrum lucidum																										
* Ligustrum sinense																					X	X				
Notelaea longifolia																										
Oxalidaceae																										
Oxalis exilis																				X	X	X	X			
Passifloraceae																										
* Passiflora edulis																										
Phytolaccaceae																										
* Phytolacca octandra																				X			X			

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Pittosporaceae																										
Billardiera scandens															X									X		
Pittosporum revolutum																										
Rhytidosporum procumbens																										
Plantaginaceae																										
* Plantago lanceolata																										
Polygalaceae																										
Comesperma ericinum																X										
Comesperma sphaerocarpum																								X		
Polygonaceae																										
Persicaria decipiens																										
Proteaceae																										
Banksia oblongifolia													X	X			X	X	X					X		
Banksia robur													X													
Banksia serrata																										
Banksia spinulosa var. collina	X		X		X							X		X			X	X	X					X		X
Grevillea linearifolia			X										X													
Grevillea parviflora subsp. parviflora	X	X										X														
# Grevillea robusta																										
Grevillea sericea														X												
Hakea bakeriana												X		X			X									
Hakea gibbosa																										
Hakea laevipes subsp. laevipes														X		X		X						X		
Hakea sericea					X																					
Isopogon anemonifolius					X											X	X	X						X		
Lambertia formosa					X		X					X		X		X		X								
Lomatia silaifolia	X																									
Persoonia levis			X		X		X										X									
Persoonia linearis			X																							
Petrophile pulchella																										
Ranunculaceae																										
Clematis aristata													X													
Clematis glycinoides																										
Rhamnaceae																										
Alphitonia excelsa																					X					
Pomaderris elliptica																										

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Rosaceae																										
* Rubus bellobatus															X						X					
Rubiaceae																										
Morinda jasminoides																						X				
Opercularia diphylla																										
Opercularia hispida																										X
Opercularia varia						X				X																
Pomax umbellata																										
* Richardia humistrata																				X						
* Richardia stellaris															X											
Rutaceae																										
Boronia polygalifolia																										
Melicope micrococca																						X				
Sapindaceae																										
Dodonaea triquetra			X																		X				X	
Scrophulariaceae																										
Veronica plebeia																										
Solanaceae																										
Duboisia myoporoides																					X	X				
* Solanum mauritianum																				X	X					
* Solanum nigrum																										
* Solanum pseudocapsicum																						X				
Stylidiaceae																										
Stylidium graminifolium	X	X																								
Thymelaeaceae																										
Pimelea linifolia	X			X						X		X		X	X									X		
Tremandraceae																										
Tetratheca juncea			X		X											X										
Urticaceae																										
Urtica incisa																							X			
Verbenaceae																										
Clerodendrum tomentosum																						X				
* Lantana camara																						X				

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Violaceae																										
Hybanthus enneaspermus subsp. enneasper																										
Hybanthus monopetalus									X															X		
Viola hederacea																						X				
4. Monocotyledons																										
Anthericaceae																										
Arthropodium milleflorum																										
Caesia parviflora							X																			
Caesia parviflora var. parviflora																										
Thysanotus juncifolius																								X		
Tricoryne elatior																										
Tricoryne simplex																		X							X	
Araceae																										
* Alocasia odora																				X						
Gymnostachys anceps																						X				
Asparagaceae																										
* Asparagus aethiopicus																						X				
Blandfordiaceae																										
Blandfordia grandiflora																										
Cannaceae																										
* Canna indica																				X						
Colchicaceae																										
Burchardia umbellata																										
Commelinaceae																										
Aneilema biflorum																					X	X				
Commelina cyanea																				X	X		X			
* Tradescantia albiflora							X															X				
Cyperaceae																										
Baumea articulata																										
Baumea rubiginosa						X		X					X													
Baumea tetragona																										
Carex breviculmis																										
Carex gaudichaudiana																										
Carex longebrachiata																					X	X				

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Chorizandra cymbaria						X							X													
Cyathochaeta diandra	X			X	X							X		X				X	X					X		X
* Cyperus aggregatus																				X						
Cyperus brevifolius																										
* Cyperus eragrostis																				X						
Cyperus polystachyos																										
Cyperus sphaeroideus																										
Eleocharis gracilis																										
Fimbristylis dichotoma																				X						
Gahnia clarkei				X				X					X		X		X				X				X	
Gahnia radula																										X
Isolepis inundata																										
* Isolepis prolifera																										
Lepidosperma laterale (narrow leaved form)																								X		
Lepidosperma quadrangulatum																										
Lepidosperma viscidum	X	X	X	X								X		X			X	X	X					X		
Ptilothrix deusta	X	X		X	X		X						X	X			X	X							X	X
Schoenus apogon				X		X		X												X						
Schoenus brevifolius													X													
Schoenus villosus																										
Dioscoreaceae																										
Dioscorea transversa																						X				
Haemodoraceae																										
Haemodorum corymbosum																										
Haemodorum planifolium																										
Iridaceae																										
Patersonia glabrata												X		X					X					X		
Patersonia sericea		X																								
Juncaceae																										
* Juncus cognatus															X					X						
Juncus continuus																										
Juncus homalocaulis																										
Juncus planifolius						X																				
Juncus prismatocarpus																										
Juncus usitatus																					X					
Lomandraceae																										
Lomandra cylindrica																										

Botanical name	Spot locations																									
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Lomandra filiformis subsp. filiformis	X	X								X				X												X
Lomandra glauca		X																								
Lomandra longifolia				X																	X	X				
Lomandra multiflora																										
Lomandra obliqua	X	X			X		X		X	X				X					X					X	X	X
Orchidaceae																										
Calochilus sp.																										
Cryptostylis erecta																										
Cryptostylis subulata	X																									
Cymbidium suave																										
Dipodium variegatum																										
Orthoceras strictum																										
Thelymitra pauciflora																										
Philesiaceae																										
Eustrephus latifolius																						X				
Geitonoplesium cymosum																					X					
Philydraceae																										
Philydrum lanuginosum																										
Phormiaceae																										
Dianella caerulea			X		X																					
Dianella revoluta																										X
Poaceae																										
* Andropogon virginicus		X				X		X				X			X					X						
Anisopogon avenaceus																										
Aristida ramosa var. ramosa																										
Aristida vagans	X	X								X		X														X
Aristida warburgii	X	X																								
Austrodanthonia tenuior	X	X	X							X																X
Austrostipa pubescens	X	X										X		X		X		X						X	X	
* Axonopus affinis		X																		X						
* Briza maxima							X																			
* Briza minor																				X						
Cynodon dactylon															X					X						
Deyeuxia microseta																										
Deyeuxia parviseta																										
Deyeuxia quadriseta			X									X		X												
Dichelachne inaequiglumis																										

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Dichelachne micrantha						X														X						
Digitaria diffusa																										
Echinopogon ovatus		X				X																				
* Ehrharta erecta																				X	X		X			
Entolasia marginata						X															X					
Entolasia stricta	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X		X		X	X	X	X
Eragrostis brownii																				X						
Hemarthria uncinata																										
Imperata cylindrica var. major	X	X		X			X					X			X											X
Ischaemum australe var. australe								X																		
Lachnagrostis filiformis																				X						
* Lolium perenne						X																				
Microlaena stipoides	X	X				X			X	X		X								X		X	X	X		
Oplismenus aemulus																					X		X			
Oplismenus imbecillis																						X				
Panicum simile			X			X																		X		X
Paspalidium distans															X					X						
* Paspalum dilatatum																										
Paspalum orbiculare						X																				
* Paspalum urvillei																				X						
* Pennisetum clandestinum							X																X			
* Setaria gracilis		X																								
* Stenotaphrum secundatum																										
Tetrarrhena juncea																										
Themeda australis	X	X	X	X			X		X	X		X		X	X				X	X						X
Restionaceae																										
Baloskion pallens																										
Empodisma minus													X													
Lepyrodia muelleri																										
Lepyrodia scariosa														X			X									
Smilacaceae																										
Smilax australis																						X				
Smilax glyciphylla																										
Xanthorrhoeaceae																										
Xanthorrhoea fulva													X													
Xanthorrhoea latifolia subsp. latifolia	X	X	X		X							X		X		X	X	X	X					X	X	X

Botanical name	Spot locations																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Zingiberaceae																										
* Hedychium gardnerianum							X																			

Botanical name	Spot locations																								
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP											
1. Pteridophytes																									
Adiantaceae																									
Adiantum aethiopicum						X	X																		
Blechnaceae																									
Blechnum cartilagineum														X											
Blechnum indicum													X												
Doodia aspera																									
Doodia caudata																									
Dennstaedtiaceae																									
Histiopteris incisa																									
Hypolepis muelleri		X												X											
Pteridium esculentum			X			X	X							X											
Dicksoniaceae																									
Calochlaena dubia																									
Gleicheniaceae																									
Gleichenia dicarpa																									
Lindsaeaceae																									
Lindsaea linearis				X							X														
Lindsaea microphylla										X															
Schizaeaceae																									
Schizaea bifida																									
Selaginellaceae																									
Selaginella uliginosa																									
Sinopteridaceae																									
Cheilanthes sieberi subsp. sieberi					X																				
2. Gymnosperms																									
Pinaceae																									
* Pinus patula		X																							

Botanical name	Spot locations																								
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP											
3. Dicotyledons																									
Acanthaceae																									
Brunoniella pumilio							X			X															
Pseuderanthemum variabile							X																		
Anacardiaceae																									
* Anacardium occidentale																									
Apiaceae																									
Centella asiatica	X			X			X		X																
Centella cordifolia																									
Hydrocotyle geraniifolia																									
Hydrocotyle peduncularis																									
Platysace ericoides																									
Xanthosia tridentata				X	X																				
Apocynaceae																									
Parsonsia straminea			X				X																		
Araliaceae																									
Polyscias sambucifolia				X										X											
Asteraceae																									
* Ageratina adenophora																									
* Ambrosia sp.																									
* Bidens pilosa																									
Cassinia leptocephala																									
* Cirsium vulgare																									
* Conyza albida																									
Epaltes australis												X													
* Erechtites valerianifolia																									
* Gnaphalium coarctatum																									
* Hypochoeris radicata		X		X	X																				
Lagenifera gracilis																									
Ozothamnus diosmifolius					X																				
* Senecio madagascariensis																									
Sigesbeckia orientalis							X																		
* Sonchus oleraceus																									
Vernonia cinerea																									

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Caprifoliaceae																										
* Lonicera japonica						X	X																			
Casuarinaceae																										
Allocasuarina littoralis			X			X		X		X	X															
Allocasuarina torulosa																										
Celastraceae																										
Maytenus silvestris																										
Clusiaceae																										
Hypericum gramineum												X														
Convolvulaceae																										
Convolvulus erubescens							X	X																		
Dichondra repens		X																								
Polymeria calycina																										
Cunoniaceae																										
Ceratopetalum gummiferum																										
Dilleniaceae																										
Hibbertia aspera																										
Hibbertia empetrifolia																										
Hibbertia scandens																										
Hibbertia vestita				X																						
Droseraceae																										
Drosera spatulata																										
Epacridaceae																										
Astroloma humifusum																										
Epacris pulchella					X					X	X															
Leucopogon juniperinus																										
Leucopogon lanceolatus																										
Leucopogon microphyllus												X														
Melichrus procumbens																										
Monotoca scoparia																										
Euphorbiaceae																										
Breynia oblongifolia							X																			
Glochidion ferdinandi			X																							
Phyllanthus hirtellus				X	X																					
Poranthera ericifolia																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Fabaceae Caesalpinioideae																										
* Senna pendula var. glabrata						X																				
Fabaceae Faboideae																										
Bossiaea heterophylla																										
Bossiaea obcordata					X					X																
Daviesia ulicifolia																										
Dillwynia retorta					X					X																
Glycine clandestina							X																			
Gompholobium glabratum																										
Gompholobium latifolium										X																
Gompholobium pinnatum																										
Gompholobium uncinatum																										
Hardenbergia violacea																										
Hovea heterophylla					X																					
Mirbelia rubiifolia										X	X															
Podolobium ilicifolium										X																
Podolobium scandens																										
Pultenaea paleacea											X	X														
Pultenaea polifolia																										
Pultenaea retusa																										
Pultenaea tuberculata												X														
Pultenaea villosa																										
Sphaerolobium minus																										
Sphaerolobium vimineum																										
Fabaceae Mimosoideae																										
Acacia irrorata subsp. irrorata																										
Acacia longifolia								X				X	X	X												
Acacia myrtifolia																										
# Acacia podalyriifolia																										
Acacia suaveolens					X																					
Acacia terminalis																										
Acacia ulicifolia					X																					
Gentianaceae																										
Centaurium spicatum																										
* Centaurium tenuiflorum																										
Geraniaceae																										
Geranium homeanum																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
* Pelargonium (Zonal hybrid)	X																									
Goodeniaceae																										
Dampiera stricta					X					X	X			X												
Goodenia bellidifolia																										
Goodenia heterophylla subsp. eglandulosa												X														
Goodenia ovata																										
Goodenia paniculata												X														
Scaevola ramosissima																										
Haloragaceae																										
Gonocarpus micranthus subsp. micranthus																										
Gonocarpus tetragynus										X		X	X													
Lauraceae																										
Cassytha glabella				X																						
Cassytha pubescens										X	X															
* Cinnamomum camphora	X	X	X	X		X	X																			
Lobeliaceae																										
Isotoma fluviatilis subsp. fluviatilis																										
Lobelia alata																										
Pratia purpurascens		X	X	X	X			X																		
Loganiaceae																										
Logania pusilla																										
Mitrasacme alsinoides																										
Mitrasacme polymorpha																										
Loranthaceae																										
Dendrophthoe vitellina																										
Malvaceae																										
* Modiola caroliniana																										
* Sida rhombifolia		X	X																							
Menispermaceae																										
Stephania japonica			X			X																				
Menyanthaceae																										
Villarsia exaltata																										
Myrtaceae																										
Acmena smithii							X																			
Angophora costata				X	X			X	X	X	X															

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Angophora floribunda																										
Angophora inopina											X	X		X												
Babingtonia pluriflora		X																								
Babingtonia similis																										
Callistemon citrinus													X													
Callistemon linearis	X																									
Callistemon salignus	X		X		X	X																				
Corymbia gummifera			X	X	X					X	X	X		X												
Eucalyptus amplifolia	X																									
Eucalyptus capitellata		X	X	X	X			X		X	X															
Eucalyptus globoidea																										
Eucalyptus haemastoma		X	X	X	X			X		X	X			X												
Eucalyptus pilularis						X																				
Eucalyptus resinifera subsp. resinifera													X	X												
Eucalyptus robusta									X				X													
Eucalyptus saligna							X																			
Leptospermum juniperinum								X				X	X													
Leptospermum polygalifolium subsp. cismont								X	X		X	X	X	X												
Leptospermum trinervium											X															
Melaleuca linariifolia								X	X				X													
Melaleuca nodosa	X	X				X																				
Melaleuca sieberi												X	X													
Melaleuca thymifolia												X														
Syncarpia glomulifera				X																						
Ochnaceae																										
* Ochna serrulata			X																							
Oleaceae																										
* Ligustrum lucidum		X					X																			
* Ligustrum sinense	X		X			X																				
Notelaea longifolia																										
Oxalidaceae																										
Oxalis exilis							X	X																		
Passifloraceae																										
* Passiflora edulis						X	X																			
Phytolaccaceae																										
* Phytolacca octandra																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Pittosporaceae																										
Billardiera scandens				X	X			X		X	X															
Pittosporum revolutum						X																				
Rhytidosporum procumbens																										
Plantaginaceae																										
* Plantago lanceolata	X	X																								
Polygalaceae																										
Comesperma ericinum					X																					
Comesperma sphaerocarpum																										
Polygonaceae																										
Persicaria decipiens																										
Proteaceae																										
Banksia oblongifolia											X			X												
Banksia robur																										
Banksia serrata																										
Banksia spinulosa var. collina								X			X			X												
Grevillea linearifolia																										
Grevillea parviflora subsp. parviflora										X	X															
# Grevillea robusta		X																								
Grevillea sericea																										
Hakea bakeriana											X															
Hakea gibbosa																										
Hakea laevipes subsp. laevipes																										
Hakea sericea																										
Isopogon anemonifolius																										
Lambertia formosa										X																
Lomatia silaifolia										X																
Persoonia levis					X																					
Persoonia linearis																										
Petrophile pulchella																										
Ranunculaceae																										
Clematis aristata																										
Clematis glycinoides			X																							
Rhamnaceae																										
Alphitonia excelsa																										
Pomaderris elliptica																										

Botanical name	Spot locations																								
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP											
Rosaceae																									
* Rubus bellobatus		X				X	X																		
Rubiaceae																									
Morinda jasminoides									X																
Opercularia diphylla																									
Opercularia hispida				X																					
Opercularia varia																									
Pomax umbellata																									
* Richardia humistrata																									
* Richardia stellaris																									
Rutaceae																									
Boronia polygalifolia				X																					
Melicope micrococca																									
Sapindaceae																									
Dodonaea triquetra					X																				
Scrophulariaceae																									
Veronica plebeia																									
Solanaceae																									
Duboisia myoporoides			X	X	X	X																			
* Solanum mauritianum							X																		
* Solanum nigrum							X																		
* Solanum pseudocapsicum																									
Stylidiaceae																									
Stylidium graminifolium																									
Thymelaeaceae																									
Pimelea linifolia																									
Tremandraceae																									
Tetratheca juncea										X															
Urticaceae																									
Urtica incisa																									
Verbenaceae																									
Clerodendrum tomentosum																									
* Lantana camara			X																						

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Violaceae																										
Hybanthus enneaspermus subsp. enneasper																										
Hybanthus monopetalus																										
Viola hederacea																										
4. Monocotyledons																										
Anthericaceae																										
Arthropodium milleflorum																										
Caesia parviflora					X																					
Caesia parviflora var. parviflora																										
Thysanotus juncifolius											X															
Tricoryne elatior																										
Tricoryne simplex																										
Araceae																										
* Alocasia odora																										
Gymnostachys anceps																										
Asparagaceae																										
* Asparagus aethiopicus	X	X																								
Blandfordiaceae																										
Blandfordia grandiflora																										
Cannaceae																										
* Canna indica																										
Colchicaceae																										
Burchardia umbellata																										
Commelinaceae																										
Aneilema biflorum																										
Commelina cyanea																										
* Tradescantia albiflora							X																			
Cyperaceae																										
Baumea articulata																										
Baumea rubiginosa												X	X													
Baumea tetragona																										
Carex breviculmis																										
Carex gaudichaudiana																										
Carex longebrachiata																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Chorizandra cymbaria																										
Cyathochaeta diandra				X	X						X															
* Cyperus aggregatus																										
Cyperus brevifolius																										
* Cyperus eragrostis																										
Cyperus polystachyos																										
Cyperus sphaeroideus																										
Eleocharis gracilis																										
Fimbristylis dichotoma																										
Gahnia clarkei				X	X			X	X			X	X	X												
Gahnia radula																										
Isolepis inundata																										
* Isolepis prolifera																										
Lepidosperma laterale (narrow leaved form)				X		X					X															
Lepidosperma quadrangulatum													?X													
Lepidosperma viscidum					X																					
Ptilothrix deusta										X	X	X														
Schoenus apogon																										
Schoenus brevifolius																										
Schoenus villosus																										
Dioscoreaceae																										
Dioscorea transversa																										
Haemodoraceae																										
Haemodorum corymbosum																										
Haemodorum planifolium					X																					
Iridaceae																										
Patersonia glabrata				X	X					X	X															
Patersonia sericea					X																					
Juncaceae																										
* Juncus cognatus																										
Juncus continuus	X																									
Juncus homalocaulis	X																									
Juncus planifolius																										
Juncus prismatocarpus																										
Juncus usitatus																										
Lomandraceae																										
Lomandra cylindrica																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Lomandra filiformis subsp. filiformis		X									X															
Lomandra glauca																										
Lomandra longifolia							X																			
Lomandra multiflora																										
Lomandra obliqua					X					X																
Orchidaceae																										
Calochilus sp.																										
Cryptostylis erecta				X																						
Cryptostylis subulata																										
Cymbidium suave																										
Dipodium variegatum																										
Orthoceras strictum																										
Thelymitra pauciflora																										
Philesiaceae																										
Eustrephus latifolius						X																				
Geitonoplesium cymosum																										
Philydraceae																										
Philydrum lanuginosum																										
Phormiaceae																										
Dianella caerulea	X	X	X	X	X																					
Dianella revoluta																										
Poaceae																										
* Andropogon virginicus	X			X						X		X														
Anisopogon avenaceus																										
Aristida ramosa var. ramosa																										
Aristida vagans										X																
Aristida warburgii	X																									
Austrodanthonia tenuior		X																								
Austrostipa pubescens				X	X					X	X															
* Axonopus affinis	X	X																								
* Briza maxima	X																									
* Briza minor																										
Cynodon dactylon																										
Deyeuxia microseta																										
Deyeuxia parviseta																										
Deyeuxia quadriseta																										
Dichelachne inaequiglumis																										

Botanical name	Spot locations																									
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP												
Dichelachne micrantha	X																									
Digitaria diffusa																										
Echinopogon ovatus					X		X																			
* Ehrharta erecta			X																							
Entolasia marginata							X																			
Entolasia stricta				X	X	X	X	X	X	X	X	X	X													
Eragrostis brownii	X											X														
Hemarthria uncinata																										
Imperata cylindrica var. major		X	X			X	X						X	X												
Ischaemum australe var. australe																										
Lachnagrostis filiformis																										
* Lolium perenne																										
Microlaena stipoides	X	X	X	X	X																					
Oplismenus aemulus			X																							
Oplismenus imbecillis						X																				
Panicum simile										X																
Paspalidium distans	X																									
* Paspalum dilatatum			X		X																					
Paspalum orbiculare																										
* Paspalum urvillei																										
* Pennisetum clandestinum																										
* Setaria gracilis																										
* Stenotaphrum secundatum																										
Tetrarrhena juncea																										
Themeda australis					X					X	X	X														
Restionaceae																										
Baloskion pallens																										
Empodisma minus												X														
Lepyrodia muelleri																										
Lepyrodia scariosa												X														
Smilacaceae																										
Smilax australis																										
Smilax glyciphylla																										
Xanthorrhoeaceae																										
Xanthorrhoea fulva																										
Xanthorrhoea latifolia subsp. latifolia			X	X						X	X															

Botanical name	Spot locations																								
	AB	AC	AD	AE	AF	AG	AI	AJ	AK	AL	AM	AN	AO	AP											
Zingiberaceae																									
* Hedychium gardnerianum																									

Table 5. Maximum height and number of all species >2 m height in the Quadrats

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Quadrat 1								
Angophora inopina	6	4 m	8	6 m	10	6 m	4	6 m
Corymbia gummifera							1	11 m
Eucalyptus haemastoma	7	10 m	3	10 m	3	9 m	4	10 m
Leptospermum trinervium	9	6 m	8	4 m	10	6 m	4	5 m
Melaleuca sieberi							3	6 m
Persoonia levis	1	2 m	1	2 m				
Quadrat 2								
Angophora inopina			3	6 m			2	6 m
Corymbia gummifera	8	11 m	6	5 m	3	11 m	9	11 m
Eucalyptus capitellata	1	16 m			1	2 m		
Eucalyptus haemastoma			3	10 m	3	9 m	1	9 m
Leptospermum trinervium	12	5 m	11	4 m	5	5 m	12	5 m
Persoonia levis			1	2 m				
Quadrat 3								
Angophora inopina	2	7 m	5	6 m	4	8 m	4	6 m
Eucalyptus capitellata	1	17 m	1	11 m	1	17 m	1	12 m
Eucalyptus haemastoma	1	18 m					1	8 m
Eucalyptus resinifera			1	13 m			1	4 m
Leptospermum trinervium	4	3 m	2	3 m	3	3 m	3	3 m
Melaleuca linariifolia			1	3 m				
Melaleuca nodosa	4	5 m	2	3 m			1	3 m
Melaleuca sieberi	2	7 m	4	5 m	7	7 m	2	5 m
Quadrat 4								
Angophora costata					1	15 m		
Corymbia gummifera	2	12 m	1	11 m	1	11 m	3	13 m
Eucalyptus capitellata	1	11 m	1	11 m	1	17 m		
Eucalyptus haemastoma	1	10 m	1	13 m	1	15 m		
Quadrat 5								
Allocasuarina torulosa	2	9 m						
Angophora costata	1	2 m	1	23 m	1	5 m	4	23 m
Corymbia gummifera			2	16 m			1	13 m
Eucalyptus capitellata			3	23 m	2	21 m	2	26 m
Eucalyptus resinifera	3	6 m	2	5 m	1	23 m	2	12 m
Leptospermum polygalifolium					1	2 m		
Leptospermum trinervium	1	4 m	3	6 m	5	5 m		
Melaleuca linariifolia	5	4 m			2	6 m	6	9 m
Melaleuca nodosa					1	8 m	1	10 m
Quadrat 6								
Angophora costata			1	8 m				
Corymbia gummifera	3	12 m	3	15 m	5	12 m	8	13 m
Eucalyptus capitellata			1	14 m			1	14 m
Eucalyptus haemastoma	2	12 m	2	12 m	1	10 m		
Lambertia formosa	2	2 m						
Leptospermum trinervium	2	3 m			3	4 m	3	4 m
Persoonia levis	1	2 m						
Quadrat 7								
Corymbia gummifera	2	14 m	3	19 m	8	16 m	1	16 m
Eucalyptus capitellata	3	18 m					1	16 m
Eucalyptus haemastoma			1	18 m	1	8 m	1	18 m
Leptospermum trinervium	1	3 m	1	3 m	3	4 m	2	4 m
Quadrat 8								
Acacia ulicifolia							1	3 m
Allocasuarina littoralis	10	8 m	4	8 m	9	8 m	12	8 m
Angophora costata	1	6 m			1	12 m	1	12 m
Angophora inopina			1	6 m	1	4 m	3	4 m
Callistemon linearis	1	3 m						
Corymbia gummifera	3	10 m	1	10 m	3	10 m		
Dodonaea triquetra	1	2 m	6	3 m				
Eucalyptus capitellata	1	4 m	2	16 m	2	18 m		
Eucalyptus haemastoma	1	14 m	1	10 m			1	16 m
Eucalyptus resinifera	1	12 m			7	18 m	2	6 m

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Leptospermum trinervium	1	2 m	4	3 m	2	2 m		
Melaleuca sieberi			2	8 m				
Quadrat 9								
Angophora costata					1	16 m		
Corymbia gummifera	1	7 m						
Corymbia gummifera			2	8 m	1	7 m	3	11 m
Eucalyptus capitellata			3	15 m			1	13 m
Eucalyptus haemastoma					1	13 m		
Leptospermum trinervium							3	3 m
Melaleuca sieberi			1	9 m				
Quadrat 10								
Angophora inopina	1	3 m	2	3 m				
Corymbia gummifera	2	11 m					1	12 m
Eucalyptus capitellata							1	10 m
Eucalyptus haemastoma	2	11 m	2	11 m	1	8 m	1	10 m
Hakea laevipes							2	2 m
Leptospermum trinervium	2	4 m	4	4 m	6	3 m	5	3 m
Persoonia levis			1	2 m			1	2 m
Quadrat 12								
Allocasuarina littoralis	1	8 m			2	12 m	1	10 m
Angophora costata	1	6 m					1	3 m
Banksia spinulosa subsp. collina	2	2 m						
Callistemon salignus	1	8 m	3	6 m				
Dodonaea triquetra	3	4 m			1	3 m		
Eucalyptus capitellata	4	10 m						
Eucalyptus globoidea			3	20 m	1	13 m	13	19 m
Eucalyptus haemastoma	2	10 m	9	11 m	3	12 m	3	5 m
Eucalyptus resinifera					3	10 m		
Leptospermum polygalifolium	11	2 m			1	2 m		
Leptospermum trinervium	5	3 m	4	5 m	5	3 m	3	3 m
Persoonia levis	2	2 m	2	2 m	2	3 m	1	3 m
Polyscias sambucifolia	1	2 m	2	2 m				
Quadrat 13								
Allocasuarina littoralis					1	6 m		
Angophora inopina	1	7 m			5	8 m	2	6 m
Corymbia gummifera	5	13 m	3	13 m	2	11 m	2	8 m
Eucalyptus capitellata			3	11 m				
Eucalyptus haemastoma	1	11 m	1	9 m			4	6 m
Leptospermum trinervium	5	4 m	1	3 m	5	5 m	10	4 m
Persoonia levis	1	2 m						
Quadrat 14								
Allocasuarina littoralis	1	3 m	1	6 m			1	7 m
Angophora costata	1	7 m	9	15 m			5	13 m
Banksia spinulosa subsp. collina			1	2 m				
Callistemon salignus	2	7 m						
Ceratopetalum gummiferum							1	9 m
Corymbia gummifera	3	13 m	2	14 m	1	15 m	1	13 m
Eucalyptus capitellata	1	12 m	3	14 m			2	13 m
Eucalyptus globoidea			1	3 m	1	10 m		
Eucalyptus haemastoma	8	8 m	3	9 m	8	15 m	4	16 m
Eucalyptus resinifera	2	9 m			2	10 m		
Leptospermum polygalifolium					1	2 m	1	2 m
Leptospermum trinervium	20	4 m	12	4 m	13	4 m	4	3 m
Persoonia levis	1	2 m						
Quadrat 15								
Allocasuarina littoralis							1	5 m
Angophora costata	1	8 m	1	14 m			1	10 m
Corymbia gummifera	4	14 m	1	14 m	9	17 m	6	17 m
Eucalyptus capitellata			4	17 m				
Eucalyptus haemastoma			6	10 m	1	5 m	2	14 m
Hakea leavipes							1	2 m
Persoonia levis					1	2 m		
Quadrat 16								
Corymbia gummifera	4	12 m	2	12 m	4	14 m	4	16 m

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Angophora costata	1	12 m	2	16 m	3	14 m	2	16 m
Eucalyptus haemastoma	1	14 m			3	12 m		
Eucalyptus capitellata	1	16 m	5	18 m	1	16 m	3	16 m
Persoonia levis					1	2 m		
Quadrat 17								
Angophora costata			2	14 m			4	13 m
Corymbia gummifera	1	12 m	3	13 m	2	13 m		
Eucalyptus capitellata	1	14 m	1	15 m	4	18 m	1	15 m
Eucalyptus haemastoma	2	13 m	1	10 m			3	15 m
Quadrat 18								
Angophora costata					1	15 m		
Callistemon salignus							2	3 m
Eucalyptus robusta	1	16 m						
Melaleuca linariifolia	30	12 m	28	12 m	26	10 m	33	10 m
Melaleuca sieberi	1	16 m						
Quadrat 19								
Angophora inopina							1	4 m
Corymbia gummifera	5	14 m	2	14 m	6	14 m	3	14 m
Dodonaea triquetra	1	2 m						
Eucalyptus capitellata	3	16 m	5	16 m	4	16 m	3	14 m
Eucalyptus haemastoma	2	16 m	2	14 m			1	10 m
Persoonia levis	1	3 m	1	2 m				
Quadrat 20								
Allocasuarina littoralis					2	6 m		
Angophora inopina	3	6 m	2	10 m	2	10 m	2	10 m
Eucalyptus capitellata	2	16 m	3	18 m	1	14 m	2	12 m
Eucalyptus haemastoma	3	12 m	2	8 m	1	4 m	1	16 m
Hakea ?gibbosa	3	2 m			2	2 m	1	2.5 m
Leptospermum polygalifolium	8	2 m	6	2 m	4	2 m		
Leptospermum trinervium	12	4 m	8	3 m	5	3 m	17	4 m
Melaleuca nodosa	3	6 m	1	4 m	2	5 m		
Quadrat 21								
Corymbia gummifera	6	16 m	2	14 m	6	10 m	2	18 m
Eucalyptus capitellata	2	15 m	1	17 m	2	14 m	1	17 m
Eucalyptus haemastoma	2	13 m			2	16 m	3	15 m
Leptospermum trinervium			1	4 m				
Persoonia levis			1	2 m	1	2 m	1	2 m
Quadrat 22								
Callistemon linearis	1	2 m						
Callistemon salignus					1	6 m		
Eucalyptus robusta	1	9 m			1	6 m	1	2 m
Leucopogon juniperinum							4	2 m
Melaleuca linariifolia					3	2 m	2	3 m
Quadrat 23								
Corymbia gummifera	1	13 m	1	14 m	1	14 m	2	17 m
Eucalyptus capitellata	3	18 m			2	17 m	2	15 m
Eucalyptus haemastoma			1	13 m	2	15 m	1	16 m
Quadrat 24								
Angophora inopina			3	6 m	1	3 m	3	5 m
Corymbia gummifera	2	16 m	2	14 m	2	12 m	4	13 m
Eucalyptus capitellata					2	18 m	1	19 m
Eucalyptus haemastoma			4	15 m	1	15 m	5	16 m
Quadrat 25								
Eucalyptus capitellata			1	4 m				
Eucalyptus haemastoma	1	4 m						
Quadrat 26								
Angophora costata	1	15 m			1	10 m	1	14 m
Corymbia gummifera	2	18 m	3	17 m	3	18 m	4	18 m
Eucalyptus capitellata	2	19 m			3	18 m	3	19 m
Eucalyptus haemastoma	2	22 m						

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Leptospermum polygalifolium							1	4 m
Quadrat 27								
Babingtonia similis	1	2 m						
Cinnamomum camphora	6	6 m	12	9 m	6	8 m	8	5 m
Eucalyptus robusta	2	10 m	6	10 m	2	8 m	7	18 m
Leucopogon juniperinum	2	2 m	1	4 m				
Melaleuca linariifolia					1	3 m		
Melaleuca sieberi	2	6 m	12	11 m	5	6 m	6	9 m
Melaleuca thymifolia	1	2 m						
Quadrat 28								
Angophora costata					1	10 m		
Corymbia gummifera	3	14 m	1	15 m			2	13 m
Eucalyptus capitellata	2	16 m	1	17 m				
Eucalyptus haemastoma	2	15 m	1	14 m	1	12 m		
Leptospermum trinervium			1	3 m	2	4 m	1	4 m
Quadrat 29								
Angophora costata			1	9 m				
Corymbia gummifera	1	13 m	1	8 m	3	16 m	2	14 m
Eucalyptus capitellata	6	19 m	2	18 m	4	18 m	1	30 m
Eucalyptus haemastoma			1	12 m	2	13 m	1	7 m
Hakea bakeri	1	2 m						
Leptospermum polygalifolium	2	6 m			2	4 m	1	5 m
Persoonia levis					2	3 m		
Quadrat 30								
Angophora costata	2	16 m			1	9 m	1	14 m
Eucalyptus capitellata	1	17 m	2	18 m	3	18 m	1	18 m
Leptospermum trinervium	2	5 m	3	3 m	1	3 m		
Melaleuca sieberi	1	3 m	2	3 m	1	2 m		
Leptospermum polygalifolium					5	3 m	3	2 m
Hakea bakeri			4	2 m			1	2 m
Melaleuca linariifolia							2	3 m
Quadrat 31								
Allocasuarina littoralis			3	7 m				
Angophora inopina			2	8 m				
Corymbia gummifera			2	12 m			4	18 m
Eucalyptus capitellata	4	12 m	2	16 m	1	10 m	1	14 m
Eucalyptus haemastoma	3	11 m	1	9 m	4	14 m	2	14 m
Leptospermum trinervium	6	4 m			5	3 m		
Quadrat 32								
Acacia irrorata					1	6 m		
Eucalyptus robusta	4	25 m	3	25 m	8	28 m	3	26 m
Eucalyptus robusta	2	13 m						
Melaleuca linariifolia			6	15m				
Melaleuca sieberi	3	4 m			6	16 m	5	16 m
Quadrat 33								
Cinnamomum camphora			1	4 m				
Eucalyptus resinifera	1	8 m	1	5 m	2	7 m		
Eucalyptus robusta	1	6 m						
Leptospermum polygalifolium			10	3 m			7	3 m
Melaleuca nodosa	70	7 m	20	8 m	80	8 m	35	8 m
Melaleuca sieberi	2	8 m					1	10 m
Quadrat 34								
Allocasuarina littoralis	12	13 m	17	13 m	18	9 m	11	14 m
Angophora costata	1	25 m					1	20 m
Banksia spinulosa subsp. collina							1	2 m
Corymbia gummifera			1	20 m	1	14 m	1	15 m
Eucalyptus capitellata	2	20 m	2	25 m				
Leptospermum polygalifolium	1	2 m	3	2 m			3	2 m
Leptospermum trinervium					1	2 m	3	3 m
Quadrat 35								
Corymbia gummifera			1	2 m	1	11 m		

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Eucalyptus capitellata	2	18 m			1	14 m		
Eucalyptus haemastoma	2	12 m	7	15 m	5	12 m	3	12 m
Leptospermum trinervium	2	2 m	2	2 m	4	3 m	4	3 m
Quadrat 36								
Allocasuarina littoralis	5	11 m	7	14 m	4	13 m	6	12 m
Angophora costata	1	13 m			3	15 m	1	14 m
Banksia oblongifolia	1	2 m	3	2 m				
Banksia spinulosa subsp. collina							3	3 m
Corymbia gummifera			3	12 m	1	4 m	1	15 m
Eucalyptus capitellata					2	12 m	1	14 m
Eucalyptus haemastoma	2	10 m	3	11 m			2	12 m
Hakea bakeriana							3	3 m
Hakea laevipes	1	3 m			1	2 m		
Leptospermum polygalifolium	2	2 m						
Leptospermum trinervium	15	4 m	22	6 m	14	5 m	40	5 m
Melaleuca sieberi	2	3 m						
Quadrat 37								
Angophora costata	1	5 m						
Angophora inopina			2	5 m			1	6 m
Banksia oblongifolia			1	2 m	1	2 m	1	3 m
Callistemon citrinis	11	3 m	1	3 m	8	2 m	1	2 m
Callistemon linearis					1	2 m		
Eucalyptus resinifera	2	16 m	2	13 m	2	12 m	1	11 m
Leucopogon juniperinum	11	6 m	8	6 m	30	8 m	6	6 m
Leptospermum polygalifolium			4	2 m	3	2 m	7	2 m
Melaleuca linariifolia	1	7 m			1	6 m		
Melaleuca sieberi	2	11 m	2	10 m	4	16 m	3	6 m
Melaleuca thymifolia							1	2 m
Quadrat 38								
Angophora inopina	5	4 m	4	6 m	2	4 m	3	6 m
Banksia oblongifolia	1	2 m						
Banksia spinulosa subsp. collina			1	2 m				
Corymbia gummifera	10	9 m	13	9 m	4	6 m	9	10 m
Eucalyptus haemastoma	4	11 m	8	11 m	4	12 m	2	6 m
Hakea bakeri			2	3 m				
Hakea laevipes	1	2 m	2	2 m				
Leptospermum trinervium	15	4 m	17	4 m	15	4 m	12	4 m
Persoonia levis							1	3 m
Quadrat 39								
Angophora inopina			1	7 m				
Corymbia gummifera			1	6 m	6	10 m	2	11 m
Eucalyptus capitellata					1	11 m	3	15 m
Hakea bakeriana					2	2 m		
Leptospermum polygalifolium	11	3 m	15	3 m	10	2 m	11	4 m
Leptospermum trinervium	3	4 m	1	3 m	5	3 m	6	4 m
Melaleuca sieberi	6	5 m	3	5 m	1	3 m	4	5 m
Quadrat 40								
Angophora costata			4	25 m	1	10 m	4	14 m
Corymbia gummifera	2	13 m						
Eucalyptus capitellata	2	10 m	3	12 m				
Leptospermum polygalifolium			2	3 m				
Melaleuca nodosa	3	4 m			8	9 m	13	9 m
Melaleuca sieberi	1	5 m			1	4 m		
Quadrat 41								
Acacia irrorata	2	4 m	1	3 m	2	3 m	1	3 m
Allocasuarina littoralis	1	3 m					3	3 m
Angophora costata			1	16 m				
Callistemon salignus	2	2 m	1	2 m				
Dodonaea triquetra	40	3 m	11	3 m	15	2 m	20	3 m
Eucalyptus pilularis	1	32 m	1	19 m	6	35 m	2	32 m
Melaleuca nodosa	4	5 m					3	4 m
Pomaderris ?elliptica	1	5 m	1	4 m	2	2 m	5	4 m
Quadrat 42								
Acacia irrorata	4	9 m			2	4 m		

	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
Species	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Allocasuarina littoralis							1	5 m
Angophora floribunda	3	14 m						
Bossiaea obcordata	5	2 m						
Breynia oblongifolia	1	2 m						
Callistemon salignus	5	11 m	7	8 m	6	8 m	11	12 m
Cinnamomum camphora			1	2 m	1	3 m		
Eucalyptus pilularis			1	40 m	1	35 m	1	40 m
Eucalyptus saligna	2	35 m					1	37 m
Glochidion ferdinandi	4	3 m			1	2 m		
Leptospermu polygalifolium	1	2 m						
Melaleuca linariifolia	1	2 m	1	4 m			1	3 m
Senna pendula var. glabrata	1	4 m						
Quadrat 43								
Angophora costata	4	14 m	1	11 m	2	20 m	1	2 m
Angophora inopina			1	6 m			2	3 m
Corymbia gummifera	4	18 m			3	13 m	5	20 m
Eucalyptus capitellata			1	20 m				
Eucalyptus haemastoma	1	11 m	1	14 m				
Quadrat 44								
Allocasuarina littoralis	11	8 m	15	7 m	4	5 m	6	8 m
Angophora costata	1	14 m	5	15 m	3	16 m	4	16 m
Banksia oblongifolia					1	2 m		
Banksia spinulosa subsp. collina					1	2 m	1	2 m
Callistemon linearis	1	9 m						
Corymbia gummifera	1	12 m						
Eucalyptus capitellata	3	16 m	2	13 m	3	11 m	3	17 m
Eucalyptus haemastoma	1	14 m	2	16 m				
Hakea sericea	13	5 m	4	6 m	16	4 m	8	9 m
Leptospermum polygalifolium	2	2 m	1	2 m	5	2 m	1	2 m
Leptospermum trinervium	2	4 m			2	3 m		
Melalueca linariifolia					5	6 m	2	4 m
Quadrat 45								
Angophora costata	2	12 m			2	12 m		
Angophora inopina	1	4 m	1	4 m	1	5 m		
Banksia oblongifolia			1	2 m	3	2 m		
Corymbia gummifera			3	14 m	2	5 m	1	3 m
Eucalyptus haemastoma	7	5 m	5	9 m	10	6 m	16	11 m
Leptospermum polygalifolium							1	2 m
Leptospermum trinervium	15	4 m	13	3 m	40	4 m	40	4 m
Petrophile pulchella					1	2 m		
Quadrat 46								
Angophora inopina	5	5 m	3	4 m	3	4 m	1	3 m
Banksia oblongifolia							1	2 m
Corymbia gummifera	4	10 m	3	5 m	1	5 m	2	4 m
Eucalyptus capitellata	1	4 m	1	15 m	1	18 m		
Eucalyptus haemastoma	3	8 m			3	14 m	2	14 m
Quadrat 47								
Angophora inopina					4	3 m	2	3 m
Corymbia gummifera	1	2 m	4	2 m			10	3 m
Eucalyptus haemastoma	8	8 m	6	9 m	3	11 m	1	9 m
Leptospermum trinervium	1	2 m	1	2 m	1	3 m	7	3 m

Table 6. Summary of data in sampling locations

Sampling location	Total spp	Exotics		Natives		REMS 30		REMS 31		REMS 42		REMS 5		SSF	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	41	0	0	41	100	11	38	21	50	11	39	0	0	4	7
2	52	0	0	52	100	12	41	25	60	9	32	0	0	2	3
3	49	0	0	49	100	12	41	21	50	14	50	3	9	9	15
4	42	0	0	42	100	13	45	25	60	8	29	0	0	5	8
5	56	0	0	56	100	18	62	13	31	12	43	5	14	14	23
6	41	0	0	41	100	11	38	16	38	4	14	0	0	2	3
7	37	0	0	37	100	13	45	21	50	5	18	0	0	4	7
8	34	0	0	34	100	14	48	17	40	7	25	0	0	7	12
9	42	0	0	42	100	13	45	21	50	8	29	1	3	6	10
10	37	0	0	37	100	10	34	24	57	7	25	0	0	5	8
12	46	0	0	46	100	15	52	14	33	7	25	4	11	14	23
13	40	0	0	40	100	12	41	24	57	6	21	0	0	4	7
14	50	0	0	50	100	17	59	19	45	8	29	1	3	6	10
15	40	0	0	40	100	19	66	21	50	9	32	0	0	7	12
16	46	1	2	45	98	15	52	20	48	6	21	1	3	7	12
17	39	0	0	39	100	14	48	20	48	9	32	0	0	4	7
18	34	1	3	33	97	7	24	4	10	11	39	6	17	13	22
19	55	3	5	52	95	18	62	23	55	7	25	2	6	7	12
20	42	0	0	42	100	13	45	21	50	8	29	1	3	6	10
21	38	0	0	38	100	13	45	22	52	9	32	0	0	4	7
22	40	2	5	38	95	4	14	2	5	14	50	5	14	9	15
23	30	6	20	24	80	8	28	12	29	3	11	1	3	4	7
24	40	1	3	39	98	12	41	22	52	4	14	0	0	2	3
25	43	3	7	40	93	14	48	24	57	7	25	0	0	4	7
26	43	0	0	43	100	17	59	20	48	6	21	1	3	7	12
27	52	10	19	42	81	0	0	0	0	8	29	4	11	11	18
28	32	0	0	32	100	10	34	18	43	4	14	0	0	2	3
29	33	0	0	33	100	10	34	16	38	8	29	0	0	3	5
30	32	0	0	32	100	13	45	13	31	14	50	3	9	10	17
31	43	1	2	42	98	14	48	22	52	5	18	0	0	4	7
32	19	1	5	18	95	1	3	0	0	4	14	5	14	14	23

Sampling location	Total spp	Exotics		Natives		REMS 30		REMS 31		REMS 42		REMS 5		SSF	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
33	43	3	7	40	93	6	21	3	7	11	39	4	11	14	23
34	29	0	0	29	100	13	45	14	33	7	25	1	3	7	12
35	24	0	0	24	100	7	24	15	36	3	11	0	0	2	3
36	37	0	0	37	100	13	45	19	45	9	32	0	0	6	10
37	29	0	0	29	100	7	24	5	12	15	54	3	9	8	13
38	33	0	0	33	100	9	31	20	48	5	18	0	0	3	5
39	35	0	0	35	100	12	41	16	38	13	46	1	3	8	13
40	36	0	0	36	100	14	48	14	33	9	32	4	11	11	18
41	42	1	2	41	98	10	34	5	12	8	29	5	14	16	27
42	45	4	9	41	91	7	24	2	5	13	46	3	9	17	28
43	36	0	0	36	100	13	45	19	45	0	0	7	20	5	8
44	33	0	0	33	100	17	59	15	36	3	11	6	17	11	18
45	34	0	0	34	100	13	45	21	50	0	0	12	34	5	8
46	41	1	2	40	98	15	52	24	57	0	0	7	20	4	7
47	26	0	0	26	100	9	31	18	43	0	0	5	14	3	5
A	34	1	3	33	97	12	41	20	48	5	18	3	9	7	12
B	31	4	13	27	87	8	28	15	36	4	14	0	0	4	7
C	31	0	0	31	100	15	52	12	29	7	25	2	6	10	17
D	25	0	0	25	100	10	34	7	17	8	29	7	20	13	22
E	23	0	0	23	100	11	38	13	31	3	11	0	0	3	5
F	21	2	10	19	90	2	7	2	5	4	14	1	3	3	5
G	18	4	22	14	78	8	28	7	17	2	7	1	3	3	5
H	16	15	94	1	6	1	3	0	0	6	21	2	6	6	10
I	28	3	11	25	89	6	21	9	21	2	7	0	0	2	3
J	18	2	11	16	89	7	24	10	24	4	14	0	0	2	3
L	30	1	3	29	97	11	38	15	36	7	25	0	0	5	8
M	30	0	0	30	100	6	21	6	14	12	43	2	6	7	12
N	33	0	0	33	100	11	38	21	50	9	32	0	0	6	10
O	26	5	19	21	81	6	21	4	10	6	21	2	6	7	12
P	13	0	0	13	100	6	21	7	17	2	7	0	0	2	3
Q	18	0	0	18	100	5	17	9	21	7	25	1	3	4	7
R	18	0	0	18	100	7	24	11	26	3	11	0	0	4	7
S	19	0	0	19	100	12	41	16	38	4	14	0	0	5	8

Sampling location	Total spp	Exotics		Natives		REMS 30		REMS 31		REMS 42		REMS 5		SSF	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T	34	20	59	14	41	1	3	1	2	2	7	0	0	2	3
U	38	7	18	31	82	3	10	1	2	2	7	14	40	15	25
V	31	7	23	24	77	2	7	0	0	0	0	14	40	8	13
W	17	5	29	12	71	2	7	1	2	1	4	4	11	4	7
X	37	0	0	37	100	14	48	17	40	8	29	0	0	3	5
Y	23	0	0	23	100	9	31	14	33	6	21	1	3	5	8
Z	31	0	0	31	100	15	52	17	40	6	21	1	3	8	13
AB	21	8	38	13	62	0	0	1	2	1	4	1	3	3	5
AC	22	9	41	13	59	3	10	3	7	0	0	2	6	4	7
AD	24	7	29	17	71	7	24	5	12	0	0	5	14	10	17
AE	30	3	10	27	90	8	28	9	21	4	14	3	9	6	10
AF	38	2	5	36	95	11	38	12	29	4	14	3	9	7	12
AG	20	6	30	14	70	5	17	2	5	4	14	1	3	8	13
AH	23	1	4	22	96	3	10	1	2	8	29	2	6	10	17
AI	26	8	31	18	69	4	14	1	2	8	29	1	3	11	18
AJ	15	0	0	15	100	7	24	5	12	3	11	4	11	7	12
AK	8	0	0	8	100	3	10	1	2	3	11	4	11	6	10
AL	31	1	3	30	97	16	55	17	40	0	0	4	11	4	7
AM	29	0	0	29	100	13	45	19	45	0	0	6	17	5	8
AN	24	1	4	23	96	6	21	5	12	1	4	13	37	6	10
AO	14	0	0	14	100	4	14	1	2	2	7	7	20	9	15
AP	15	0	0	15	100	5	17	6	14	2	7	3	9	8	13
Total	**313**	**50**	**16**	**263**	**84**	**28**	**97**	**33**	**79**	**25**	**89**	**25**	**71**	**39**	**65**

REMS 30 = Coastal Plains Smoothbarked Apple Woodland
REMS 31 = Coastal Plains Scribbly Gum Woodland
REMS 42 = Riparian Melaleuca Swamp Woodland
REMS 5 = Alluvial Tall Moist Forest
SSF = Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Appendices

Appendix 1

Creek Assessment by Patterson Britton

lr5368.01ew040524 - North Cooranbong Creeks.doc

JW Planning
PO Box 3252
Valentine
NSW 2280

7 June 2004

Attention: Mr Jason Wasiak

Dear Jason

NORTH COORANBONG CREEK ASSESSMENT

Patterson Britton and Partners (PBP) was engaged by JW Planning Pty Ltd to provide an assessment of creeks within the North Cooranbong investigation area. A discussion of work undertaken and findings is provided below.

A comprehensive site visit was undertaken by two PBP engineers *(Mark Tooker and Eric Wingate)* and an ecologist *(Ann Clements)*, including walking along sections of each of the drainage corridors as shown on topographic mapping and site survey. The assessment focussed on ascertaining whether the drainage lines across the site would be considered as significant waterbodies *(or 'rivers')* under the Rivers and Foreshore Improvement Act (R&FI Act), as might be concluded by the Department of Infrastructure Planning and Natural Resources (DIPNR).

Our assessment was largely based on the 'architectus' master plan *'Option 5'* provided to PBP by JW Planning. We note that this plan shows two options for retaining drainage corridors: creek lines (flood prone); and open space (flood prone); as well as areas where drainage lines are not retained.

Attachment A shows the results of the creek assessment undertaken by both PBP and Ann Clements. Comment has been provided on each drainage line where applicable, including the major corridors which are being retained for ecological reasons. We note that drainage lines on the master plan *'Option 5'* do not completely line-up with the aerial survey, therefore general commentary appropriate to both has been provided.

In general, the indicative master plan showing riparian corridors generally appears appropriate and the major creeks, floodplains and drainage corridors have been identified. We

Principals Greg Britton BE MEngSc FIEAust Peter Coltman BE MEngSc MIEAust Bruce Druery BE Dip Sc(Geol) M AppSc MIEAust Paul Harvey-Walker BE FIEAust David McConnell BSc MIEAust Joe Marson BE MEngSc FIEAust Andrew Patterson BE FIEAust Christopher Thomas BE MEngSc MIEAust Mark Tooker BSc(Eng) MEngSc FIEAust CPEng Michael Wright BE MEngSc MIEAust

Senior Associates Steve Barrett Andrew Chitty BE MIEAust CPEng Paul Macinante BE MEnvEngSc Ben Patterson BE MIEAust Marc Roberts BE Michael Shaw BE MIEAust CPEng Michael Turner BE MIEAust

Associates Stephen Aebi BE MIEAust Simon Batt BE MIEAust Scot Cranfield Tod Hall BA (Bio) MEM (Coastal) Alexandra Stone BE MIEAust

ACEA The Association of Consulting Engineers Australia

benchmark IN QUALITY AS/NZS ISO 9001

recommend that appropriate buffer zones be retained around those watercourses considered to be 'rivers', and Attachment A shows areas where this should be further considered. Other drainage lines not considered to be significant may be developed, with stormwater controlled by piping minor storms, and conveying major flows along roadways. This is also shown on Attachment A. The location of proposed 'river' road crossing should be given additional consideration, as 'river' crossings by road would require special design.

We trust the above information meets with your requirements. Please do not hesitate to contact Eric Wingate on 4928 7777 or Mark Tooker on 9957 1619 with any queries regarding the above. As indicated in our proposal, we are available to undertake further negotiation with DIPNR should this be required.

Yours Faithfully
Patterson Britton & Partners

Reviewed by Date

.....

Mark Tooker
Principal

Patterson Britton
& Partners Pty Ltd

Not a Creek
Creek
Creek
Not a Creek
Not a Creek
Not a Creek
Not a Creek
Not a Creek
Creek: 20m Buffer either side
at head of creek.
(within subject site)
Creek
20m buffer at
head end of creek
Not a Creek
Not a Creek
Not required as a floodway
(Can be piped / run along roads)
Not a Creek
Not a Creek
(Not considered a creek and
not required as a floodway)
Creek
20m Buffer either side
at head of creek.
Not a Creek
(Dam is limit of creek)
Not a Creek
Creek
Not a Creek
(Highly Modified)
Not a Creek
Not a Creek
Creek
Not a Creek
Creek
Flood evacuation
problems may preclude
development in this area

40 0 80 160 200 Metres
SCALE 1:10000

Sources:
- Creek alignments based on "architectus" overlay of 1:25,000 topographic map
- Aerial Survey of Site Supplied by JW Planning Pty Ltd
5368.01_North Cooranbong Creeks - FIGURE 1.dwg

NOTES:

1 - All creeks to have 40m buffer on either side unless noted otherwise

2 - Where creek on 1:25,000 topographic map does not match survey. Then survey to be used to locate creeks.

Attachment A
North Cooranbong Investigation Area
Creek Assessment

Appendix 2

Photographic record



Quadrat 1 – evidence of recent fire


Quadrat 2



Quadrat 3 – drainage line



Quadrat 4



Quadrat 5 – shallow gully



Quadrat 6



Quadrat 7



Quadrat 8



Quadrat 9



Quadrat 10



Quadrat 12



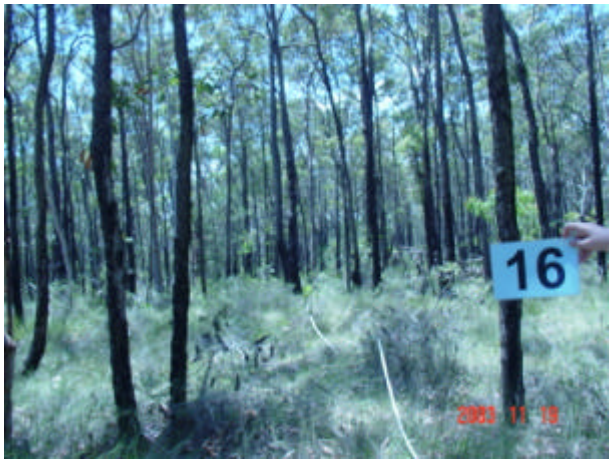
Quadrat 13 – bushland beside airstrip



Quadrat 14



Quadrat 15



Quadrat 16



Quadrat 17



Quadrat 18



Quadrat 19



Quadrat 20


Quadrat 21



Quadrat 22



Quadrat 23 – paddock with trees



Quadrat 24



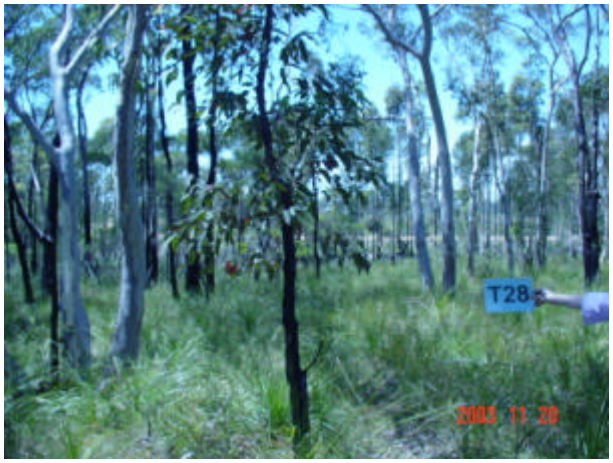
Quadrat 25



Quadrat 26 – woodland next to swamp



Quadrat 27 – swampy creekline



Quadrat 28



Quadrat 29



Quadrat 31



Quadrat 32



Quadrat 33 - Melaleuca swamp



Quadrat 34



Quadrat 35



Quadrat 36



Quadrat 37 – perpendicular to creekline



Quadrat 38



Quadrat 39



Quadrat 40 – State Forest land



Spot location A - Airstrip



Spot location B - Airstrip



Spot location C



Spot location D



Spot location E



Spot location F – disturbed swampy area



Spot location G


Spot location H


Spot location I – grazed understorey


Spot location J – grazed understorey


Spot location L


Spot location M



Spot location N



Spot location O



Spot location P


Spot location Q



Spot location R



Spot location S



Spot location T



Spot location U - creekline



Spot location V



Spot location W – trees with cleared, grazed understorey



Spot location X



Spot location Y



Spot location Z



Spot location AB



Spot location AC



Spot location AD – canopy height to 20 m



Spot location AE



Spot location AF – regenerating species amongst mown vegetation

Appendix 3

Final Determination for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence to omit reference to Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion from Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species:

Acacia irrorata
Acacia longifolia
Acmena smithii
Adiantum aethiopicum
Allocasuarina littoralis
Banksia oblongifolia
Banksia spinulosa
Baumea articulata
Baumea juncea
Blechnum camfieldii
Blechnum indicum
Breynia oblongifolia
Callistemon salignus
Calochlaena dubia
Carex appressa
Casuarina glauca
Centella asiatica
Dianella caerulea
Dodonaea triquetra
Elaeocarpus reticulatus
Entolasia marginata
Entolasia stricta
Eucalyptus botryoides
Eucalyptus longifolia
Eucalyptus resinifera subsp. *hemilampra*
Eucalyptus robusta
Ficus coronata
Gahnia clarkei
Gahnia sieberiana
Glochidion ferdinandi
Glycine clandestina
Gonocarpus tetragynus
Hydrocotyle peduncularis
Hypolepis muelleri

Imperata cylindrica var. *major*
Isachne globosa
Leptospermum polygalifolium subsp. *polygalifolium*
Livistona australis
Lomandra longifolia
Lophostemon suaveolens
Melaeuca ericifolia
Melaleuca linariifolia
Melaleuca quinquenervia
Melaleuca sieberi
Melaleuca styphelioides
Morinda jasminoides
Omalanthus populifolius
Oplismenus aemulus
Oplismenus imbecillis
Parsonsia straminea
Phragmites australis
Polyscias sambucifolia
Pratia purpurascens
Pteridium esculentum
Stephania japonica var. *discolor*
Themeda australis
Villarsia exaltata
Viola banksii
Viola hederacea

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

4. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia* (woollybut). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp turpentine). A layer of small trees may be present, including *Acacia irrorata* (green wattle), *Acmena smithii* (lilly pilly), *Elaeocarpus reticulatus* (blueberry ash), *Glochidion ferdinandi* (cheese tree), *Melaleuca linariifolia* and *M. styphelioides* (paperbarks). Shrubs include *Acacia longifolia* (Sydney golden wattle), *Dodonaea triquetra* (a hopbush), *Ficus coronata* (sandpaper fig), *Leptospermum polygalifolium* subsp. *polygalifolium* (lemon-scented tea tree) and *Melaleuca* spp. (paperbarks). Occasional vines include *Parsonsia straminea* (common silkpod), *Morinda jasminoides* and *Stephania japonica* var. *discolor* (snake vine). The groundcover is composed of abundant sedges, ferns, forbs, and grasses including *Gahnia clarkei, Pteridium esculentum* (bracken), *Hypolepis muelleri* (batswing fern), *Calochlaena dubia* (false bracken), *Dianella caerulea* (blue flax lily), *Viola hederacea, Lomandra longifolia* (spiny-headed mat-rush) and *Entolasia marginata* (bordered panic) and *Imperata cylindrica* var. *major* (blady grass). The endangered swamp orchids *Phaius australis* and *P. tankervillei* are found in this community. On sites downslope of lithic substrates or with soils of clay-loam texture, species such as

Allocasuarina littoralis (black she-oak), *Banksia oblongifolia, B. spinulosa* (var. *collina* or var. *spinulosa*) (hairpin banksia), *Ptilothrix deusta* and *Themeda australis* (kangaroo grass), may also be present in the understorey. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

5. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law *et al*. 2000). The blossoms of *Eucalyptus robusta* and *Melaleuca quinquenervia* are also an important food source for the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Common Blossom Bat (*Sycoyncteris australis*) (Law 1994), as well as the Yellow-bellied Glider (*Petaurus australis*), Sugar Glider (*Petaurus breviceps*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*). Other animals found in this community include the Osprey (*Pandion haliaetus*), Australasian Bittern (*Botaurus poiciloptilus*), Large-footed myotis (*Myotis adversus*), *Litoria olongburensis* and Wallum Froglet (*Crinia tinnula*).

6. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Sclerophyll Forest on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include: its relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *E. botryoides*, the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover. It generally occupies small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains. The soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water.

7. Swamp Sclerophyll Forest on Coastal Floodplains includes and replaces Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Subtropical Floodplain Forest, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, as soils become less waterlogged, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. As soil salinity increases Swamp Sclerophyll Forest on Coastal Floodplains may intergrade with, and be replaced by, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston *et al.* 2003, Stevenson 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes the *Eucalyptus robusta* (Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), those areas on floodplains mapped as 'Forest Ecosystem 112, Paperbark', and those areas on floodplains mapped as 'Forest Ecosystem 142, Swamp Mahogany' are included within this community. On the Tweed lowlands, this community includes '*Eucalyptus robusta* mid-high to very tall closed forest' (F7), '*Archontophoenix cunninghamiana-Melaleuca quinquenervia* very tall feather palm swamp forest'

(F9), those parts of *Melaleuca quinquenervia* tall to very tall open to closed forest' (F8) on alluvial soils and parts of 'Floodplain Wetland Complex' (FL) dominated by *Eucalyptus robusta* or *Melaleuca quinquenervia* (Pressey and Griffith 1992). In the lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a) of NPWS (2000). In the Sydney-Gosford region, this community includes those parts of 'Freshwater Swamp complex' (map unit 27a) dominated by *Eucalyptus robusta* or *E. botryoides* (Benson 1986, Benson and Howell 1994) and parts of the 'Freshwater wetlands – on the floodplains' of Benson and Howell (1990) and Benson et al. (1996). In the Illawarra, this community includes 'Alluvial swamp mahogany forest' (map unit 35) of NPWS (2002). On the south coast, this community includes 'Northern Coastal Lowlands Swamp Forest' (forest ecosystem 175) of Thomas *et al*. (2000) and 'Coastal Sand Swamp Forest' (map unit 45) of Tindall *et al*. (2004). Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' and 'Coastal Swamp Forest' vegetation classes of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Sclerophyll Forest on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forest on Floodplains, currently cover 800-1400 km2, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Sclerophyll Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. For example, there were less than 350 ha of native vegetation attributable to this community on the Tweed lowlands in 1985 (Pressey and Griffith 1992), less than 2500 ha on the Clarence floodplain in 1982 (Pressey 1989a), less than 700 ha on the Macleay floodplain in 1983 (Pressey 1989b), up to 7000 ha in the lower Hunter – central coast district during the 1990s (NPWS 2000), and less than 1000 ha in the Sydney – South Coast region in the mid 1990s (Tindall *et al*. 2004), including less than 40 ha on the Illawarra plain in 2001 (NPWS 2002) and about 450 ha on the South Coast in the 1990s (Thomas *et al*. 2000).

10. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Sclerophyll Forest on Coastal Floodplains in other parts of the NSW North Coast bioregion (Goodrick 1970, Pressey 1989a, 1989b). In the lower Hunter – central coast district, about 30 % of the original area of Swamp mahogany – paperbark forest was estimated to remain in the 1990s (NPWS 2000).

11. Land clearing continues to threaten Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey and Griffith 1992, NPWS 2000), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnston *et al*. 2003). Anthropogenic climate change may also threaten Swamp Sclerophyll Forest on Coastal Floodplains if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire and Removal of

dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Act (1995).

12. Large areas of habitat formerly occupied by Swamp Sclerophyll Forest on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, Boulton and Brock 1999). While much of the early drainage works were associated with agricultural development, more recently they are associated with urban expansion. Additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith 1992). On the north coast of NSW, expansion of *Melaleuca quinquenervia* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al*. 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al*. 2003).

13. Relatively few examples of Swamp Sclerophyll Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Sclerophyll Forest on Coastal Floodplains include *Andropogon virginicus* (whiskey grass), *Anredera cordifolia* (Madeira vine), *Ageratina adenophora* (crofton weed), *Baccharis halimifolia* (groundsel bush), *Cinnamomum camphora* (camphor laurel), *Lantana camara* (lantana), *Ligustrum sinense* (small-leaved privet), *Lonicera japonica* (Japanese honeysuckle) and *Ludwigia peruviana* (Keith and Scott 2005).

14. Small areas of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.

16. In view of the above the Scientific Committee is of the opinion that Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam
Chairperson
Scientific Committee

Proposed Gazettal date: 17/12/04
Exhibition period: 17/12/04 – 28/01/05

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About the NSW Scientific Committee

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Last amended: 16 December 2004.

Appendix 4

Letter from Royal Botanic Gardens confirming identification of threatened species recorded on the Site (dated 29 January 2004)

ROYAL BOTANIC GARDENS SYDNEY

Mr Sian Wilkins
Anne Clements & Assoc. Pty Ltd
PO Box 1623
North Sydney NSW 2059
Australia

Inquiry No: 8825
Telephone No: (02) 9231 8155#
Fax No: (02) 9251 1952

Date: 29 January 2004

Dear Sian,

In reply to your inquiry of 15 January, 2004 the following information is supplied:

This letter is to confirm the identifications of your recent enquiry as:

Tetratheca juncea, specimen retained

Grevillea parviflora subsp. *parviflora*, specimen retained

Angophora inopina

An invoice for $27.50 (incl. GST) will be forwarded to you separately by our finance section to cover cost of identification.

Thank you for your inquiry.

Yours sincerely

Barbara Wiecek, Identifications Botanist
Botanical Information Service

The Botanical Information telephone service operates between 9:30 am and 1 pm Monday to Friday.

Appendix 5

Noxious weeds list for the Lake Macquarie LGA

NSW DEPARTMENT OF PRIMARY INDUSTRIES | AGRICULTURE

Noxious weed declarations in NSW

Lake Macquarie

The following weeds are declared noxious in the Lake Macquarie control area. The 'details' link on each listing provides further information on the legal requirements of the weed's listing and any variation in status within the local control area. A complete list of all weeds in all control areas is also available as a PDF document.

Common name	Scientific name	Category	
African boxthorn	*Lycium ferocissimum*	W2	details
Alligator weed	*Alternanthera philoxeroides*	W1	details
Bathurst Noogoora Californian Cockle burrs	*Xanthium spp.*	W3	details
Bitou bush Boneseed	*Chrysanthemoides monilifera*	W3	details
Black knapweed	*Centaurea nigra*	W1	details
Blackberry	*Rubus fruticosus (agg. spp.)*	W3	details
Broomrape	*Orobanche spp.*	W1	details
Cabomba	*Cabomba spp.*	W4g	details
Columbus grass	*Sorghum x almum*	W2	details
Crofton weed	*Ageratina adenophora*	W2	details
Dodder	*Cuscuta campestris*	W2	details
Giant Parramatta grass	*Sporobolus fertilis syn. Sporobolus indicus var. major*	W2	details
Green cestrum	*Cestrum parqui*	W3	details
Groundsel bush	*Baccharis halimifolia*	W2	details
Harrisia cactus	*Harrisia spp.*	W4f	details
Hawkweed	*Hieracium spp.*	W1	details
Horsetail	*Equisetum spp.*	W1	details
Johnson grass	*Sorghum halepense*	W2	details
Karroo thorn	*Acacia karroo*	W1	details
Kochia	*Kochia scoparia*	W1	details
Lagarosiphon	*Lagarosiphon major*	W1	details
Mexican feather grass	*Nassella tenuissima syn Stipa tenuissima*	W1	details
Miconia	*Miconia spp.*	W1	details
Mistflower	*Ageratina riparia*	W3	details
Pampas grass	*Cortaderia spp.*	W2	details
Parthenium weed	*Parthenium hysterophorus*	W1	details
Prickly pears	*Opuntia spp.*	W4f	details
Rhus tree	*Toxicodendron succedaneum*	W2	details
Salvinia	*Salvinia molesta*	W2	details
Senegal tea plant	*Gymnocoronis spilanthoides*	W1	details
Siam weed	*Chromolaena odorata*	W1	details
Spiny burrgrass	*Cenchrus incertus*	W2	details
Spiny burrgrass	*Cenchrus longispinus*	W2	details
Spotted knapweed	*Centaurea maculosa*	W1	details
St John's wort	*Hypericum perforatum*	W2	details

Water hyacinth	*Eichhornia crassipes*	W3	details
Water lettuce	*Pistia stratiotes*	W1	details
Willows	*Salix spp.*	W4g	details

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The information contained in this web page is based on knowledge and understanding at the time of writing. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser.

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1 March 2005

Assessment of impact of the proposed rezoning, subdivision and residential development in the North Cooranbong on:

- the Vulnerable species *Angophora inopina*;
- the Vulnerable species *Grevillea parviflora* subsp. *parviflora;*
- the Vulnerable species *Tetratheca juncea*; and
- the Endangered Ecological Community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

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3. Distribution of *Angophora inopina* on and adjacent to the Site in relation to the Structure Plan
4. NPWS Wildlife Atlas mapping of *Angophora inopina*
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6. Distribution of *Tetratheca juncea* on and adjacent to the Site in relation to the Structure Plan
7. Payne (2001) mapping of *Tetratheca juncea* in the region
8. Sampling locations containing vegetation meeting the criteria for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions in relation to the Structure Plan
9. NPWS (2003) mapping of Riparian Melaleuca Swamp Woodland in the region

Appendices
1. Commonwealth Environment Protection and Biodiversity Conservation Act Administrative Guidelines on Significance (July 2000)

2. Threatened Species Information for *Grevillea parviflora* subsp. *parviflora* (NPWS 2002)
3. Email correspondence from Michael Murray of Forest Fauna Surveys P/L dated 16 September 2004
4. NPWS (2000) Environmental Impact Assessment Guidelines for *Tetratheca juncea*

1.0 Introduction

This report assesses the potential impacts of a proposed rezoning, and potential future subdivision and residential development in the North Cooranbong (the Site, Figure 1) on:

- Three species listed as Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995 - *Angophora inopina*, *Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea;* and
- The endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions under NSW Threatened Species Conservation Act 1995.

These species and communities were identified in the flora assessment undertaken by Clements *et al*. (2004).

2.0 The proposal

The Structure Plan for North Cooranbong (Figure 2) with the conservation corridor areas is in accord with the recommendation of the flora assessment (Clements *et al.* 2004), namely that:

- A wide corridor from Olney State Forest be extended to join with the south flowing creek line adjoining the southern boundary of the Avondale land. Sections of this proposed corridor will require some re-creation using bush regeneration techniques. The south western section of the airport runway which forms part of the corridor will be allowed to continue to naturally regenerate.
- A second wide corridor be established linking the north east vegetated area (north of Avondale College school) with its associated south east flowing creekline to the creekline in the north west of Avondale land and extending along the associated west flowing creekline.

It is proposed to conserve the vegetation of the drainage lines in North Cooranbong in approximately 100 m to 430 m wide corridors.

3.0 Assessment of impact

3.1 Environment Protection and Biodiversity Conservation Act (1999)

In the Administrative Guidelines on Significance July 2000 (Appendix 1) on page 13, it is stated that:

> *"proposed urban development for a housing subdivision or an industrial estate on an area which contains a nationally listed threatened community or nationally listed threatened species is likely to be significant under the Act and should be referred to the Commonwealth Environment Minister."*

The test for significance of impact has been assessed by applying the 8 part test under the New South Wales Threatened Species Conservation Act 1995.

3.2 New South Wales Threatened Species Conservation Act (1995)

An 8 part test under Section 94 of the NSW Threatened Species Conservation Act (1995) (TSC Act) is:

a statutory mechanism which allows decision makers to assess whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities (NPWS November 1996).

If the application of the 8 part test reveals that a significant impact is likely then:

- A species impact statement (SIS) must be prepared and the concurrence of the Director-General of National Parks and Wildlife, or consultation with the Minister for the Environment is required; and/or
- The proposal may be modified such that a significant effect on threatened species, populations or ecological communities, or their habitats is unlikely (NPWS November 1996).

3.2.1 *Angophora inopina*

Angophora inopina is described in Harden (2002) as:

> *Tree to 8 m high, often multistemmed; bark persistent, grey, shortly fibrous. Juvenile leaves not seen. Adult leaves lanceolata to broad-lanceolata, 4-11 cm long, 0.8-2.6 cm wide, apex acute, base acute, glabrous, discolorous, regular penniveined; petiole 5-8 cm. Peduncle 3-17 mm long, hispid; pedicels 10-15 mm long, usually hispid. Buds globose, 5-6 mm long, 6-8 mm diam. Petals 3-4 mm wide, 3-4 mm long. Hypanthium ribbed. Fruit cup-shaped to pyriform, 11-15 mm long, 5-7 mm diam.; disc flat, obscured by rim of hypanthium. In open woodland with a dense shrub understorey on deep white sandy soils over sandstone, restricted to Charmhaven - Wyee area.*

In the survey by Clements *et al.* (2004), *A. inopina* was recorded at 24 sampling locations on the Site (19 quadrats Q1, Q2, Q3, Q8, Q10, Q13, Q19, Q20, Q21, Q24, Q25, Q31, Q37, Q38, Q39, Q45, Q46, Q47 and five Spot locations I, L, M, N, Y) and in four sampling locations adjacent to the Site (one quadrat Q43 and three Spot locations AM, AN, AP).

The distribution of this species on and adjacent to the Site in relation to the Structure Plan is shown in Figure 3.

The soils of the Site are derived from the map unit Rnc, part of the Narrabeen Group, described as “Claystone, sandstone and shale” with map unit Qa, described as “Alluvium, gravel, sand, silt and clay” (Bryan 1965 cited in Clements *et al.* 2004).

The proposal involves the development of 188.3 ha of the 278.3 ha Site. Of the 188.3 ha of the Site proposed for development, it is estimated from the 2002 aerial photograph interpretation that approximately 112.33 ha constitutes potential habitat for *A. inopina*.

Angophora inopina occurs within the proposed conservation corridor, which includes 11 of 24 sampling locations in which it was recorded. Of the 90 ha of the Site nominated as conservation and biodiversity corridor, it is estimated from aerial photograph interpretation that approximately 87.5 ha constitutes potential habitat for *A. inopina*.

The conservation corridor maintains connectivity between the *A. inopina* recorded on the Site and those recorded in four sampling locations outside the Site boundary.

3.2.1.1 Application of the 8 part test for *Angophora inopina*

(a) In the case of a threatened species, whether the lifecycle of a species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Angophora inopina appeared to be widespread across the Site, based on the vegetation survey by Clements *et al.* (2004). Of the 24 recorded locations of *A. inopina* on the Site, 11 were within the approximately 90 ha conservation corridor. The conservation corridor maintains connectivity between the *A. inopina* recorded on the Site and known and potential *A. inopina* habitat adjacent to the Site.

As such, it is unlikely that the proposed development under the Structure Plan will disrupt the life cycle of the species such that the local population of *A. inopina* is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

N/A. There are no listed endangered populations of *A. inopina* in the Lake Macquarie LGA.

(c) In relation to the regional distribution of the habitat of the threatened species, population or ecological community, whether a significant area of known habitat is to be removed or modified.

The proposed development under the Structure Plan will remove approximately 112.33 ha of known and potential *A. inopina* habitat from the Site. It will also conserve and enhance approximately 87.5 ha of known and potential *A. inopina* habitat in long-term sustainable conservation corridors. The conservation corridor will maintain connectivity between the *A. inopina* population on the Site and adjoining populations to the east and west.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Currently there appear to be interconnecting areas of habitat for *A. inopina* on and surrounding the Site (Figure 3). The species was recorded in four sampling locations outside the Site boundary, which are located close to the corridor areas on the Site.

The approximately 90 ha conservation corridor maintains connectivity between the *A. inopina* recorded on the Site and known and potential *A. inopina* habitat adjacent to the Site. The area of habitat retained in the conservation corridor is unlikely to become isolated from proximate areas of habitat.

(e) Whether critical habitat will be affected.

No. No critical habitat has been declared under the TSC Act.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

A search of the NPWS Wildlife Atlas (www.wildlifeatlas.nationalparks.nsw.gov.au searched 28 February 2005) indicated that *A. inopina* occurs in:

- Karuah National Park, in the Great Lakes LGA;
- Wallaroo State Forest in the Port Stephens LGA; and
- State Conservation Areas at Wyee Bay and Chain Valley Bay.

The State Conservation Area at Wyee Bay is approximately 7 km south-east of the Site (Figure 4).

> (g) *Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process.*

The clearing of native vegetation (gazetted 21 September 2001) is listed as a Key Threatening Process on Schedule 3 of the TSC Act. *A. inopina* is listed as one of the species adversely affected by this key threatening process.

Any future development will involve clearing of native vegetation.

> *(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.*

The limits of the known distribution of *A. inopina* are:

- Southern limit: the Wallarah catchment, north Wyong;
- Northern limit: Bulahdelah in the Great Lakes Shire; and
- Western limits: Avondale near Cooranbong and west of the Sydney-Newcastle Freeway in North Wyong (NPWS Wildlife Atlas, http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/, accessed 28 February 2005).

This equates to a north-south range of about 100 km and an east-west range of about 60 km.

The Site is at the western known limit of distribution for *A. inopina.*

3.2.1.2 Conclusions from the 8 part test for *Angophora inopina*

Angophora inopina is widespread over the Site including within the 100 to 430 m wide conservation corridors on the Site with connectivity to the adjoining vegetation. Securing conservation corridors to the north-east and to the west are required given that only 11 of the 24 recorded *A. inopina* sampling locations are within the proposed conservation corridors.

For long-term conservation of *A. inopina,* the proposed conservation corridors should be connected to the north-east (Council land), north-west (private land) and south-west (Olney State Forest). If this is implemented, then from application of the 8 part test it is concluded that the proposed Cooranbong North Structure Plan is unlikely to adversely impact *A. inopina* in Cooranbong North in the long term.

3.2.2 *Grevillea parviflora* subsp. *parviflora*

Grevillea parviflora R.Br. subsp. *parviflora* is described in Harden (2002) as:

> *Low spreading, dense to erect shrub usually ≤1m high*, … *Major branches ascending to erect, branchlets not secund; leaves mostly 0.8-1.3 mm wide; stipe of ovary 1-1.2 mm long. Grows in heath or shrubby woodland, in sandy*

or light clay soils usually over thin shales; mainly from the Prospect area (where probably now extinct) and lower Georges River to Camden, Appin and Cordeaux Dam area; disjunct population near Putty, Cessnock and Cooranbong, and possibly near Moss Vale.

In the survey by Clements *et al.* (2004), *Grevillea parviflora* subsp. *parviflora* was recorded at nine sampling locations on the Site (six quadrats Q1, Q5, Q12, Q15, Q30, Q39, and three Spot locations A, B, L,) and in three sampling locations adjacent to the Site (one Quadrat Q40 and two Spot locations AL, AM).

The distribution of this species on and adjacent to the Site in relation to the Structure Plan is shown in Figure 5.

Of the nine sampling locations where *G. parviflora* subsp. *parviflora* was recorded on the Site, eight sampling locations (Q1, Q12, Q15, Q30, Q39, Spot locations A, B and L) are located within the proposed conservation corridors as nominated on the Structure Plan development.

3.2.2.1 Application of the 8 part test for *Grevillea parviflora* subsp. *parviflora*

(a) In the case of a threatened species, whether the lifecycle of a species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Eight of the nine sampling locations in which *Grevillea parviflora* subsp. p*arviflora* was recorded will be conserved within the long-term conservation corridors proposed as part of the future site development, ranging in width from 100 m to 430 m. *G. parviflora* subsp. p*arviflora* appears to be widespread and abundant within the corridor area and it is unlikely that the proposed development will disrupt the lifecycle of the species such that the local population is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

N/A. There are no listed endangered populations of *Grevillea parviflora* subsp. p*arviflora* in the Lake Macquarie LGA.

(c) In relation to the regional distribution of the habitat of the threatened species, population or ecological community, whether a significant area of known habitat is to be removed or modified.

Most of the area (eight out of the nine sampling locations on the Site) where *G. parviflora* subsp. *parviflora* was recorded will be conserved under the proposed long-term conservation corridors. A small area of known habitat will be removed under any future Site development, but it is not considered to be a significant area compared to the 90 ha of land to be set aside as a conservation corridor.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

No. *Grevillea parviflora* subsp. p*arviflora* will be conserved on the Site in sustainable long-term conservation corridors of approximately 100 m to 430 m in width. The

corridors link with other areas of known and potential habitat outside the Site; one record of the species occurs to the west of the Site (Q40, approximately 180 m to the west of the Site) and two records occur to the north-east (Spot location AM, 380 m to the east of the Site and Spot location AL, 540 m to the east of the Site).

(e) Whether critical habitat will be affected

No. No critical habitat has been declared under the TSC Act.

(f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

Grevillea parviflora subsp. parviflora is known to occur in only one reserve, Werakata National Park, in which a substantial population occurs (NPWS 2002, Appendix 2). Werakata National Park is approximately 24 km to the north of the Site.

(g) *Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process.*

The clearing of native vegetation (gazetted 21 September 2001) is listed as a Key Threatening Process on Schedule 3 of the TSC Act. *Grevillea parviflora* subsp. *parviflora* is listed as one of the species adversely affected by this key threatening process.

Any future development will involve clearing of native vegetation, though eight of the nine sampling location in which it was recorded are with the proposed conservation corridors.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The main distribution of *Grevillea parviflora* subsp. p*arviflora* is in the south of Sydney in the Appin-Wedderburn-Picton-Bargo districts, with disjunct northern populations found in the Lower Hunter Valley and at Dooralong, Cooranbong and Awaba (NPWS 2002).

The Site does not appear to be at the limit of the known distribution for *Grevillea parviflora* subsp. p*arviflora;* it appears to be in the centre of the northern distribution of this species (see map in NPWS 2002, Appendix 2).

3.2.2.2 Conclusions from the 8 part test for *Grevillea parviflora* subsp. *parviflora*

From the application of the 8-part test, it is concluded that the proposed Cooranbong North Structure Plan is unlikely to adversely impact *Grevillea parviflora* subsp. *parviflora.*

3.2.3 Tetratheca juncea

T. juncea is described in Harden (1993) as :

a prostrate shrub with stems to 1 m long; stems with 2 or 3 wings, glabrous with minute tubercles. Leaves alternate, usually reduced to narrow-triangular scales, to 3 mm long, otherwise +/- narrow-elliptic, to 20 mm long and c. 5 mm wide, glabrous, margins flat or recurved; sessile. Flowers are solitary or

paired; peduncles 5-10 mm long, glabrous. Sepals 1-1.5 mm long, pink. petals 7-11 mm long, deep lilac-pink. Flowers mostly July to December. Grows in sandy, occasionally swampy heath and in dry sclerophyll forest; chiefly in coastal districts from Buladelah to Lake Macquarie, also recorded from Port Jackson to Botany from which it is possibly extinct.

In the survey by Clements *et al.* (2004), *T. juncea* was recorded at six sampling locations on the Site (three quadrat Q12, Q19, Q20 and three Spot locations C, E, P) and in one sampling location adjacent to the Site (one Spot location AL). Additionally, Michael Murray of Forest Fauna Surveys P/L (email correspondence in Appendix 3) recorded approximately 23 to 24 clumps of *T. juncea* on the Site during fauna investigations on 14 and 15 September 2004. The distribution of this species on and adjacent to the Site in relation to the Structure Plan is shown in Figure 6.

Of the six sampling locations where *T. juncea* was recorded on the Site, four (Q12, Q20, Spot locations C and P) are located within the proposed conservation corridors as part of the proposed development. Of the additional 23-24 clumps recorded by Michael Murray, 19-20 clumps are located within the proposed conservation corridors and four are located outside the conservation corridor.

It appears likely that there is additional potential habitat for *T. juncea* on the Site outside of the recorded sampling locations. Inferring from the records from the current surveys:

- Of the six sampling locations on the Site containing *T. juncea* recorded by Clements *et al.* (2004), four (66%) were within the conservation corridor and two were outside the conservation corridors; and
- Of the 23-24 clumps of *T. juncea* recorded by Michael Murray, 19-20 (83%) were within the conservation corridors and four were outside the conservation corridors.

3.2.2.1 Application of the 8 part test for *Tetratheca juncea*

(a) In the case of a threatened species, whether the lifecycle of a species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

NPWS (2000) states that, "key components of the species lifecycle remain unknown. Research is currently underway investigating soil seed bank, mycorrhiza, population dynamics, fecundity and pollination."

The *T. juncea* identified on the Site appear to consitute a viable local population as defined by the environmental impact assessment guideines for *T. juncea* (Appendix 4, NPWS 2000), that is" discrete areas of *T. juncea* habitat where interchange of genetic material (e.g. seed/pollen dispersal) is likely."

Although it is proposed to remove some individuals and areas of potential habitat for *T. juncea* on the Site, it is unlikely that the local population will be placed at risk of extinction. The long-term conservation corridors proposed as part of the development, ranging in width from 100 m to 430 m, will conserve and enhance most of the individuals of *T. juncea* on the Site as well as large areas of potential habitat.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

N/A. There are no listed endangered populations of *Tetratheca juncea* in the Lake Macquarie LGA.

> *(c) In relation to the regional distribution of the habitat of the threatened species, population or ecological community, whether a significant area of known habitat is to be removed or modified.*

Tetratheca juncea was found in the south-western and central parts of the Site, as well as outside the Site to the north-east (Spot location AL). It is likely that *T. juncea* occurs elsewhere on the Site, although it was not found during sampling in November and December 2003, within the known flowering season for this species.

The proposed development will require clearing of vegetation that includes some areas of known habitat for and may include areas of potential habitat for *T. juncea.* Known and potential habitat for *T. juncea* will be conserved and enhanced in long-term conservation corridors between 100 m and 430 m in width (Figure 6).

> *(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

No. *Tetratheca juncea* will be conserved on the Site in sustainable long-term conservation corridors of 100 m to 430 m in width. The corridors link with other areas of known and potential habitat outside the Site; one record of the species occurs to the north-east of the Site (Spot location AL, approximately 540 m to the east of the Site). The closest location of *T. juncea* mapped by Payne (2001) was approximately 1.35 km south-east of Spot location AL and approximately 1.7 km east of the Site.

Payne (2001) recommends that a maximum of 500 m be maintained between sub-populations to provide 'stepping stones' for pollinators. In terms of the mapped locations of *Tetratheca juncea,* the sub-population on the Site appears to be currently isolated, although there may be some connectivity to the east.

> *(e) Whether critical habitat will be affected.*

No. No critical habitat has been declared under the TSC Act.

> (f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The NPWS (2000) considers that *T. juncea* is adequately conserved in the south-eastern portion of its range with approximately 1300 plant clumps known from Awabakal Nature Reserve, Glenrock State Recreation Area, Lake Macquarie Recreation Area, and Munmorah State Recreation Area.

T. juncea is inadequately conserved in the northern and western portions of its range as there are no formal reserves in these areas. The Site is within the south-western portion of the known range of *T. juncea.*

> (g) *Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process.*

The clearing of native vegetation (gazetted 21 September 2001) is listed as a Key Threatening Process on Schedule 3 of the TSC Act. *Tetratheca juncea* is listed as one of the species adversely affected by this key threatening process.

Future development will involve clearing of native vegetation.

> *(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.*

The Site appears to be at the western edge of the known distribution for *Tetratheca juncea* (Figure 7)

3.2.3.2 Conclusions from the 8 part test for *Tetratheca juncea*

From the application of the 8 part test, it is concluded that the proposed Cooranbong North Structure Plan is unlikely to adversely impact *Tetratheca juncea.*

3.2.4 Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

The endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions was gazetted by Scientific Committee on 17 December 2004 under the NSW Threatened Species Conservation Act 1995.

This community is restricted to waterlogged or periodically inundated alluvial flats and drainage lines. The vegetation recorded on and adjacent to the Site was compared with the Final Determination for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions in Clements *et al.* (2004). Nine sampling locations on the Site and two adjacent to the Site satisfied the criteria for Swamp Sclerophyll Forest (Figure 8).

3.2.4.1 Application of the 8 part test for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

> *(a) In the case of a threatened species, whether the lifecycle of a species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

N/A. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions is not a threatened species.

> *(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.*

N/A. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions is not an endangered population.

> *(c) In relation to the regional distribution of the habitat of the threatened species, population or ecological community, whether a significant area of known habitat is to be removed or modified.*

The proposed development under the Structure Plan includes conservation corridors ranging in width from 100 m to 430 m. The corridors will conserve the major creeklines that cross the Site and the adjoining vegetation. All the sampling locations on the Site that meet the criteria for Swamp Sclerophyll Forest are located within the conservation corridors.

As such, no areas of known habitat for Swamp Sclerophyll Forest will be removed or modified.

> *(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

No. The proposed long-term conservation corridors on the Site will maintain the connectivity between Swamp Sclerophyll Forest occurring on the Site and adjacent areas of this vegetation community.

> *(e) Whether critical habitat will be affected.*

No. No critical habitat has been declared under the TSC Act.

> (f) *Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

No. According to the Final Determination for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, this community is conserved in Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. The closest of these reserves to the Site is Garigal National Park, approximately 74 km to the south.

> (g) *Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process.*

The clearing of native vegetation (gazetted 21 September 2001) is listed as a Key Threatening Process on Schedule 3 of the TSC Act. The future Site development will involve clearing of native vegetation, the Swamp Sclerophyll Forest on the Site will not be affected by it as it is all retained in the conservation corridors.

> *(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.*

Swamp Sclerophyll Forest occurs in the NSW North Coast, Central Coast and South East Corner Bioregions. In the Lower Hunter-Central Coast region, this community includes the NPWS (2003) map units 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a). Riparian Melaleuca Swamp Woodland (map unit 42) has been mapped to the west and south-west of the Site, however it does not extend west for more than a few kilometres (Figure 9).

The Site appears to be close to the known western limit of distribution for Swamp Sclerophyll Forest in the region.

3.2.4.2 Conclusions from the 8 part test for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

From application of the 8 part test, it is concluded that the proposed Cooranbong North Structure Plan is unlikely to adversely impact Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

4.0 Conclusions

From application of the 8 part tests, it is concluded that the future urban development under the proposed Cooranbong North Structure Plan which incorporates 100 to 430 m wide conservation corridors is unlikely to adversely impact the three Vulnerable plant species (*Angophora inopina*, *Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea*) and the endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

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Figures

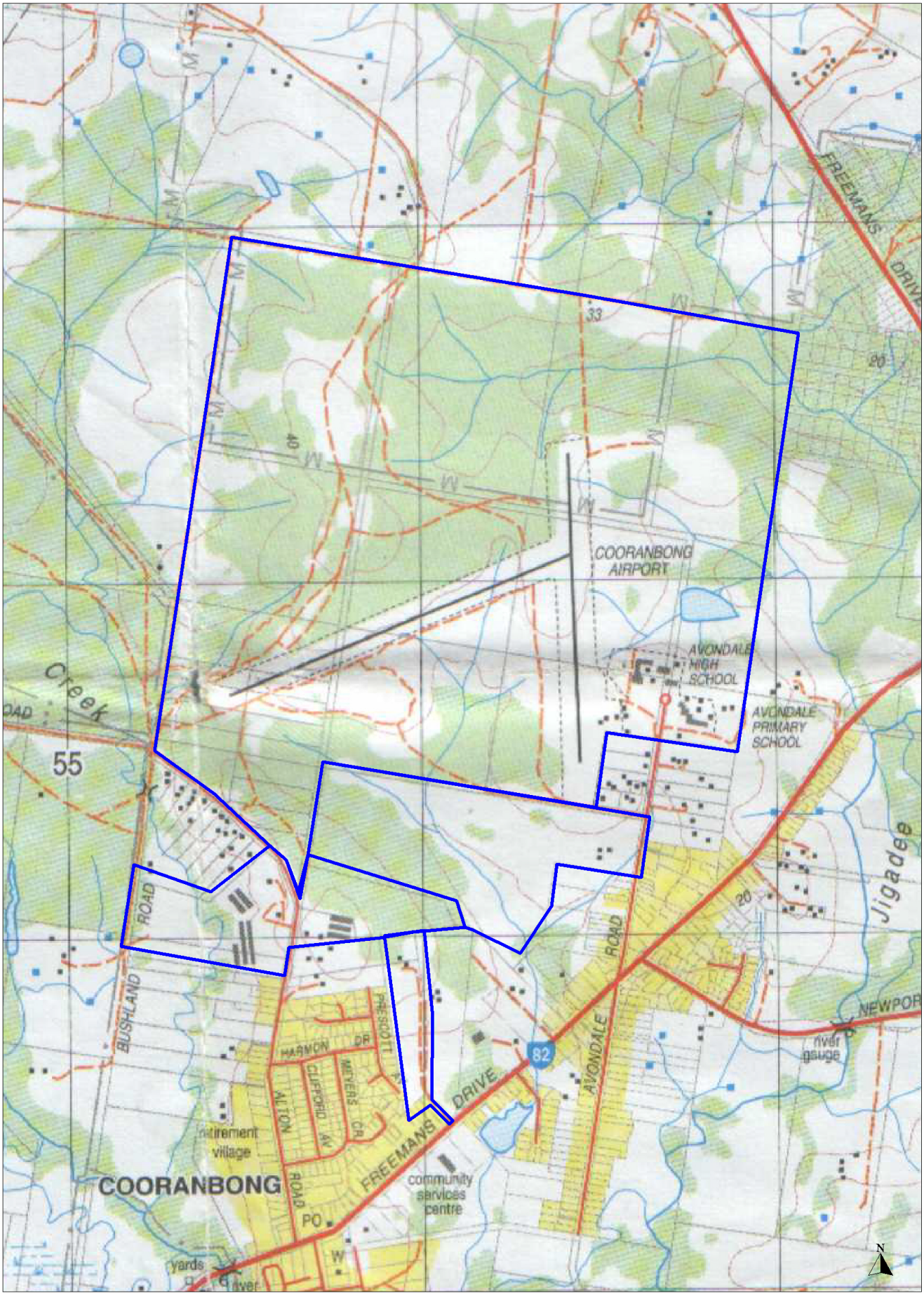


Figure 1.
Site location



AREA	retained landscape (ha)	developable land (ha)	TOTALS
1	74.5 ha	155.1 ha	229.6 ha
2	8.5 ha	18.5 ha	27.0 ha
3	6.0 ha	11.2 ha	17.2 ha
4	1.0 ha	3.4 ha	4.4 ha
TOTALS	90.0 ha	188.2 ha	278.2 ha

Figure 2.
Structure Plan

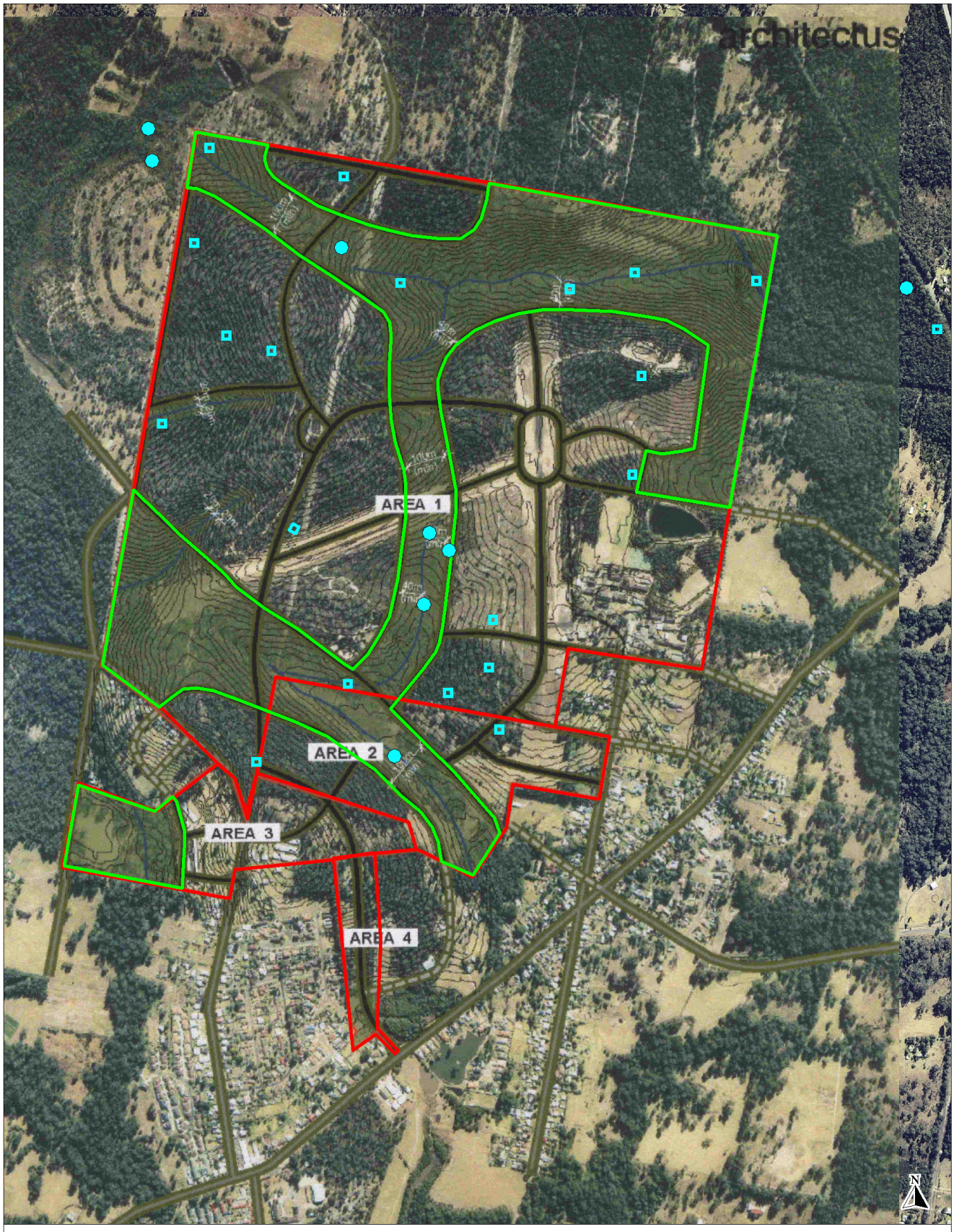
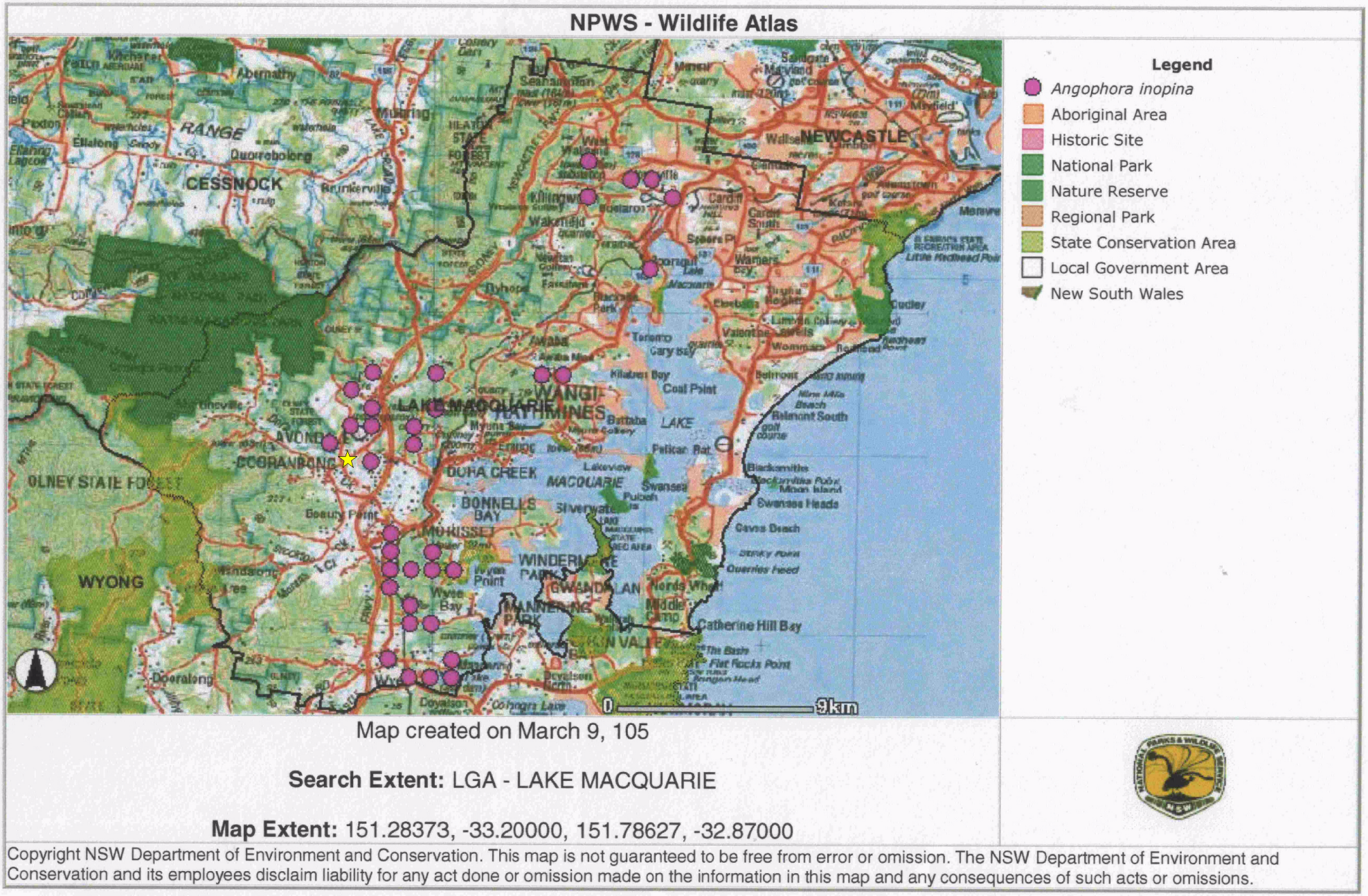


Figure 3.
Distribution of Angophora inopina on and adjacent to the Site in relation to the Structure Plan



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☆ Approximate location of the Site

Figure 4.
NPWS Wildlife Atlas mapping of Angophora inopina

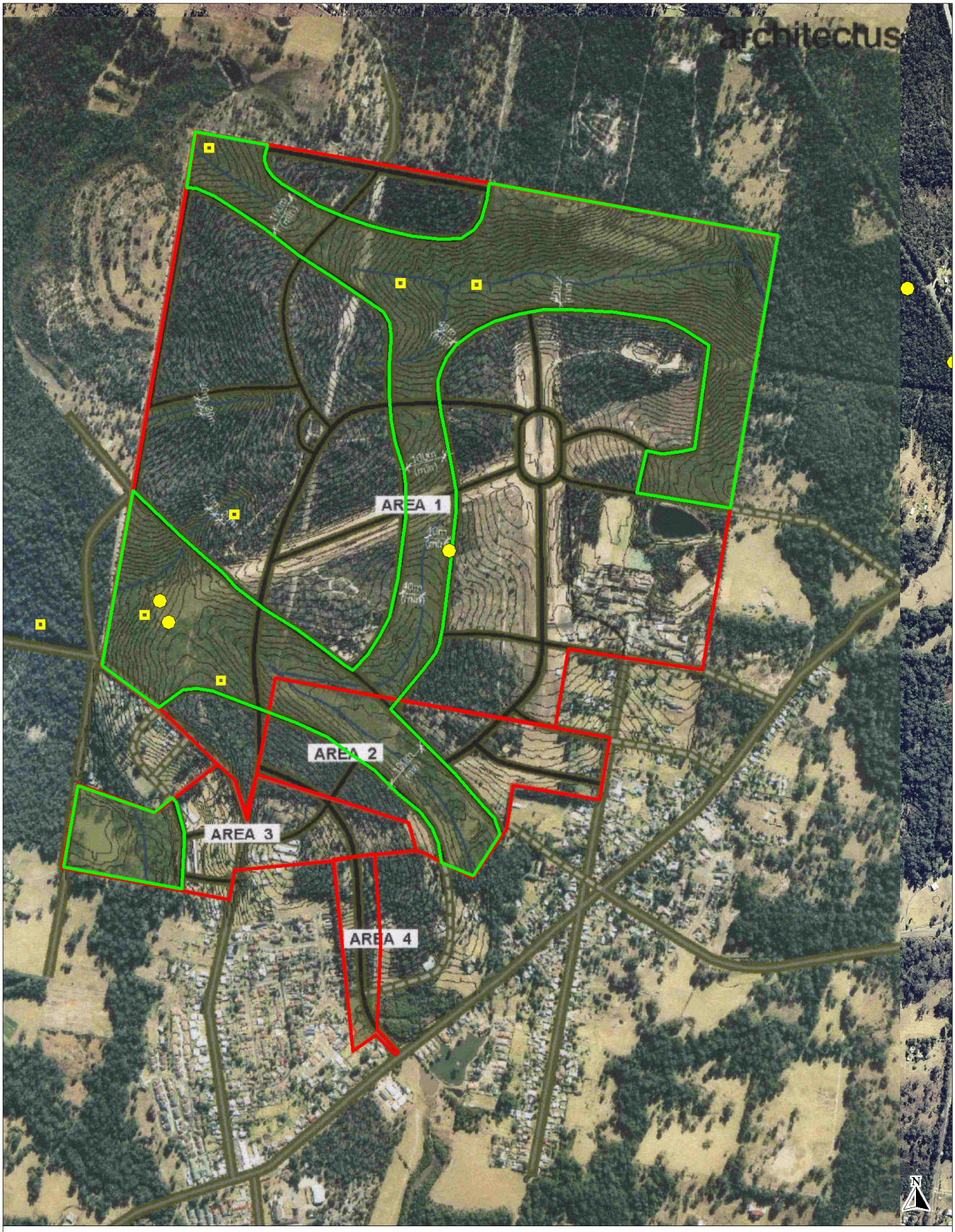

Figure 5.
Distribution of Grevillea parviflora subsp. parviflora on and adjacent to the Site in relation to the Structure Plan

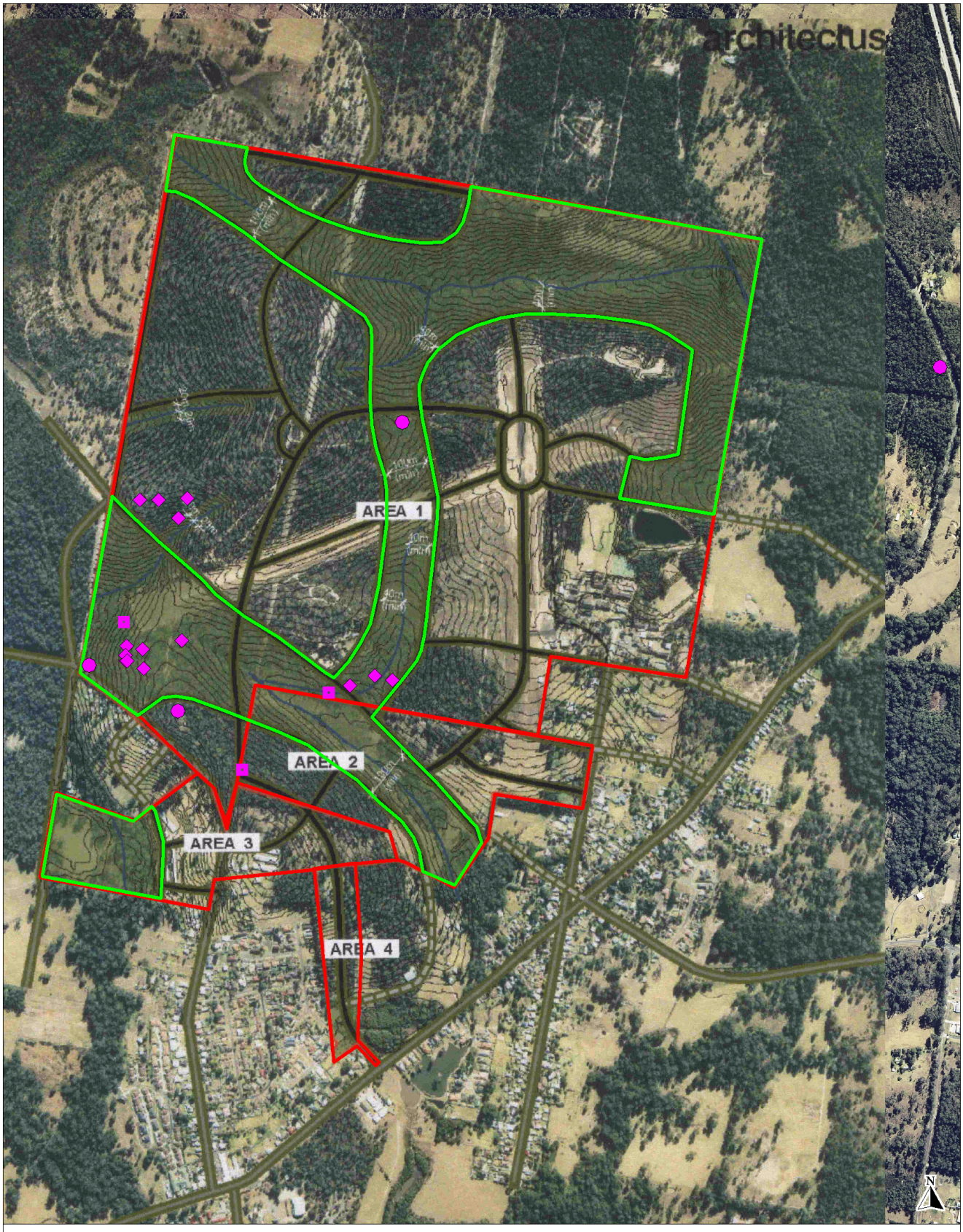

Figure 6.
Distribution of Tetratheca juncea on and adjacent to the Site in relation to the Structure Plan

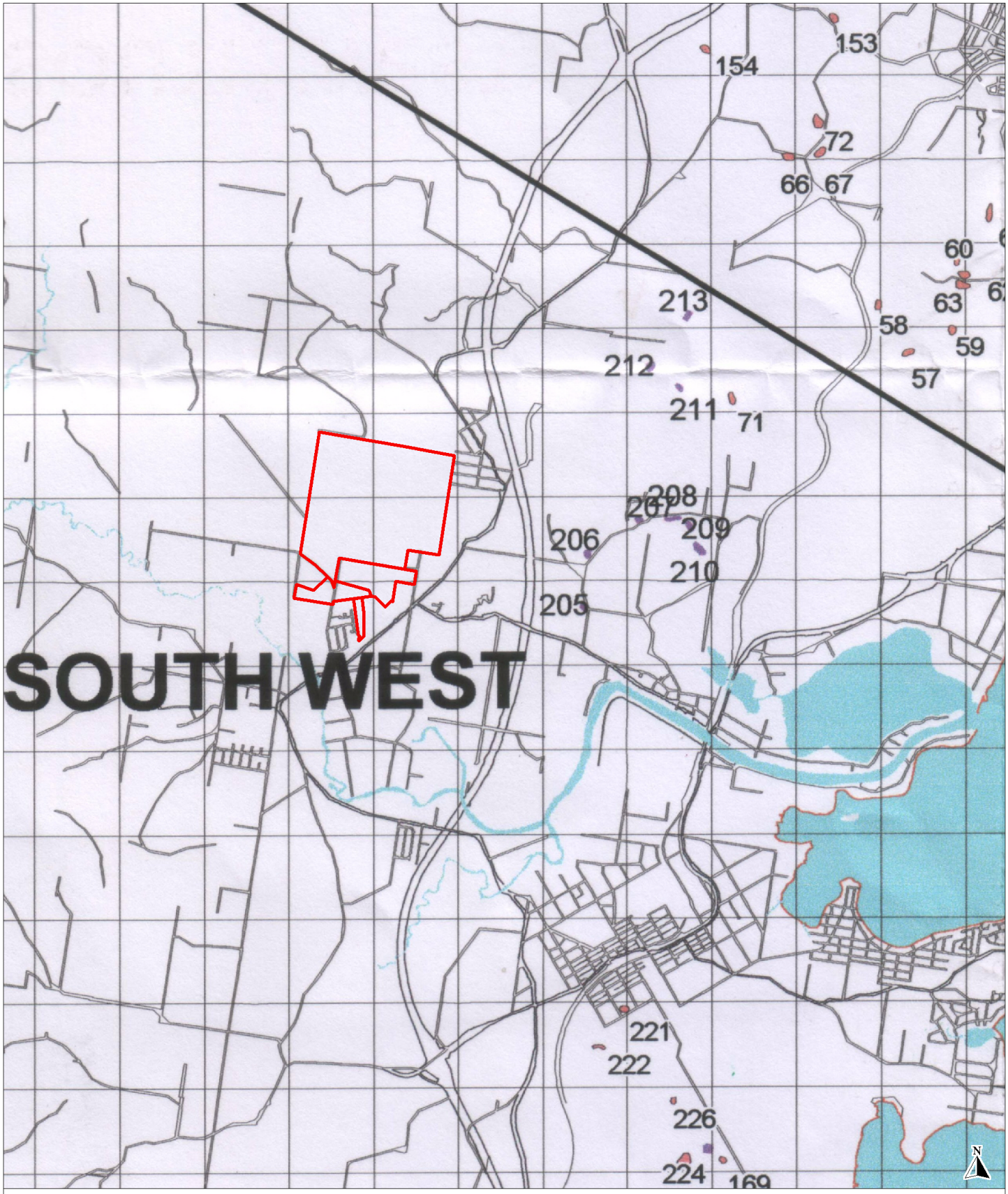

Figure 7.
Payne (2001) mapping of Tetratheca juncea in the region

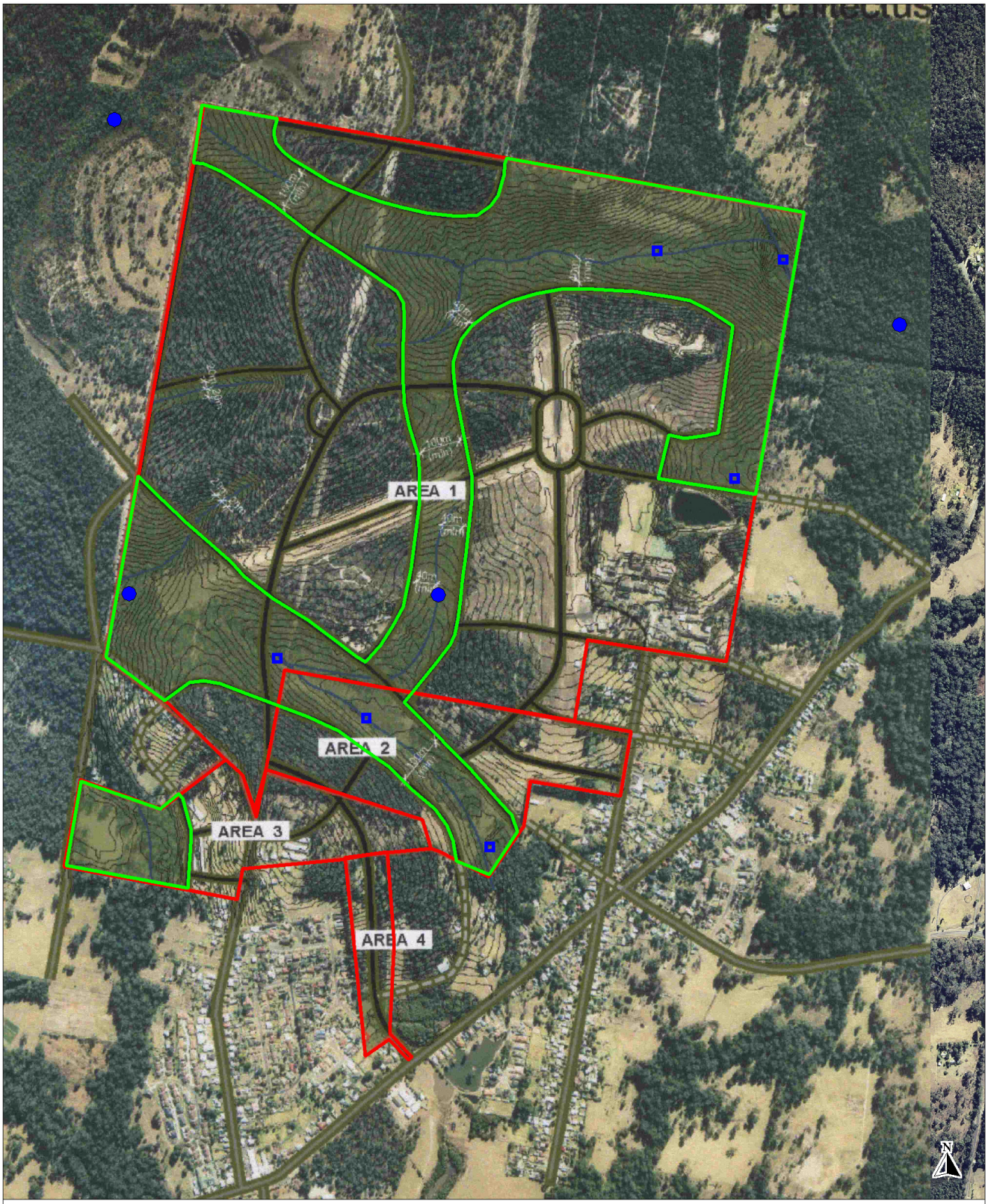

Figure 8.
Sampling locations containing vegetation meeting the criteria for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions in relation to the Structure Plan

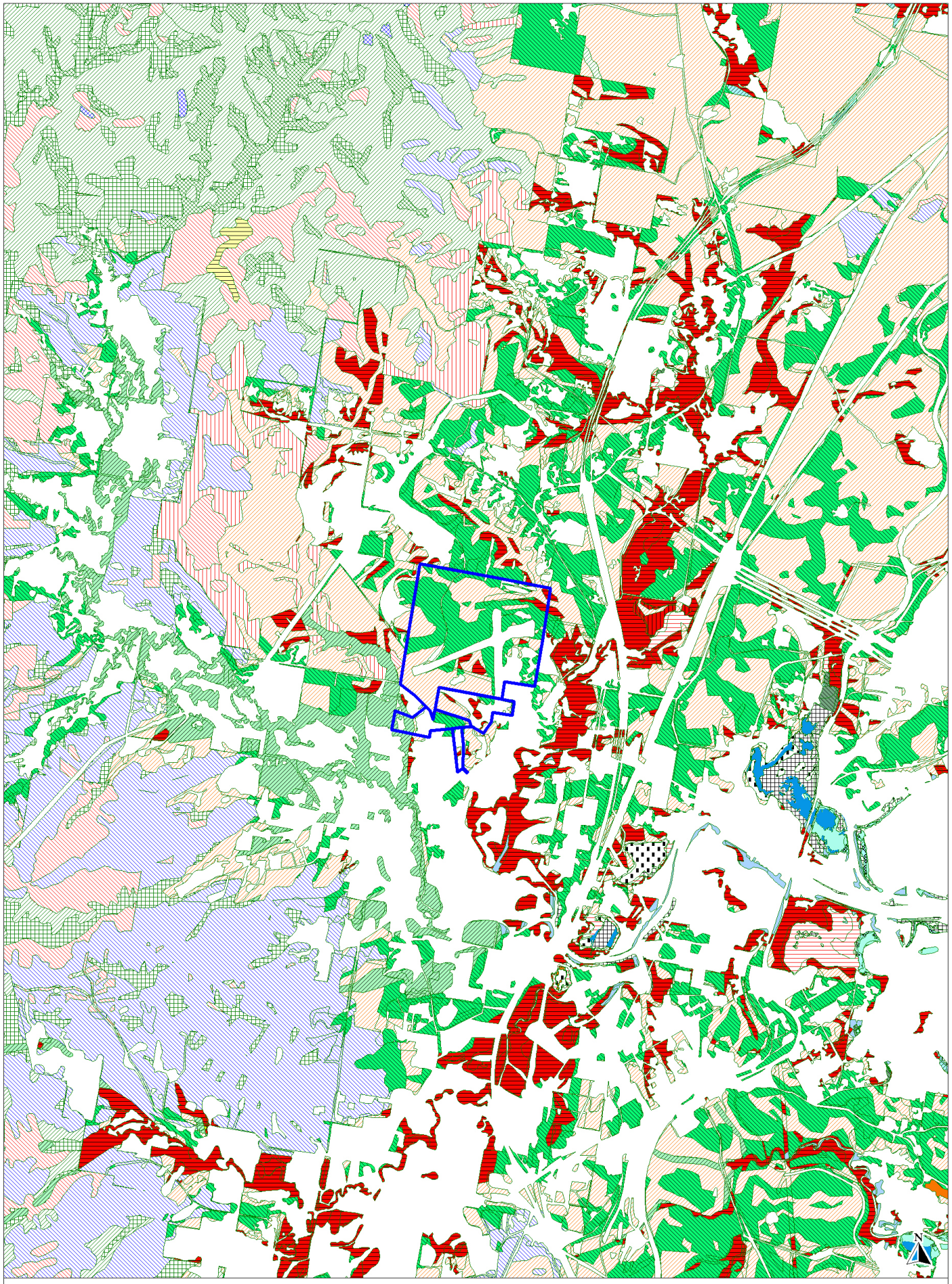

Figure 9.
NPWS (2003) mapping of Riparian Melaleuca Swamp Woodland in the region

Appendices

Appendix 1

Commonwealth Environment Protection and Biodiversity Conservation Act Administrative Guidelines on Significance (July 2000)

Australian Government
Department of the Environment and Heritage

Environment Protection and Biodiversity Conservation Act

EPBC Act Administrative guidelines on significance, July 2000

Environment Australia, 2000

Contents

- Introduction
- World Heritage properties
- Ramsar wetlands of international importance
- Listed threatened species and communities
- Listed migratory species
- Nuclear actions
- The Commonwealth marine environment
- Appendix: Sectoral information

Introduction

Purpose of these guidelines

Under the *Environment Protection and Biodiversity Conservation Act 1999* (the Act), an action will require approval from the Environment Minister if:

- the action has, will have, or is likely to have a significant impact on a matter of national environmental significance*; and
- the action is not subject to one of the exceptions identified below.

The matters of national environmental significance are:

- World Heritage properties,
- Ramsar wetlands of international importance,
- listed threatened species and communities,
- migratory species protected under international agreements,
- nuclear actions, and
- the Commonwealth marine environment.

The purpose of these guidelines is to assist in determining whether an action should be referred to the Environment Minister for a decision on whether approval is required. In particular, they are intended to provide guidance on whether a proposed action is likely to have a significant impact on any of the matters of national environmental significance.

The guidelines will be subject to review following experience with operation of the Act in order to

improve the guidance available to proponents, industry, conservation groups and other members of the community.

A person who proposes to take an action should consider whether the action is covered by one of the exceptions identified below. If an action qualifies for one of these exceptions then it does not require approval under the Act and it is not necessary to refer the action to the Environment Minister.

**In addition to actions having a significant impact on a matter of national environmental significance, the Act provides that certain actions taken by the Commonwealth, and actions affecting Commonwealth land, also require approval. These guidelines do not seek to deal with actions in these categories.*

The referral process - Triggering the Act

If a proposed action is not covered by one of the exceptions identified below, a person proposing to take an action that he or she thinks will have, or is likely to have, a significant impact on a matter of national environmental significance must refer that action to the Minister for the Environment.

The Minister will decide whether the action will, or is likely to, have a significant impact on a matter of national environmental significance:

- if the Minister decides that the action is likely to have a significant impact on a matter of national environmental significance, then the action requires approval under the EPBC Act;
- if the Minister decides that the action is not likely to have a significant impact on a matter of national environmental significance, then the action does not require approval under the Act.

The Minister is generally required to make a binding decision on whether an action requires approval within 20 business days of receiving a referral (in some cases the decision must be made within 10 business days). If the Minister's decision is that an action does not require approval, a person will not contravene the Act if the action is taken in accordance with that decision.

If the Minister decides that an action requires approval, then an environmental assessment of the action must be carried out. The Minister decides whether to approve the action, and what conditions (if any) to impose, after considering the environmental assessment.

Documentation on the referral process, including documentation requirements, can be obtained by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772, or by accessing the EPBC website at http://www.deh.gov.au/epbc.

Determining whether an action is likely to have a significant impact on a matter of national environmental significance

The guidelines set out below include criteria which are intended to assist in determining whether the impact of an action on any matter of national environmental significance is likely to be significant.

Criteria are set out for each matter of national environmental significance.

The guidelines are intended to provide general guidance on the types of actions that will require approval and the types of actions that will not require approval. They are not intended to be exhaustive or definitive. The particular facts and circumstances of a proposed action will need to be taken into account in determining whether that action will have a significant impact on a matter of national environmental significance.

In order to decide whether an action is likely to have a significant impact, it is necessary to take into account the nature and magnitude of potential impacts.

In determining the nature and magnitude of an action's impact, it is important to consider matters such as:

- all on-site and offsite impacts,
- all direct and indirect impacts,
- the frequency and duration of the action,
- the total impact which can be attributed to that action over the entire geographic area affected, and over time,
- the sensitivity of the receiving environment, and
- the degree of confidence with which the impacts of the action are known and understood.

The Act provides that the Minister must, in deciding whether an action is likely to have a significant impact on a matter of national environmental significance, take account of the precautionary principle. Accordingly, the fact that there is a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance.

The Act provides that in deciding whether the action is a controlled action, the Minister must not consider any beneficial impacts that the action has, will have or is likely to have. Therefore, activities which will have only beneficial impacts will not be captured by the Act.

Exceptions

An action does not require approval from the Environment Minister under the Act if:

- the action is approved under, and taken in accordance with, a State management plan that is accredited by the Commonwealth for the purposes of a bilateral agreement (see section 46 of the Act), or
- the action is approved under, and taken in accordance with, a Commonwealth management plan that is accredited by the Environment Minister for the purposes of a Ministerial declaration (see section 33 of the Act), or
- the action is a forestry operation taken in a Regional Forest Agreement region (see Part 4, Division 2 of the Act), or
- the action is taken in the Great Barrier Reef Marine Park and is authorised by certain instruments issued under the Great Barrier Marine Park Act 1975 (see section 43 of the Act), or
- the action has been authorised by a Government decision on which the Minister's advice has been sought (see section 160 of the Act).

In addition, an approval is not required for an action if:

- the action was authorised by the Commonwealth, a State or a Territory prior to the EPBC Act commencing (16 July 2000), and
- at the time the EPBC Act commences, no further authorisation is required to allow the action to be lawfully taken.

Finally, the EPBC Act provides that approval is not required for an action that is a lawful continuation of a use of land, sea or seabed that was occurring immediately before the commencement of the Act. (This exception does not apply to an enlargement, intensification or expansion of an existing use.)

Information available

The Department of Environment and Heritage maintains a range of information that can help assess the likely magnitude and nature of an action's impact relative to the thresholds.

This information includes:

- Copies of legislation, conventions, principles, and guidelines
- Boundaries of:
  - Australia and its external Territories. Including boundaries of Exclusive Economic Zone, coastal waters, State or Territory waters, Commonwealth managed fisheries, Torres Strait Fisheries and Commonwealth marine areas.
  - Regional Forest Agreement Areas
  - Commonwealth reserves, Conservation Zones, Biosphere Reserves, and the Australian Whale Sanctuary, together with copies of management plans and IUCN categories for reserves.
  - World heritage properties, together with a list of the values of each property. Copies of management plans. Copies of World Heritage management principles.
  - Ramsar wetlands, together with information about their ecology and hydrology. Copies of management plans. Copies of Ramsar wetland management principles.
- Lists of species and communities (threatened species and communities, migratory species, native marine species, cetaceans, and species posing a serious threat to human health and key threatening processes, including species in other countries covered by international agreements that Australia is a party to.)
- Range/distribution maps for listed taxa, and their habitat
- Information about the ecology of listed species (eg critical habitats, habitat requirements, life cycles etc - the details required vary with the category in which the species are listed). Copies of recovery plans, threat abatement plans, and wildlife conservation plans
- Information about threatening processes
- Distribution of terrestrial and marine vegetation/habitats (National Vegetation Information System)
- Information about management of access to biological resources
- Topographic and cadastral information (such as catchment boundaries, roads, rivers)

Further information is available through the EPBC website at http://www.deh.gov.au/epbc. Hard copies of lists, recovery plans and threat abatement plans can also be obtained from Government Information Shops or by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772.

State and Territory Government agencies also have a range of information that may be useful, including geographic information.

World Heritage properties

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on the World Heritage values of a declared World Heritage property. (However, an action does not require approval if it is covered by one of the exceptions identified above.)

A declared World Heritage property is an area that has been included in the World Heritage list or declared by the Minister for the Environment to be a World Heritage property in accordance with sections 14 and 15 of the Act.

Note that an action which has, will have, or is likely to have a significant impact on the World Heritage values of a declared World Heritage property might take place outside the boundaries of a World Heritage property.

Criteria

An action has, will have, or is likely to have a significant impact on the World Heritage values of a declared World Heritage property if it does, will, or is likely to result in:

- one or more of the World Heritage values being lost, or
- one or more of the World Heritage values being degraded or damaged.

The World Heritage values of each declared World Heritage property will be available through the EPBC website at http://www.deh.gov.au/epbc or by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772.

For example, the World Heritage values of the Central Eastern Rainforest Reserves of Australia include significant and important natural habitats species of conservation significance, particularly associated with rainforest which once covered much of the continent of Australia and is now restricted to archipelagos of small areas of rainforest isolated largely by sclerophyll vegetation and cleared land. The World Heritage values include habitats associated with subtropical rainforest, wet sclerophyll forest, montane heathlands, rocky outcrops, and ecotones between rainforest and sclerophyll communities.

Wetlands of international importance

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on the ecological character of a declared Ramsar wetland. (However, an action does not require approval if it is covered by one of the exceptions identified above.)

A declared Ramsar wetland is an area that has been designated under Article 2 of the Ramsar Convention or declared by the Minister for the Environment to be a declared Ramsar wetland in accordance with section 16 the Act.

Note that an action which has, will have, or is likely to have a significant impact on the ecological character of a declared Ramsar wetland might take place outside the boundaries of the wetland.

Criteria

An action has, will have, or is likely to have a significant impact on the ecological character of a declared Ramsar wetland if it does, will, or is likely to result in:

- areas of the wetland being destroyed or substantially modified, or
- a substantial and measurable change in the hydrological regime of the wetland for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland, or
- the habitat or lifecycle of native species dependant upon the wetland being seriously affected, or
- a substantial and measurable change in the physico-chemical status of the wetland for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- an invasive species that is harmful to the ecological character of the wetland being established in the wetland*.

The ecological character of each Ramsar wetland is available through the EPBC website at http://www.deh.gov.au/epbc or by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772.

**Introducing an invasive species into or near the wetland may result in that species becoming established. An invasive species may cause harm by direct competition with native species,*

modification of habitat, or predation.

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct in the wild,
- critically endangered,
- endangered, or
- vulnerable.

An action will also require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on an ecological community listed in any of the following categories:

- critically endangered, or
- endangered.

An action does not require approval if it is covered by one of the exceptions identified above.

Threatened species and ecological communities are listed by the Minister for the Environment under Part 13, Division 1, Subdivision A of the Act. The lists are available through the EPBC website at http://www.deh.gov.au/epbc. Hard copies of lists can be obtained from Government Information Shops, or by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772.

Some of the criteria below refer to the concept of 'habitat critical to the survival of a species or ecological community'. This habitat includes the critical habitat for many species and community identified in recovery plans for those species/communities and the critical habitat on the Register maintained by the Minister for the Environment under the Act. However, there may not be recovery plans in place for all listed species and communities, as plans take some time to prepare. Similarly, the Register may not be comprehensive. The absence of a recovery plan or the fact that an area may not be listed on the Register of Critical Habitat does not mean that there is no habitat critical to the survival of the species or community.

Habitat critical to the survival of a species or ecological community may include areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal,
- for succession,
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species / community.

Habitat critical to the survival of a species or ecological community will depend largely on the particular requirements of the species/community in question. For example, areas only incidentally used by a vulnerable species, and which the species is unlikely to be dependent upon for its survival or recovery, are not areas of habitat critical to the survival of a species or ecological community.

Some of the criteria below refer to actions likely to lead to a "longterm decrease" in the size of a population or a "long-term adverse affect" on a community. Depending on the level of endangerment and the nature of the action, not all actions which create an immediate decrease in the population of a nationally listed threatened species or impact on a community will have long-term consequences. For example, an action which causes injury or death to only one or a very small number of a species will not, except in the case of the most endangered of species, generally lead to a long-term or irreversible

decrease in the population that normal processes, rates of mortality and recruitment could not buffer.

Extinct in the wild species
Criteria

An action has, will have, or is likely to have a significant impact on extinct in the wild species if it does, will, or is likely to:

- adversely affect a captive or propagated population or one recently introduced/reintroduced to the wild, or
- interfere with the recovery of the species or its reintroduction into the wild.

Critically endangered and endangered species
Criteria

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species´ habitat*, or
- interfere with the recovery of the species.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species
Criteria

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or
- fragment an existing important population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population, or
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species´ habitat*, or
- interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This

may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

Critically endangered and endangered ecological communities
Criteria

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered ecological community if it does, will, or is likely to:

- lead to a long-term adverse affect on an ecological community, or
- reduce the extent of a community, or
- fragment an occurrence of the community, or
- adversely affect habitat critical to the survival of an ecological community, or
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, or
- result in invasive species that are harmful to the critically endangered or endangered community becoming established in an occurrence of the community*, or
- interfere with the recovery of an ecological community.

In addition to the above information, Commonwealth adopted Recovery Plans may also provide further guidance on whether an action is likely to be significant.

**Introducing an invasive species into the occurrence may result in that species becoming established. An invasive species may harm a critically endangered or endangered ecological community by direct competition, modification of habitat, or predation.*

Listed migratory species

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. (However, an action does not require approval if it is covered by one of the exceptions identified above.)

Lists of migratory species are established by the Minister for the Environment under Part 13, Division 2, Subdivision A of the Act. The lists are available through the EPBC website at http://www.deh.gov.au/epbc. Hard copies of lists can be obtained by contacting the Department of Environment and Heritage's Community Information Unit on 1800 803 772.

Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

Criteria

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or

altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of thespecies.

An area of important habitat is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
2. habitat utilised by a migratory species which is at the limit of the species range, or
3. habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.*

Nuclear actions

A nuclear action will require approval from the Environment Minister if it has, will have, or is likely to have a significant impact on the environment.

Criteria

All nuclear actions, as detailed in section 22 of the Act, should be referred to the Commonwealth Environment Minister for a decision on whether approval is required.

These are:

- establishing or significantly modifying a nuclear installation or a facility for storing spent nuclear fuel, or
- transporting spent nuclear fuel or radioactive waste products arising from reprocessing, or
- establishing or significantly modifying a facility for storing radioactive waste products arising from reprocessing, or
- mining or milling uranium ore, or
- establishing or significantly modifying a large-scale disposal facility for radioactive waste, or
- de-commissioning or rehabilitating any facility or area in which an activity described above has been undertaken, or
- any other action prescribed by the regulations.

The Commonwealth marine environment

An action will require approval from the Environment Minister if:

- the action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment, or
- the action is taken outside a Commonwealth marine area and the action has, will have, or is

likely to have a significant effect on the environment in a Commonwealth marine area.

An action does not require approval if it is covered by one of the exceptions identified above.

The Commonwealth marine area is defined in section 24 of the Act. Maps showing Commonwealth marine areas are available through the EPBC website at http://www.ea.gov.au/epbc or by contacting Environment Australia's Community Information Unit on 1800 803 772.

Criteria

An action has, will have or is likely to have a significant impact on the environment in a Commonwealth marine area if it does, will, or is likely to:

- result in a known or potential pest species becoming established in the Commonwealth marine area*, or
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results, or
- have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (eg breeding, feeding, migration behaviour, and life expectancy) and spatial distribution, or
- result in a substantial change in air quality** or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.

**Translocating or introducing a pest species may result in that species becoming established.*

***The Commonwealth marine area includes any airspace over Commonwealth waters.*

Appendix
Sectoral Information

The purpose of this Appendix is to provide more detailed guidance in relation to whether, and in what circumstances, some selected sectoral activity is likely to have a significant impact on a matter of national environmental significance. This guidance relates to the following sectoral activities:

- mineral exploration,
- urban development,
- local government, and
- marine activities.

Mineral exploration activity
Terrestrial exploration

Surface geological mapping examining rock outcrops and exposures, which may involve the taking of small samples, is not likely to have a significant impact on a matter of national environmental significance.

Surface geochemical sampling, using both regular grid pattern and irregular pattern methods to collect small samples, is not likely to have a significant impact on a matter of national environmental significance.

Surface geophysical surveys including airborne surveys, gravity, magnetic and electromagnetic surveys, is not likely to have a significant impact on a matter of national environmental significance.

Other geophysical surveys that include seismic surveys, would not normally be expected to have a significant impact on matters of national environmental significance. However, an action involving seismic surveys (shot hole method or vibroseis) may have a significant impact on an endangered or critically endangered species if, for example, it is likely to damage critical habitat for the species or disrupt the breeding cycle of a population of the species. Such an action may also have a significant impact on listed threatened ecological communities where, for example, it adversely impacts on habitat. (See the criteria which relate to endangered and critically endangered species and communities.)

All exploratory drilling (including new field, wildcat, and appraisal drilling, auger, rotary air blast (RAB), open hole percussion, reverse circulation (RC), diamond drilling and wide diameter drilling), including the construction of drill pads, would not be expected to have a significant impact on a matter of national environmental significance where the discharges, emissions and waste from the drilling are contained and managed in an environmentally sensitive manner. However, an action involving exploratory drilling may have a significant impact on an endangered or critically endangered species if, for example, it is likely to damage critical habitat for the species or disrupt the breeding cycle of a population of the species. Such an action may also have a significant impact on listed threatened ecological communities where, for example, it adversely impacts on habitat. (See the criteria which relate to endangered and critically endangered species and communities.) It will also be necessary to consider the Ramsar criteria if the exploratory drilling is to occur in or immediately adjacent to a Ramsar wetland.

Costeaning and trenching (small scale) would not be expected to have a significant impact on a matter of national environmental significance where small trenches are excavated using hand tools. However, an action involving costeaning and trenching (small scale) may have a significant impact on an endangered or critically endangered species if, for example, it is likely to damage critical habitat for the species or disrupt the breeding cycle of a population of the species. Such an action may also have a significant impact on listed threatened ecological communities where, for example, it adversely impacts on habitat. (See the criteria which relate to endangered and critically endangered species and communities.) It will also be necessary to consider the Ramsar criteria if the costeaning or trenching is to occur in or immediately adjacent to a Ramsar wetland.

Costeaning and trenching (large scale), surface bulk sampling (such as establishing a trial pit, sinking shafts or driving decline tunnels deep into the target) and **underground exploration and development** (such as underground sampling, drilling and mine construction): whether or not these exploration activities are likely to have a significant impact on a matter of national environmental significance will depend upon the particular facts and circumstances of the proposed activity. It is necessary to apply the guidelines developed to assist in determining when an action is likely to have a significant impact on a matter of national environmental significance. For example, if surface bulk sampling occurs in an area that is not in or near a Ramsar wetland, and if it is not damaging the habitat of a threatened species or important habitat for a migratory species, then the proposed exploration activity is not likely to have a significant impact on a matter of national environmental significance. However, if the proposed activity will result in the pollution of a Ramsar wetland then it is likely to have a significant impact on the ecological character of a Ramsar wetland.

Offshore exploration

Aerial surveys and diving for samples are not likely to have a significant impact on a matter of national environmental significance.

Seismic exploration (using air guns) is not likely to have a significant impact on a matter of national environmental significance unless the activity is undertaken in an area that contains habitat for threatened or migratory species and the seismic activity is likely to interfere with breeding, feeding or

migration. Similarly, seismic exploration using air guns would not normally be expected to have a significant impact on the Commonwealth marine environment unless it was undertaken in an area that contains habitat for threatened or migratory species and the seismic activity is likely to interfere with breeding, feeding or migration. In addition, seismic activity in shallow or near shore environments in or adjacent to a Commonwealth marine area or a Ramsar wetland is likely to have a significant impact on a matter of national environmental significance.

Offshore exploratory drillingwould not normally be expected to have a significant impact on a matter of national environmental significance except in the circumstances identified above for seismic exploration. In addition, drilling is likely to have a significant impact on a threatened species (or a migratory species) if critical habitat (or important habitat for a migratory species) is damaged by the drilling, and on the marine environment if drilling occurs in a sensitive area (eg sea mounts and other areas with high biodiversity value or which contain important habitat).

Other issues

The above discussion does not address issues associated with mineral exploration activity in a world heritage property. In addition, it does not take into account any impacts associated with gaining access to the exploration site.

Urban Development

Repairing, maintaining, or making alterations to **commercial and domestic buildings and properties** would not be expected to have a significant impact on a matter of national environmental significance.

Repairing and maintaining existing distribution infrastructure for **utilities for power, water and sewage** is not likely to have a significant impact on a matter of national environmental significance.

Building a house on land in an existing subdivision in the vicinity of a Ramsar wetland, a World Heritage property or a listed threatened species or community would not be expected to have a significant impact on a matter of national environmental significance.

By way of illustration, establishing a **new subdivision** in an existing suburb on a tributary of the Brisbane River would not normally be expected to have a significant impact on the Moreton Bay Ramsar wetland.

By contrast, establishing **a new subdivision**in the vicinity of a Ramsar wetland is likely to have a significant impact on the wetland if it involves extensive vegetation clearing, clearing riparian vegetation, modifying the flow of water to or within the wetland, or if it will result in significant discharges of pollutants into the wetland.

Similarly, proposed urban development for a **housing subdivision or an industrial estate**on an area which contains a nationally listed threatened community or nationally listed threatened species is likely to be significant under the Act and should be referred to the Commonwealth Environment Minister.

Local Government

Maintaining **existing facilities**such as visitor centres and roadside facilities would not be expected to have a significant impact on a matter of national environmental significance.

Routine vegetation management to maintain existing roads in or adjacent to a World Heritage property, a Ramsar wetland or a listed threatened species or community is not likely to have a significant impact on a matter of national environmental significance.

A proposed **new road** through a World Heritage area or Ramsar site or a road that would require

clearing of native vegetation that contains nationally listed threatened species or communities is likely to be significant under the Act and should be referred to the Commonwealth Environment Minister.

Where **road verge maintenance** is carried out regularly (say every one or two years) it is not likely to have a significant impact on a critically endangered or endangered plant species.

On the other hand, if a population of a **critically endangered or endangered plant species**becomes established on a road verge (because the verge has not been graded or weeded for a number of years), then clearing that road verge is likely to have a significant impact on a matter of national environmental significance.

Widening an existing road is not likely to be significant under the Act where the road verge has previously been cleared or the vegetation beside the road has been heavily modified. However, if road widening would require removal of native vegetation that contains critically endangered or endangered plant species or communities, it is likely to have a significant impact and should be referred to the Commonwealth Environment Minister.

Development of a **tourist resort** in or adjacent to a World Heritage area is likely to be significant under the Act and should be referred to the Commonwealth Environment Minister. However, a residential development such as a block of units or other accommodation in an existing city or coastal town would not be expected to have a significant impact on an adjacent World Heritage area.

Marine activities

Otherwise lawful **recreational fishing and recreational boating** would not be expected to have a significant impact on a matter of national environmental significance.

Routine ship transits where appropriate precautions have been taken against translocating potential pest species are not likely to have a significant impact on a matter of national environmental significance.

Ballast water operations from vessels in Australian waters, undertaken in accordance with an approved Commonwealth Government arrangement for the management of ballast water, are not likely to have a significant impact on the Commonwealth marine environment.

Small scale infrastructure projects such as new jetties within an existing port are not likely to have a significant impact on a matter of national environmental significance.

Expansion of an existing port which requires land reclamation in a World Heritage area, a Ramsar site or an area containing nationally listed threatened species or communities, or which involves modifying an area of important habitat for a nationally listed migratory species, is likely to have a significant impact on a matter of national environmental significance.

A **proposed new port** in a Commonwealth marine area or where a shipping channel needs to be dredged through a World Heritage area, a Ramsar site or an area containing nationally listed threatened species or communities, or which involves modifying an area of important habitat for a nationally listed migratory species, is likely to have a significant impact on a matter of national environmental significance.

Dredging to maintain existing navigational channels would not normally be expected to have a significant impact on the environment where the activity is undertaken as part of normal operations and the disposal of spoil does not have a significant impact.

Large scale **aquaculture operations** in or adjacent to a World Heritage Area, a Ramsar site or a Commonwealth marine area or which impact on sites of nationally listed threatened species or communities or migratory species are likely to have a significant impact on a matter of national environmental significance.

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Appendix 2

Threatened Species Information for *Grevillea parviflora* subsp. *parviflora* (NPWS 2002)

THREATENED SPECIES INFORMATION

Grevillea parviflora subsp. *parviflora*

Common names: Small-flower Grevillea

Conservation Status

G. parviflora R. Br. subspecies *parviflora* is listed as a Vulnerable species on Schedule 2 of the *Threatened Species Conservation Act* 1995 (NSW). It is also listed as a nationally vulnerable species under the *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth).

General description

G. parviflora subspecies *parviflora* is a low spreading to erect shrub mostly to 1.5m high. It suckers readily from rhizomes, although sometimes has single stems. Leaves are crowded, erect to ascending, narrow, mostly 2-3.5cm long, to 1.3 mm wide with the lower surface silky hairy and the tip with a short point. Flowers are "spider-like", small and white or pinkish (Lower Hunter populations) with rusty-brown hairs. Fruiting capsule 8-10mm long with 1-2 seeds. A full scientific description can be found in Makinson (2000).



Photo: T.James/NPWS

Distribution

Grevillea parviflora subsp. *parviflora* has a widespread but sporadic distribution within the Sydney Basin Bioregion. The main occurrence is centred south of Sydney in the Appin-Wedderburn-Picton-Bargo districts associated with the Nepean and Georges Rivers. Disjunct northern populations are found in the Lower Hunter Valley at Kurri Kurri and Heddon Greta and on the western shores of Lake Macquarie at Dooralong, Cooranbong and Awaba. To the west of Sydney small populations occur at Kemps Creek & Voyager Point. The attached maps show those sites for which accurate locations and approximate locations are known. Other sites with only vague locational descriptions also exist. A far southern population may occur at Moss Vale (Makinson 2000). There are at least 21 known populations of *G. parviflora* subsp. *parviflora* with several other older records requiring confirmation.

Recorded occurrences in conservation reserves

G. parviflora subsp. *parviflora* is only known from Werakata (formerly Lower Hunter) National Park, but has substantial populations in that reserve.

Habitat

G. parviflora subsp. *parviflora* occurs on sandy clay loam soils, often with lateritic ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park. *Grevillea parviflora* subsp. *parviflora* is found on crests, upper slopes or flat plains in both low-lying areas between 30-65m asl (particularly Lower Hunter Valley and Lake Macquarie) and on higher topography between 200-300m asl. south of Sydney.

G. parviflora subsp. *parviflora* has been recorded from a range of communities

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including two endangered communities; Shale Sandstone Transition Forest (south of Sydney) and the Kurri Sand Swamp Woodland (Lower Hunter). It is also found in open-forest of *Eucalyptus maculata-Angophora costata* on Narrabeen Group and Permian Sandstones (Dooralong), Sydney Sandstone Ridgetop Woodland (Wedderburn) and Castlereagh Ironbark Woodland (Kemps Creek).

Associated species in the Kurri Sand Swamp Woodland include *Eucalyptus parramattensis* subsp. *decadens*, *Angophora bakeri* and *E. fibrosa* with *Acacia elongata, Dillwynia parvifolia, Melaleuca thymifolia, Grevillea montana, Eragrostis brownii* and *Aristida vagans*. In the Shale Sandstone Transition Forest associated species include *Eucalyptus fibrosa, E. punctata, Corymbia gummifera, Pultenaea scabra* var. *biloba, Kunzea ambigua, Allocasuarina littoralis* and *Themeda australis*. At sites with a stronger sandstone influence *Eucalytpus sclerophylla, E. piperita, E. oblonga, Grevillea diffusa, G. mucronulata, Acacia suaveolens* and *Persoonia pinifolia* are found. Despite the range of associated communities several understorey species which are common to several of the known sites of *Grevillea parviflora* subsp. *parviflora* can be identified and include *Allocasuarina littoralis, Daviesia ulicifolia, Kunzea ambigua, Banksia spinulosa, Leptospermum trinervium, Melaleuca nodosa, Pimelea linifolia, Themeda australis, Entolasia stricta* and *Eragrostis brownii*.

G. parviflora subsp. *parviflora* has been recorded growing with several other threatened species including *Acacia bynoeana* (Heddon Greta), *Dillwynia tenuifolia* (Kemps Creek) and *Persoonia bargoensis* (S. of Appin and at Bargo).

Ecology

The biology and ecology of *G. parviflora* subsp. *parviflora* is poorly known and current knowledge is based on general observations. Most populations are found in open, slightly disturbed sites, particularly close to roads and tracks. Populations vary mostly from small (<20 plants) to medium size (50-100 plants) and large (>200 plants). The largest known population occurs north of Bargo with an estimated 2000+ plants. *G. parviflora* subsp. *parviflora* exhibits a degree of vegetative spread with stems capable of suckering from underground rhizomes. Due to this habit it is often difficult to determine the number of plants present at a site and population estimates are essentially a reflection of the number of suckers rather than individual plants. Populations may be smaller and less genetically diverse than they appear.

There is a marked increase in stem density of *G. parviflora* subsp. *parviflora* following fire, predominantly as a result of suckering. Although plants of *G. parviflora* subsp. *parviflora* are reported to be killed by fire (Benson & McDougall 2000), they can regenerate from rhizomes protected below the soil and can be relatively long-lived between 25-60 years (Benson & McDougall 2000).

Flowering has been recorded from between July to December and in April to May. Flowers are insect-pollinated (Makinson 2000). Seeds are released at maturity (Benson & McDougall 2000) and there is probably minimal local dispersal of seed. After fire, regeneration can occur from both rhizomes and from the germination of seed in the soil seedbank (Benson & McDougall 2000), however, field observations suggest that seedling recruitment after fire is uncommon. Little information is known about the production and viability of seed, seed predation or germination rates and requirements.

Plants of *G. parviflora* subsp. *parviflora* prefer open habitat conditions with the largest populations in open woodland and along exposed roadside areas. Competition and shading from dense growth of Tick Bush *Kunzea ambigua* appears to limit it's spread at several sites.

Threats

Populations of *Grevillea parviflora* subsp. *parviflora* are threatened by

clearing and fragmentation. Potential impacts include direct loss of habitat, plants and/or local populations and habitat degradation. Several former sites of *G. parviflora* subsp. *parviflora* near Prospect and at Tahmoor and Thirlmere are now developed and nearby areas of potential habitat degraded. Road widening and maintenance works, and vehicular use are a threat to populations due to their frequent roadside location. The maintenance of transmission line and gas pipeline easements are also known to impact on some populations.

High frequency fire may impact on populations occurring close to urban areas. It is important that the interval between successive fires is sufficient to allow adequate accumulation of seeds in the soil seedbank for subsequent seedling recruitment. Although *G. parviflora* subsp. *parviflora* is not dependant solely on regeneration from seed, this form of regeneration is important for maintaining genetic diversity within populations. The ability to resprout and sucker following disturbance does not ensure the long term survival of a species for which seedling recruitment is necessary. Known populations of *G. parviflora* subsp. *parviflora* appear to have low levels of seedling recruitment. Frequent fire will also encourage weedy species such as Blady Grass *Imperata cylindrica*, reducing suitable habitat conditions for *G. parviflora* subsp. *parviflora*.

Known populations of *G. parviflora* subsp. *parviflora* are also threatened by rubbish dumping, recreational activities (particularly trail bikes), weed invasion, the maintenance of easements and inappropriate fire regimes. Although high fire frequency is recognised as a potential threat, the absence of fire is also undesirable. Low fire frequency may result in low levels of seed germination and encourage the dense regrowth of *Kunzea ambigua*, reducing available habitat for *G. parviflora* subsp. *parviflora*.

Management

Management should focus on the protection of habitat and known populations of *G. parviflora* subsp. *parviflora*. The establishment of appropriate fire regimes at known sites is a prime objective. Research is needed to determine fire intervals compatible with maintaining a varied age structure within populations and open habitat conditions. Bush regeneration programs should be prepared and implemented at known sites to maintain favourable habitat conditions. The control of Tick Bush *Kunzea ambigua* is likely to be important in disturbed sites. The fencing of some sites may be appropriate to control recreational use and the dumping of rubbish. It is important to protect populations from road or track upgrading or maintenance.

Recovery Plan

There is currently no recovery plan for *G. parviflora* subsp. *parviflora*.

For Further Information contact

Threatened Species Unit Conservation Programs and Planning Division, Central Directorate NSW NPWS PO Box 1967, Hurstville NSW 2220 Phone 02 9585 6678. www.npws.nsw.gov.au

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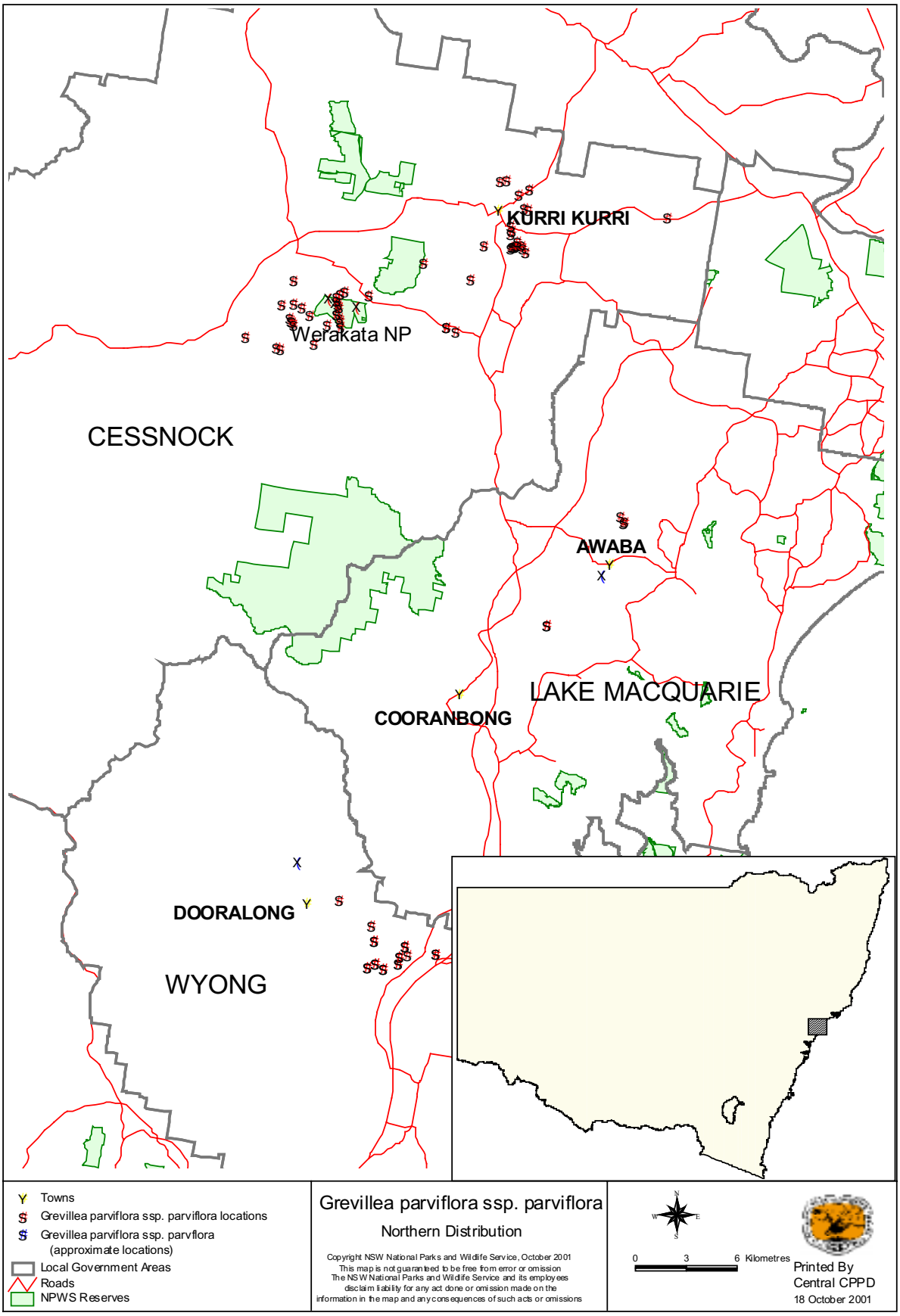
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Grevillea parviflora ssp. parvflora (approximate locations)
Local Government Areas
Roads
NPWS Reserves
Grevillea parviflora ssp. parviflora
Northern Distribution
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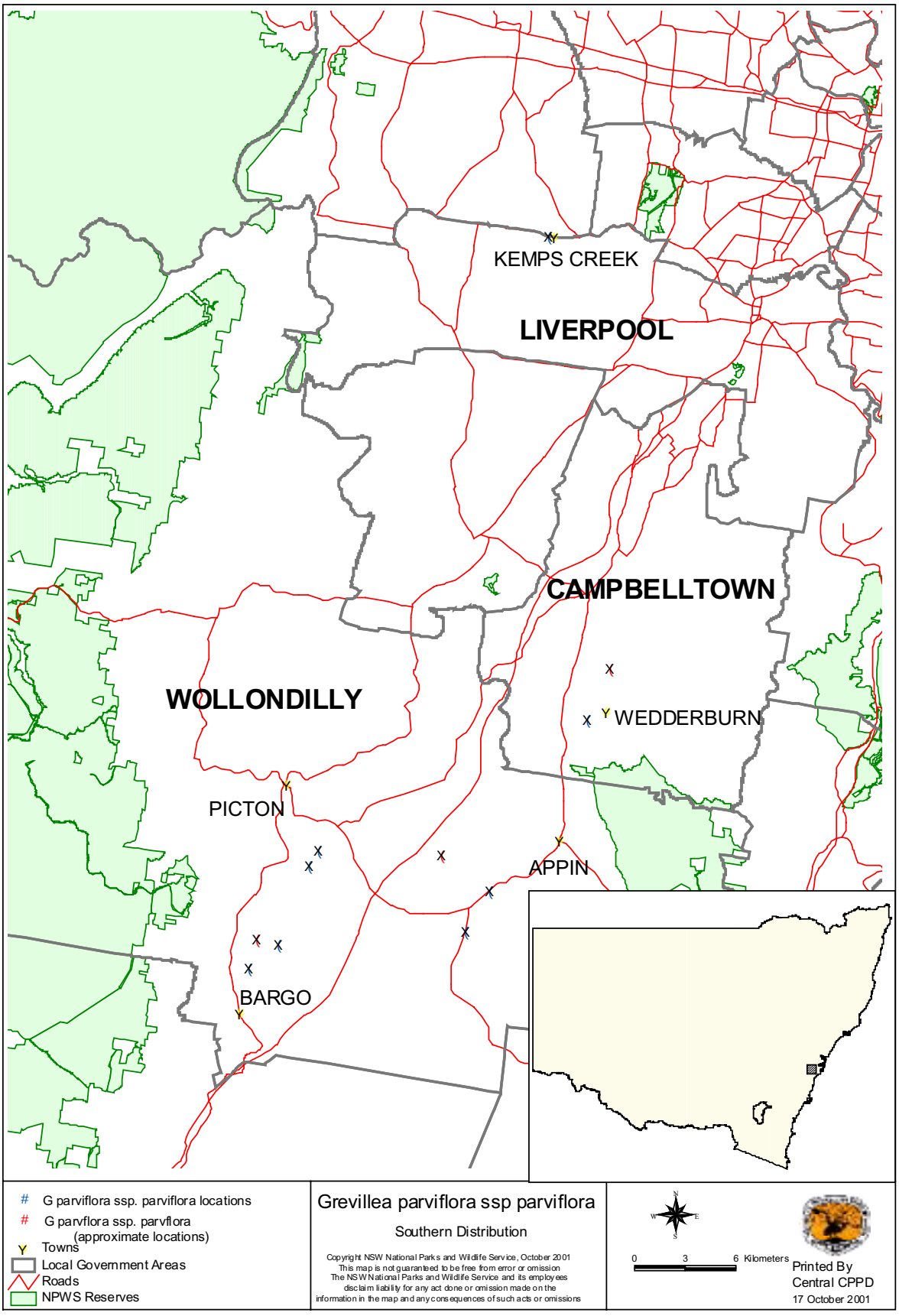
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Towns
Local Government Areas
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NPWS Reserves
Grevillea parviflora ssp parviflora
Southern Distribution
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Appendix 3

Email correspondence from Michael Murray of Forest Fauna Surveys P/L dated 16 September 2004

ACABOTANIC

From: "Michael Murray" <forestfauna@hunterlink.net.au>
To: "Anne Clements" <mail@acabotanic.com>
Sent: Thursday, 16 September 2004 2:26 PM
Attach: Tetratheca juncea records.xls
Subject: tetratheca juncea records

Dear Anne
Attached is records of Tetratheca juncea I found during fauna investigations at North Cooranbong. I hope they are of assistance to you.
regards
++++++++++++++++++++++++++++++++
Michael Murray
Forest Fauna Surveys Pty Ltd
35 Sheridan Avenue
ADAMSTOWN HEIGHTS NSW 2289
(02) 4946 2977
++++++++++++++++++++++++++++++++

Tetratheca juncea plants located by Michael Murray of Forest Fauna Surveys P/L during fauna investigations of North Cooranbong Land

Date	14-15/09/2004	Coordinates	**AMG - AGD 66**	
Species	**Easting**	**Northing**	**No. plant clumps**	**No. flowers**
Tetratheca juncea	355311	6340352	3 small clumps	< 20
Tetratheca juncea	355263	6340373	4 clumps	20 - 40
Tetratheca juncea	355306	6340404	1 clump	< 10
Tetratheca juncea	355420	6340809	1 clump	5
Tetratheca juncea	355341	6340805	1 clump	3
Tetratheca juncea	355290	6340806	1 clump	2
Tetratheca juncea	355397	6340757	1 clump	~10
Tetratheca juncea	355263	6340414	1 clump	~20
Tetratheca juncea	355260	6340388	2 clumps	~30
Tetratheca juncea	355266	6340373	3 - 4 large clumps	> 30
Tetratheca juncea	355413	6340427	2 small	4
Tetratheca juncea	355874	6340304	1 clump	2
Tetratheca juncea	355940	6340331	large	40+
Tetratheca juncea	355989	6340319	large clump	50+

Appendix 4

NPWS (2000) Environmental Impact Assessment Guidelines for *Tetratheca juncea*

Tetratheca juncea

Smith

The following information is provided to assist authors of Species Impact Statements, proponents, and determining and consent authorities, who are required to prepare or review assessments of likely impacts on threatened species pursuant to the provisions of the *Environmental Planning and Assessment Act* 1979. These guidelines should be read in conjunction with the NPWS *Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The '8 Part Test' of Significance* (November 1996) and with the accompanying "Threatened Species Information" sheet.

Glossary

The following terms have been adopted by these guidelines.

Sub-population: describes discrete areas of *T. juncea* habitat where interchange of genetic material (e.g. seed/pollen dispersal) is likely. A sub-population may contain one or many plant clumps.

Plant clump: Describes a single occurrence of *T. juncea* that may contain one or multiple seems which are likely to arise from a single rootstock.

Survey

T. juncea plant clumps should be counted rather than individual plant stems in view of the rhizomatous nature of the species.

In view of the sporadic flowering nature of the species, the survey should be repeated 2–3 times during the flowering season between late August and the end of November (in dry years) and between August and January (in wet years). Where this is not possible, the assessment should assume that the survey has underestimated the distribution and abundance of the species on the site.

Life cycle of the species

Key components of the species lifecycle remain unknown. Research is currently underway investigating soil seed bank, mycorrhiza, population dynamics, fecundity and pollination.

Threatening processes

"High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition" is listed in the NSW *Threatened Species Conservation Act* 1995 as a key threatening process that may affect *T. juncea*.

Payne 2000 also identifies weed invasion, habitat destruction and fragmentation as threats.

Viable local population of the species

Local population is a term adopted by the TSC Act. It is analogous to the definition of sub-population as defined by these guidelines.

A viable sub-population is one which is capable of being self-sustaining in the medium to long term.

Current management regimes are an important consideration, i.e. the site has an appropriate fire regime, is free of weeds and not subject to any other management practice which is likely to eliminate the species.

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May 2000

A significant area of habitat

Assessment of significance of habitat for *T. juncea* requires consideration of:

- the number of plant clumps to be effected within the context of the sub-population;
- any characteristics of population on the site which may be of conservation significance eg the population displays:
  - any morphological variants;
  - is found on atypical substrate; or
  - is outside or at the edge of the current known range of the species;
- Whether the habitat in question is subject to threat and the likelihood of ameliorating any existing threatening processes;
- Whether the habitat in question will be permanently or temporarily removed.

Isolation/fragmentation

T. juncea, particularly in the eastern part of its range, has already been subject to isolation and fragmentation through the combined effects of urbanisation and agricultural developments on the central coast.

Assessment of isolation and fragmentation effects requires consideration of the impact of development on adjacent or proximate habitat on this species.

Fragmentation of existing sub-populations is clearly undesirable and exposes sub-populations to increased risk of genetic isolation and subsequent decline through reduced opportunities for outcrossing.

Regional distribution of habitat

The majority of *T. juncea* records are located within the northern portion of the Sydney Basin Region. Populations within Port Stephens and the Great Lakes Shire are at the southern limit of the North Coast Bioregion.

Limit of distribution

The southern limit of the species' current known range is the Wallarah catchment, north Wyong. The northern limit is around Buledelah in the Great Lakes Shire. The species does not occur further west than the Sugarloaf Range. This represents a north-south range of about 125km and a east-west range of about 50km.

Adequacy of representation in conservation reserves

The NPWS considers that *T. juncea* is adequately conserved in the south-eastern portion of its range with approximately 1300 plant clumps known from Awabakal Nature Reserve, Glenrock State Recreation Area, Lake Macquarie Recreation Area, and Munmorah State Recreation Area (Payne 2000)

It is inadequately conserved in the northern and western portions of its range, with no formal reserves existing in those areas.

Prospects for the conservation of the species in the northern and western areas of the species' known range is largely dependent on the future land-uses and current land management practices for large tracts of land covered by mining leases and subject to underground coal mining operations.

Critical habitat

Critical habitat has not been declared for *T. juncea* as it is not listed as endangered under the TSC Act.

For further information contact

Threatened Species Unit, Central Directorate, NSW NPWS, PO Box 1967, Hurstville NSW 2220. Phone (02) 9585 6678 or visit our website www.npws.nsw.gov.au.

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