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**Flora assessment:**

**Lot 201 DP 749272, Lot 1 DP 209779 and Lot 1 DP 558807,  
Macquariedale Road, Appin**

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raindays per annum is 97 days at Picton and 109 days at Camden (Bureau of Meteorology website [www.bom.gov.au/climate](http://www.bom.gov.au/climate) accessed 5 October 2006 and 12 February 2007).

Prior to the survey, the rainfall recorded has consistently been below average since at least January 2000 (data provided by NSW Climate Services Centre) with:

**Rainfall (mm) at Camden AWS (Station 068192)**

| Year           | Jan   | Feb   | Mar   | Apr  | May   | Jun  | Jul  | Aug  | Sep  | Oct   | Nov   | Dec  | Annual Total |
|----------------|-------|-------|-------|------|-------|------|------|------|------|-------|-------|------|--------------|
| 2000           | 24.4  | 32.4  | 162.6 | 32.0 | 32.8  | 26.2 | 13.2 | 11.2 | 26.2 | 47.4  | 129.6 | 30.6 | 568.6        |
| 2001           | 27.8  | 95.4  | 97.4  | 52.0 | 15.2  | 2.0  | 78.4 | 29.6 | 15.2 | 53.4  | 45.2  | 20.2 | 531.8        |
| 2002           | 39.0  | 256.6 | 79.4  | 25.8 | 29.6  | 7.2  | 22.0 | 4.6  | 5.2  | 3.2   | 10.8  | 36.4 | 519.8        |
| 2003           | 29.0  | 79.0  | 49.0  | 59.4 | 160.0 | 31.0 | 29.0 | 35.4 | 6.0  | 61.4  | 46.6  | 38.4 | 624.2        |
| 2004           | 33.0  | 87.2  | 29.6  | 27.0 | 13.8  | 6.2  | 25.8 | 22.4 | 41.4 | 167.2 | 87.8  | 91.0 | 632.4        |
| 2005           | 49.0  | 109.6 | 44.6  | 7.8  | 3.0   | 58.0 | 58.6 | 2.0  | 52.0 | 91.6  | 155.8 | 37.0 | 669.0        |
| 2006           | 114.6 | 31.4  | 35.2  | 2.8  | 18.6  | 50.6 | 29.4 | 23.6 | 83.8 | 5.4   | 22.6  | 57.0 | 475          |
| Long term mean | 83.6  | 95.9  | 86.1  | 66.5 | 60.6  | 52.3 | 40.7 | 44.5 | 39.7 | 68.4  | 73.7  | 52.3 | 792.8        |

| Year | Annual total rainfall | % below long-term mean annual rainfall |
|------|-----------------------|----------------------------------------|
| 2000 | 568.6                 | 28%                                    |
| 2001 | 531.8                 | 33%                                    |
| 2002 | 519.8                 | 34%                                    |
| 2003 | 624.2                 | 21%                                    |
| 2004 | 632.4                 | 20%                                    |
| 2005 | 669.0                 | 16%                                    |
| 2006 | 475.0                 | 40%                                    |

In 2006, prior to the current survey, rainfall was extremely low with an annual total of 475 mm, 40% below the long-term mean.

## 2.2 Geology and soil landscape

### 2.2.1 Geology

The geology of the Site (Figure 3) was mapped by Stroud *et al.* (1985) at a scale of 1:100 000 as:

- Hawkesbury Sandstone (map unit Rh) over the majority of the Site. Map unit Rh is described as *Medium to coarse-grained quartz sandstone, very minor shale and laminite lenses*; and
- Ashfield Shale (map unit Rwa), a member of the Wianamatta Group, in the south-east of the Site and upslope of the eastern boundary. Map unit Rh is described as *Medium to coarse-grained quartz sandstone, very minor shale and laminite lenses*.

### 2.2.2 Soil landscape

The soil landscape of the Site (Figure 4) has been mapped by Hazelton *et al.* (1990) at a scale of 1:100 000 as Blacktown soil landscape (map unit bt) over most of the Site. Map unit bt is described as:

*Landscape - gently undulating rises on Wianamatta Group shales. The local relief is to 30m with slopes usually <5%. Broad rounded crests and ridges with gently inclined slopes.*

on the sandstone side of the ecotone, (cf. map unit 9mf which is found on the shale of the ecotone) and occurs in the northwest of the area along the edge of the sandstone plateau from Menangle to Tahmoor.

**NPWS (2002)** mapped the vegetation communities of the Cumberland Plain at a scale of 1:25 000 using aerial photograph interpretation and limited ground survey. A total of twelve polygons comprising three vegetation communities were mapped on and adjoining the Site (Figure 8) with about 51 ha of the 60 ha Site mapped as:

- 42.32 ha of Shale Sandstone Transition Forest (SSTF) (High Sandstone Influence) with Crown Cover Projection Density >10%.
- 0.3 ha of Shale Sandstone Transition Forest (High Sandstone Influence) with Crown Cover Projection Density <10%;
- 4.3 ha of Shale Sandstone Transition Forest (SSTF) (Low Sandstone Influence) with Crown Cover Projection Density >10%.
- 4.24 ha of Shale Sandstone Transition Forest (SSTF) (Low Sandstone Influence) with Crown Cover Projection Density <10%.
- 0.2 ha of Shale Sandstone Transition Forest (Low Sandstone Influence) with Crown Cover Projection Density <10%, urban areas
- <0.1 ha of Upper Georges River Sandstone Woodland with Crown Cover Projection Density <10%.

| <b>Vegetation type</b>                 | <b>Polygon code</b> | <b>Polygon ID</b> | <b>Area of polygon within the Site boundary</b> |
|----------------------------------------|---------------------|-------------------|-------------------------------------------------|
| SSTF (High Sandstone Influence)        | A                   | 15,877            | 13.3 ha                                         |
|                                        | A                   | 15,830            | 0.87 ha                                         |
|                                        | A                   | 15,911            | 25.32 ha                                        |
|                                        | A                   | 16,007            | 2.73 ha                                         |
|                                        | A                   | 16,111            | 0.1 ha                                          |
|                                        |                     |                   | <b>42.32 ha</b>                                 |
|                                        | TX                  | 17,395            | 0.26 ha                                         |
|                                        | TX                  | 17,482            | 0.04 ha                                         |
|                                        |                     |                   | <b>0.3 ha</b>                                   |
|                                        |                     |                   |                                                 |
| SSTF (Low Sandstone Influence)         | A                   | 16,062            | <b>4.3 ha</b>                                   |
|                                        |                     |                   |                                                 |
|                                        | TX                  | 17,438            | 4.11 ha                                         |
|                                        | TX                  | 17,483            | 0.13 ha                                         |
|                                        |                     |                   | <b>4.24 ha</b>                                  |
|                                        |                     |                   |                                                 |
| Upper Georges River Sandstone Woodland | TXU                 | 3,374             | <b>0.2 ha</b>                                   |
|                                        |                     |                   |                                                 |
|                                        | TX                  | 17,321            | <b>0.06 ha</b>                                  |

The assigned codes for the twelve polygons on the Site were as follows:

| <b>Polygon ID</b> | <b>Community</b> | <b>Polygon Code</b> | <b>Species Code</b> | <b>Understorey Composition</b> | <b>Disturbance</b> | <b>Reliability</b> |
|-------------------|------------------|---------------------|---------------------|--------------------------------|--------------------|--------------------|
| 15,877            | SSTF (HSI)       | A                   | 13                  | G                              | B                  | 2                  |
| 15,830            | SSTF (HSI)       | A                   | 13                  | GL                             | B                  | 3                  |
| 15,911            | SSTF (HSI)       | A                   | 13                  | JK                             | B                  | 1                  |
| 16,007            | SSTF (HSI)       | A                   | 13                  | AG                             | B                  | 3                  |

The Guidelines for Conservation Significance Assessment of the native vegetation of Cumberland Plain (NPWS 2002), state:

**Core Habitat**

*'Core habitat' comprises areas that constitute the backbone of a viable conservation network across the landscape (core areas), or areas where the endangered ecological communities are at immediate risk of extinction (critically endangered communities – see Table 1). More specifically this category contains:*

- *all remnants of 10 ha or more of the mapped vegetation category "Canopy Cover >10% (Unless Remnant >5 ha, where Canopy Cover >5%)"*
- *all remnants of critically endangered communities in Table 1 (Note that this excludes Canopy Cover <10% (Urban Area)).*

**Support for Core**

*These are areas that provide a range of support values to the Core Habitat, including increasing remnant size, buffering from edge effects, and providing corridor connections. The focus is to identify priority areas for conservation and restoration in order to enhance the biodiversity values in the region. This category contains:*

- *all remnants of the vegetation category "Canopy Cover < 10%" which are contiguous with the Core Habitat defined above*
- *all remnants of the vegetation category "Canopy Cover >10% (Unless Remnant >5ha, where Canopy Cover >5%)" which are less than 10 hectares and contiguous with the remnants of the vegetation category "Canopy Cover < 10%" above*

**Other Remnant Vegetation**

*This category contains all native vegetation that does not fall within the above significance categories [Core habitat, Support for Core and Urban Remnant Trees (Critically Endangered Communities)].*

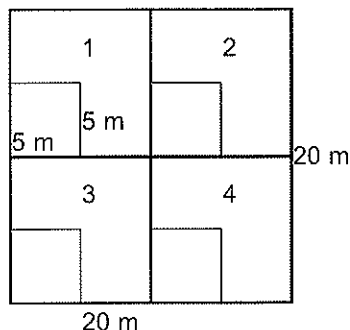
**Clements et al. (2003)** surveyed the adjoining 87 ha to the north of the Site (Figure 10). A total of 241 species were recorded on the Site, with:

- 190 native species and 51 exotic species
- no species of National, State or regional conservation significance
- two noxious weeds, namely *Rubus discolor* and *Sporobolus indicus* var. *major* (now *Sporobolus fertilis*).

A site-specific soil survey found that the Site contained shale derived soils on the upper slopes, shale/sandstone transition soils on the midslope and sandstone derived soils downslope.

The vegetation on the 45.7 ha of sandstone derived soil consisted of 31.17 ha of relatively intact vegetation, 14.24 ha of recently disturbed vegetation and 0.29 ha of regrowth on paddocks (Figure 10).

The vegetation on the 14.5 ha of shale/sandstone transition soils consisted of 1.74 ha (two patches 0.4645 ha and 1.277 ha) of relatively intact vegetation, 6.42 ha (two patches 1.746 ha and 4.675 ha) of recently disturbed vegetation, 0.14 ha of regrowth on paddocks and 6.14 ha of cleared paddocks (Figure 10).



The relative frequency of plant species was assessed by recording the presence/absence of each species in each of the 10 m x 10 m quadrats with the presence/absence of herb and shrub species recorded in 5 m x 5 m sub-quadrats in each of the 10 m x 10 m quadrats (Table 2). In each 10 m x 10 m quadrat, the number of individuals and heights of all tree species were recorded (Table 3).

At the time of survey, all sampling locations were photographed (Appendix 4) and GPS coordinates were recorded.

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. The Royal Botanic Gardens' PlantNet website ([plantnet.rbgsyd.nsw.gov.au](http://plantnet.rbgsyd.nsw.gov.au)) incorporating Flora Online is the major source for updated taxonomy.

### 3.2.2 Observations

The Site consisted of predominantly bushland from Ousedale Creek in the west to the township of Appin in the east. A 4WD access track was observed to cross the Site running in a north-south direction. Large areas of the northern section of the Site had been recently burned with little to no midstorey present. Regeneration of native groundcovers was observed at the time of survey.

The bushland on the Site was generally relatively intact with < 10% of the species recorded in most of the Quadrats being exotic (Table 4).

#### **Vegetation south of Macquariedale Road**

The vegetation south of Macquariedale Road (Quadrats 1 to 7 and 24 to 26) was surveyed on 10 October 2006 and 1 February 2007. The vegetation in the west of this area (sampled with Quadrats 1 to 7) consisted of relatively intact bushland whereas the vegetation in the east of this area (sampled with Quadrats 24 to 26) consisted mostly of cleared paddocks with scattered trees and shrubs.

The canopy of the relatively intact bushland was mainly dominated by *Eucalyptus punctata* (Grey Gum) up to 27m in height and *Eucalyptus globoidea* (White Stringybark) up to 25m, with *Eucalyptus paniculata* (Grey Ironbark) up to 30 m and *Eucalyptus pilularis* (Blackbutt) up to 25 m also recorded.

### Recently burnt vegetation

The recently burnt vegetation (sampled in Quadrats 8-12, 14, 15, 22 and 23) in the centre of the Site had a canopy dominated by *Eucalyptus punctata* up to 22 m, *E. globoidea* up to 22 m and *E. resinifera* subsp. *resinifera* (Red Mahogany) up to 18 m. *Eucalyptus crebra*, *E. paniculata* and *E. tereticornis* were also recorded in this area.

The midstorey was sparse to absent with native tall shrub species over 2 m in height recorded in only four (44%) of the nine quadrats.

The groundcover was observed to be regenerating with *Aristida vagans* (Threeawn Speargrass), *Austrostipa pubescens*, *Billardiera scandens* (Appleberry), *Calotis dentex*, *Cheilanthes sieberi* subsp. *seeberi*, *Dichondra repens*, *Echinopogon ovatus* (Forest Hedgehog Grass), *Entolasia stricta* (Wiry Panic), *Lepidosperma laterale*, *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Lomandra multiflora* (Many-flowered Mat-rush), *Microlaena stipoides*, *Oxalis perennans*, *Passiflora herbertiana* (Native Passionfruit), *Pimelea linifolia*, *Poranthera microphylla* and *Solanum prinophyllum* all common in the recently burnt vegetation.

The recently burnt vegetation had a high species diversity with 149 (63%) of the total 237 species recorded on the entire Site. In the nine quadrats, 123 (83%) of species recorded were local native and 26 (17%) were exotic species. The majority of the exotic species recorded were opportunistic early colonising species such as *Bidens pilosa* (Farmer's Friend), *Conyza albida* (Tall Fleabane) and *Senecio madagascariensis* (Fireweed).

### Vegetation of the mapped tributary of Ousedale Creek

The vegetation of the mapped creekline (sampled in Quadrat 13) flowing into Ousedale Creek had a canopy of *Eucalyptus pilularis* up to 30 m, *Eucalyptus punctata* up to 13 m, *Angophora floribunda* (Rough-barked Apple) up to 17 m and *Allocasuarina littoralis* up to 17 m.

The midstorey was diverse with *Acacia binervata* (Two-veined Hickory), *Acacia floribunda*, *Acacia implexa* (Hickory Wattle), *Allocasuarina torulosa* (Forest She-oak), *Exocarpos cupressiformis* (Native Cherry), *Kunzea ambigua*, *Leptospermum polygalifolium* subsp. *polygalifolium* (Yellow Tea-tree), *Leptospermum trinervium* (Paperbark Tea-tree), *Notelaea longifolia* (Mock-olive), *Persoonia linearis* (Narrow-leaf Geebung) and *Trema tomentosa* var. *viridis* (Poison Peach) all recorded along the creekline.

Exotic species recorded in the mapped creekline included *Ageratina adenophora* (Crofton Weed), *Senna pendula* var. *glabrata* and *Tradescantia albiflora* (Wandering Jew).

### Vegetation in the north of the Site

The vegetation in the north of the Site (sampled in Quadrats 16 to 21) was mostly unburnt with a canopy dominated by *Eucalyptus punctata* up to 20 m. *Eucalyptus globoidea*, *Eucalyptus longifolia*, *Eucalyptus paniculata* and *Eucalyptus tereticornis* were also recorded in the north of the Site. The sampling locations in the northeast of the Site (Quadrats 16, 17, 18, 20 and 21) differed from the remainder of the site by moderately dense stands of *Melaleuca styphelioides* (Prickly Paperbark).

The Advice to the Minister for Shale/Sandstone Transition Forest (Appendix 5) states:

*The determination for the ecological community Shale / Sandstone Transition Forest includes those areas identified by the NSW Scientific Advisory Committee (1998) and subsequent advice regarding locational information (NSW NPWS, 2000).*

The vegetation of the Site will hence be compared with the state listing for Shale/Sandstone Transition Forest (see section 4.1.2.1).

#### 4.1.2 State

According to Wollondilly Shire Council (2002), there were four endangered ecological communities listed on the TSC Act occurring in the Wollondilly LGA, namely:

| <b>Vegetation Community</b>                                 | <b>Habitat (Final Determination)</b>                                                                                                                                                                                                                                                                                            | <b>Likely to occur on the Site?</b>                                                                                            |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Cumberland Plain Woodland                                   | <i>occurs on soils derived from shale on the Cumberland Plain.</i>                                                                                                                                                                                                                                                              | No. The soil on the upper slopes of the Site are shale/sandstone transition derived soils, not shale derived.                  |
| O'Hares Creek Shale Forest Community                        | <i>occurs on deep, well drained red loam on small outcrops of Hawkesbury shale in the Darkes Forest area on the Woronora Plateau</i>                                                                                                                                                                                            | No. The Site is not on small outcrops of Hawkesbury shale in the Darkes Forest area.                                           |
| Shale/Sandstone Transition Forest                           | <i>occurs on areas transitional between the clay soils derived from Wianamatta Shale and the sandy soils derived from Hawkesbury Sandstone on the margins of the Cumberland Plain.</i>                                                                                                                                          | Possible. The Site is mapped as occurring on the geological boundary between the Wianamatta group and Hawkesbury Sandstone.    |
| Western Sydney Dry Rainforest in the Sydney Basin Bioregion | <i>associated with gullies and sheltered slopes of hilly, relatively steep sections of the generally elevated Cumberland Plain in the Razorback Range from Cobbitty to Picton, and sporadically elsewhere in Western Sydney including Fairfield City Farm, Grose Vale and Cattai. Soils are clay soils on Wianamatta Shale.</i> | No. The Site does not consist of gullies and sheltered slopes of the hilly, relatively steep sections of the Cumberland Plain. |

A search of the Final Determinations by date on the NSW National Parks and Wildlife website ([www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au) accessed 8 January 2007) found an additional four endangered ecological communities listed on the Threatened Species Conservation Act 1995 occurring in the Wollondilly LGA:

The Site at Appin is located on areas transitional between the clay soils derived from Wianamatta Shale and the sandy soils derived from Hawkesbury Sandstone (Figures 3 and 4) and is located on the margins of the Cumberland Plain. The Site is located within the Sydney Basin Bioregion.

As the site-specific soil survey found that a shale/sandstone transition extends across the Site from the eastern boundary to between the 210 m and 220 m contour in the west (Figure 5), only those quadrats occurring on the shale/sandstone transition will be compared with the Final Determination (Quadrats 5, 6, 8, 9, 10, 14, 16, 17, 20, 21, 22, 23, 24, 25 and 26).

*2. SSTF occurs or has occurred in the Bankstown, Baulkham Hills, Blue Mountains, Campbelltown, Hawkesbury, Liverpool, Parramatta, Penrith, and Wollondilly Local Government Areas (LGAs).*

The Site at Appin is located in the Wollondilly LGA.

*3. The floristic composition of the community includes species otherwise characteristic of, or occurring in, either sandstone or shale habitats. The structure of the community is forest or woodland.*

The vegetation on the Site was generally of either woodland or open-forest structure as defined by Specht and Specht (1999).

*4. SSTF is characterised by an assemblage of species [105 species listed in Appendix 6]*

A total of 55 (52%) of the 105 listed characteristic species of SSTF were recorded on the Site, with:

| Sampling location | Native Species | SSTF | %SSTF |
|-------------------|----------------|------|-------|
| Quadrat 5         | 49             | 24   | 23%   |
| Quadrat 6         | 37             | 15   | 14%   |
| Quadrat 8         | 47             | 25   | 24%   |
| Quadrat 9         | 35             | 13   | 12%   |
| Quadrat 10        | 40             | 17   | 16%   |
| Quadrat 14        | 43             | 22   | 21%   |
| Quadrat 16        | 41             | 21   | 20%   |
| Quadrat 17        | 28             | 13   | 12%   |
| Quadrat 20        | 35             | 15   | 14%   |
| Quadrat 21        | 30             | 14   | 13%   |
| Quadrat 22        | 59             | 31   | 30%   |
| Quadrat 23        | 56             | 22   | 21%   |
| Quadrat 24        | 17             | 7    | 7%    |
| Quadrat 25        | 23             | 8    | 8%    |
| Quadrat 26        | 24             | 13   | 12%   |

There are six quadrats (Quadrats 5, 8, 14, 16, 22 and 23) with more than 20% of the characteristic species recorded. These six quadrats had more than 40 native species recorded.

Fourteen of the 45 species listed were recorded on the Site, namely:

| Species                                                           | Sampling location                                                                           |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| <i>Arthropodium milleflorum</i>                                   | Quadrats 1, 5, 6, 13, 16 and 26                                                             |
| <i>Austrodanthonia racemosa</i> [syn. <i>Danthonia racemosa</i> ] | Quadrats 3, 5, 6, 9, 10, 12, 16, 17, 20, 23, 24, 25 and 26                                  |
| <i>Bothriochloa decipiens</i>                                     | Quadrat 24                                                                                  |
| <i>Bothriochloa macra</i>                                         | Quadrat 9                                                                                   |
| <i>Calotis dentex</i>                                             | Quadrats 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 25 |
| <i>Einadia trigonos</i>                                           | Quadrats 6, 8, 9, 10, 16, 17, 20, 21, 24, 25 and 26                                         |
| <i>Entolasia stricta</i>                                          | Quadrats 2, 3, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 26             |
| <i>Eucalyptus globoidea</i>                                       | Quadrats 1, 2, 3, 5, 6, 8, 9, 10, 12, 14, 17, 21 and 23                                     |
| <i>Eucalyptus pilularis</i>                                       | Quadrats 2, 3, 13 and 19                                                                    |
| <i>Leucopogon juniperinus</i>                                     | Quadrats 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 16, 17, 18, 20, 21, 22, 23 and 26          |
| <i>Oxalis perennans</i>                                           | Quadrats 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 17, 18, 23, 24, 25 and 26           |
| <i>Scaevola albida</i>                                            | Quadrats 16, 17 and 18                                                                      |
| <i>Senecio hispidulus</i> var. <i>hispidulus</i>                  | Quadrats 9, 16, 17 and 23                                                                   |
| <i>Thysanotus tuberosus</i>                                       | Quadrat 14                                                                                  |

9. SSTF generally occurs on soils derived from a shallow shale or clay material overlying sandstone, or where shale-derived materials has washed down over sandstone-derived substrate. Such sites are generally close to the geological boundary between the Wianamatta Shale and the Hawkesbury Sandstone.

The Site has been mapped as Hawkesbury Sandstone with Ashfield Shale upslope to the east and in the south-east of the Site (Stroud *et al.* 1985) (Figure 3). The site-specific soil survey found that a shale/sandstone transition extends across the Site from the eastern boundary to between the 210 m and 220 m contour in the west with the approximate location of the transition shown on Figure 5.

10. SSTF occurs on plateaux and hillsides and at the margins of shale cappings over sandstone.

The Site is located on gentle slopes to the west the Appin township ridge line. The site specific soil survey found that shale soils overlie sandstone in the east of the Site.

11. Many occurrences of SSTF are as linear stands, which may be as narrow as 20 metres. The small size and scattered distribution of the remnant stands of the community makes provision of a comprehensive map of occurrences impractical. Details of the distribution of many stands are provided in UBBS (1997).

No additional comments.

Contemporary vegetation cover was estimated from 1:16 000 scale aerial photography (1997/98) and sorted into six categories based on cover of *Eucalyptus* species. These categories are only approximately related to vegetation condition.

The mapped communities on the Site were:

| Map unit | Tozer (2003)/NPWS (2002) communities                         | Sampling locations in area of NPWS (2002) mapped vegetation community                   |
|----------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1        | Shale/Sandstone Transition Forest (Low sandstone influence)  | Quadrats 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23 and 25 |
| 2        | Shale/Sandstone Transition Forest (High sandstone influence) | Quadrats 5, 6 and 26                                                                    |
| 32       | Upper Georges River Sandstone Woodland                       | Not sampled, only 0.058 ha mapped on the Site in the north                              |

Tozer's (2003) description and diagnostic species for the map units are given in Appendix 3.

Tozer (2003) states that:

*Map Units 1 and 2 combined correspond to the western form of Shale/Sandstone Transition Forest described in NPWS (1997) and subsequently listed under the TSC Act 1995.*

There appears to be a conflict between the soil requirements for Map Units 1 and 2 and the listed criteria in the Final Determination:

In paragraph 1 of the Final Determination

*Shale/Sandstone Transition Forest (SSTF) ... occurs on areas transitional between the clay soils derived from Wianamatta Shale and the sandy soils derived from Hawkesbury Sandstone ...*

Tozer (2003) (pages 23 to 25) states that:

*Map Unit 1 – The community is only found in close proximity to a transition in parent geology from Wianamatta Shale to high-quartz sedimentary substrates such as the Hawkesbury and Narrabeen Group Sandstones as well as fine to medium grained quartz of the Mittagong Formation. In these peripheral areas shale soils form a shallow layer over the underlying sandstone. The majority of sample sites were located within approximately 2 km of sandstone/shale boundary. The community may also be found at greater distances of the sandstone/shale boundary where water courses have eroded the shale stratum down close to level of the sandstone.*

*Map Unit 2 occurs on the margins of the Cumberland Plain in close proximity to the sandstone/shale boundary ... The majority of sample sites were located within approximately 400 m of sandstone/shale boundary and varied considerably in the degree of sandstone influence evident in the soils.*

For the map units, the minimum number of native species required to carry out the tests and the number of positive diagnostic species required for the three map units are:

- Quadrats 2, 5, 8, 12, 14, 22 and 23 recorded the minimum number of native species and positive diagnostic species for Shale/Sandstone Transition Forest (High sandstone influence); and
- No quadrats contained the minimum number of positive diagnostic species for Upper Georges River Sandstone Woodland.

**In conclusion:**

- The vegetation recorded in Quadrats 15, 17, 18, 19, 21, 24, 25 and 26 contained fewer than the minimum number of native species to test for any of the three vegetation communities;
- The vegetation recorded in Quadrats 11, 13 and 16 contained the minimum number of native species to test for some communities but did not meet the criteria for any of the three communities. Quadrat 13 contained 92% of the minimum positive diagnostic species for SSTF (LSI) and Quadrat 16 contained 83% of the minimum positive diagnostic species for SSTF (LSI).
- The vegetation recorded in Quadrats 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 20, 22 and 23 meet the species number requirements for the Tozer (2003) test for Shale/Sandstone Transition Forest (Low sandstone influence) at a 95% confidence level. Quadrats 1, 2, 3, 4, 7, 12 are located on sandstone derived soils and do not satisfy the soil criteria listed in the Final Determination.
- The vegetation recorded in Quadrats 2, 5, 8, 12, 14, 22 and 23 meets the species number requirements for the Tozer (2003) test for Shale/Sandstone Transition Forest (High sandstone influence) at a 95% confidence level. Quadrats 2 and 12 are located on sandstone derived soils and do not satisfy the soil criteria listed in the Final Determination.

The results of applying Tozer's diagnostic procedure to the vegetation data support the conclusion that the forested vegetation above the 215 m contour on the Site is Shale/Sandstone Transition Forest. Tozer's diagnostic procedure goes further in identifying the south-west section of the Site (on sandstone substrate) as Shale/Sandstone Transition Forest (Quadrats 1, 2, 3, 4 and 7).

#### **4.1.4 Communities conclusion**

Based on a comparison of the vegetation data with the Final Determinations for Shale/Sandstone Transition Forest and the application of Tozer's (2003) diagnostic procedure, the forested vegetation east of the 215 m contour on the Site (sampled in Quadrats 5, 6, 8, 9, 10, 14, 20, 22 and 23) appears to meet the criteria for the endangered ecological community Shale/Sandstone Transition Forest. Quadrats 16, 17 and 21 are located on shale/sandstone transition derived soils and:

- Quadrat 16 had 41 native species (satisfies minimum number of native species required for the Tozer diagnostic test for any of the three communities), 10 of the 12 required diagnostic species for SSTF(LSI) and 16 of the 20 required diagnostic species for SSTF(HSI). At a 95% confidence level, Quadrat 16 was not Tozer's map unit 1 or 2. In terms of the Final Determination, 20% of the characteristic species and two of the characteristic tree species were recorded in Quadrat 16. It was concluded that Quadrat 16 satisfies the criteria listed in the Final Determination for Shale/Sandstone Transition Forest;
- Quadrat 17 and 21 did not contain the minimum number of native species required for the Tozer diagnostic test for any of the three communities. In terms of the Final Determination, 12% of the characteristic species and one of the characteristic tree species were recorded in Quadrat 17 and 13% of the characteristic species and two of the characteristic tree species were

| Species                     | Status | Habitat (Harden 1990 – 1993, 2002)                                                                       | Likely to occur on the Site? |
|-----------------------------|--------|----------------------------------------------------------------------------------------------------------|------------------------------|
| <i>Persoonia nutans</i>     | E      | In woodland to dry sclerophyll forest on laterite and alluvial sand; confined to the Cumberland Plain.   | Unlikely                     |
| <i>Pomaderris brunnea</i>   | V      | In open forest, confined to the Colo R. and upper Nepean R.                                              | Unlikely                     |
| <i>Pterostylis saxicola</i> | E      | Grows in shallow soil over sandstone sheets, often near streams; rare, from Picnic Point to Picton area. | Possible                     |
| <i>Pultenaea aristata</i>   | V      | Grows in moist, dry sclerophyll woodland to heath on sandstone; Helensburg to Mount Keira.               | Possible                     |

None of these species were recorded in or between the sampling locations on the Site.

#### 4.2.2 State

The following 24 species are scheduled in the TSC Act and have been recorded in the Wollondilly LGA (NPWS Wildlife Atlas online [www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au) accessed 11 October 2006):

| Species                                   | Status | Habitat (Harden 1990 – 1993, 2002)                                                                                                                                               | Likely to occur on the Site? |
|-------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <i>Acacia baueri</i> subsp. <i>aspera</i> | V      | Occurs chiefly in the Blue Mountains, but also near Mount Keira and reported from Royal National Park; rare. Grows in low heath, often on exposed sandstone ridges.              | Unlikely                     |
| <i>Acacia bynoeana</i>                    | E1     | Grows mainly in heath and dry sclerophyll forest, in sandy soils.                                                                                                                | Possible                     |
| <i>Acacia clunies-rossiae</i>             | V      | Grows in dry sclerophyll forest, in valleys, on slopes and ridges, and along creeks; from the Kowmung River and adjacent Cocks River district                                    | Possible                     |
| <i>Acacia flocktoniae</i>                 | V      | Grows in dry sclerophyll forest on sandstone; in the Blue Mountains from Mount Wilson south to the Picton district; rare.                                                        | Possible                     |
| <i>Acacia pubescens</i>                   | V      | Usually grows in dry sclerophyll forest and woodland in clay soils; Bilpin to Georges River and the Oakdale area; dubiously recorded at Woodford where it is possibly cultivated | Unlikely                     |
| <i>Acrophyllum australe</i>               | V      | Grows in damp crevices in sandstone, usually near waterfalls. Restricted to the Blue Mountains, near Springwood, Linden, Woodford and Lawson.                                    | Unlikely                     |
| <i>Bossiaea oligosperma</i>               | V      | Known only from near Yerranderie, on stony slopes or ridges on sandstone.                                                                                                        | Possible                     |

| Species                   | Status | Habitat (Harden 1990 – 1993, 2002)                                                                                            | Likely to occur on the Site? |
|---------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <i>Solanum armourense</i> | E1     | A species of limited range: Yerranderie to Wombeyan Caves.<br>Eucalypt woodland with shrubby understorey, on rocky hillsides. | Unlikely                     |
| <i>Thesium australe</i>   | V      | Grows in grassland or woodland, often in damp sites; widespread but rare and possibly endangered.                             | Unlikely                     |

None of these species were recorded in or between the sampling locations on the Site.

#### 4.2.3 Regional

**Benson and Howell (DRAFT 1994)** listed 23 botanically significant species in the Hawkesbury-Nepean catchment. These species are 'either rare or threatened (Briggs and Leigh 1988) or of regional botanical significance in terms of geographic distribution or localised populations disjunct from other occurrences'.

Of the 23 listed species, none were recorded on the Site.

#### 5.0 Noxious Weeds

The NSW Department of Primary Industries list of Noxious weed declarations ([www.dpi.nsw.gov.au/agriculture/noxweed](http://www.dpi.nsw.gov.au/agriculture/noxweed), accessed 10 January 2006) identifies 93 noxious weeds for the Wollondilly Local Government Area (Appendix 7). Two of the 51 exotic species recorded in the current survey of the Site are declared noxious weeds in the Wollondilly LGA, namely:

| Botanical name                | Common name      | Control category | Sampling location                     |
|-------------------------------|------------------|------------------|---------------------------------------|
| <i>Asparagus asparagoides</i> | Bridal Creeper   | 5                | Quadrats 2, 5, 6, 7, 9, 13, 25 and 26 |
| <i>Echium plantagineum</i>    | Paterson's Curse | 4                | Quadrat 24                            |

Control categories:

- 4 The growth and spread of the weed must be controlled according to the measures specified in a management plan published by the local control authority.
- 5 The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

#### 6.0 NSW Rivers and Foreshores Improvement Act 1948

Ousedale Creek forms the western boundary of the Site and a tributary flows through the northern section of the Site.

The Department of Land and Water Conservation guidelines (Appendix 8) for the Rivers and Foreshores Improvement Act 1948 (R&FI Act) state that the Act:

*applies to natural and artificial water bodies, which are known as protected waters, and which include:*

- *all clearly defined drainage lines;*

## **8.0 Recommendations**

It is recommended that:

- Given that the 16.5 ha identified Shale/Sandstone Transition Forest is immediately west of the existing Appin township and on gently sloping land, and will be impacted by the future Appin Bypass alignment, an investigation of biobanking options should be considered; and
- Given the similarity of the vegetation on the shale/sandstone transition derived soils and the sandstone derived soils, the relatively intact vegetation downslope of the future Appin Bypass should be retained as an extension of the existing conservation area adjoining Ousedale Creek on the land to the north of the Site. The retention of the vegetation includes the riparian corridors identified by Patterson Britton (Appendix 9).