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Responses to DECCW's biodiversity related comments and Department of Planning's flora related issues for Major Project Application MP09_0195, MP09_0217 and MP09_0218 at 120–128 Herring Road, Macquarie Park

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Preamble

This report addresses DECCW biodiversity related comments attached to Department of Planning letter signed 23 June 2010 together with flora related issues raised by the Department of Planning in Schedule 1 attached to correspondence dated 28 July 2010 regarding Major Project Application MP09_0195, MP09_0217 and MP09_0218, at 120–128 Herring Road, Macquarie Park. This report has been prepared on instruction from Paul Clark of Lipman Properties Pty Ltd.

Director General Requirements relating to flora were issued on 28 January 2010, namely:

9. Flora and Fauna

- *Address impacts on flora (including trees to be retained) and fauna, including threatened species, populations and endangered ecological communities and their habitats and steps taken to mitigate any identified impacts to protect the environment and land in accordance with DECCW "Draft Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning Act 1979."*
- *The EA shall detail actions that will be taken to avoid or mitigate impacts or compensate for unavoidable impacts of the project on threatened species, populations, Endangered Ecological Communities and their habitats. Any proposed offsetting measures should be developed in accordance with the "Principles of the use of Biodiversity Offsets in NSW"*
- *The EA shall demonstrate the implementation of measures to protect and rehabilitate the adjoining University Creek and riparian corridor in accordance with the Guidelines for Controlled activities in riparian corridors.*

The DECCW provided biodiversity related comments in response to the Flora and Fauna assessment prepared by Total Earth Care (2010) submitted with the Environmental Assessment by Urbis (2010), namely:

> *The Flora and Fauna Assessment (FFA) states that no endangered ecological communities (EECs) occur on site, but Sydney Turpentine Ironbark Forest (STIF) occurs adjacent to the site. However trees …are component tree and understorey species of STIF …In view of this, further assessment of whether any vegetation on site is STIF should be undertaken.*
>
> *The proposal could lead to direct loss of areas of STIF, as well as indirect impacts on STIF on site and on the adjacent site. The assessment of significance for this EEC will also need be amended.*
>
> *The FFA notes that two threatened flora species,* Syzygium paniculatum *and* Eucalyptus scoparia *occur on the site. However, the assessment of significance of impact on these two species will still need to be prepared given their listed status.*

In Schedule 1 attached the Department of Planning correspondence dated 28 July 2010, a flora related issues was raised, namely:

> *Department of Environment Climate Change and Water (DECCW) in their letter dated 23 June 2010 identified the need for further assessment of whether any vegetation on site is Sydney Turpentine Ironbark Forest (STIF). An assessment of the impact of the development on two threatened flora species on site is also required.*

This report has been prepared in three parts:

Part A Whether the endangered ecological community (EEC) Sydney Turpentine-Ironbark Forest occurs on or adjacent to the Site

The current flora assessment by Clements *et al*. (2010) supplements the biodiversity information presented in Total Earth Care (2010) and Treescan (2010), that were submitted as part of the Environmental Assessment by Urbis (2010).

The current flora assessment finds that the endangered ecological community Sydney Turpentine-Ironbark Forest (STIF) does not occur on or adjacent to the Site as the soils on and adjoining the Site to the northeast are not those described in the Final Determination for STIF. The soils were found to be Shale/Sandstone Transition soils based on the data in Douglas Partners (2009) and in the site-specific soil survey by Dr Pam Hazelton (Appendix 1)).

The extensive plantings of Australian native and exotic species on and adjoining the Site are not of conservation significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and NSW Threatened Species Conservation Act 1995.

The vegetation on the adjoining Macquarie University land was not a “remnant” of Sydney Turpentine-Ironbark Forest as previous reported by EDAW (2006), Total Earth Care (2010). The vegetation was largely plantings of Australian native species.

Possible remnant trees have been identified from a review of the historic aerial photographs (1930, 1943, 1951, 1956, 1961, 1970, 1986) held by Land and Property Information, Sydney and the most recent Nearmap Image.

There is a mapped creek in the northwest of the Site. Office of Water NSW has issued requirements for a riparian corridor on the Site. It is recommended that the vegetation of this riparian corridor for the 47 m length of mapped creek be re-established utilising only local native species from local sources and appropriate to the Shale/Sandstone Transition soils occurring here.

Part B Assessment of significance for Sydney Turpentine-Ironbark Forest

The presence of Sydney Turpentine-Ironbark Forest is not possible as the soil and vegetation criteria are not met.

The site-specific field soil investigation by Dr Pam Hazelton and the geotechnical investigation by Douglas Partners (2009) are indicative of soils which occur on areas transitional between clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed are close to the geological boundary often evidenced by the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The Mittagong Formation consists of interbedded shale, laminite and fine to medium-grained quartz sandstone. As such, the soils satisfy the criteria listed in the Final determination for Shale/Sandstone Transition Forest.

The soils do not satisfy the criteria listed in the Final Determination for Sydney Turpentine-Ironbark Forest.

Part C Assessment of significance for *Eucalyptus scoparia* and *Syzygium paniculatum*

Two threatened species were recorded on Site by Treescan (2010), as non-indigenous native species (not naturally occurring at this locality).

The species are listed as:

Species	Listing under EPBC Act	Listing under TSC Act
Eucalyptus scoparia	Vulnerable	Endangered
Syzygium paniculatum	Vulnerable	Endangered

The tree identified as *Eucalyptus scoparia* was not that species. It has been identified by Tony Rodd as *Angophora costata,* not *Eucalyptus scoparia.* The only other possible tree on the Site that could have been misidentified as *Eucalyptus scoparia* was identified by Treescan (2010) as *Eucalyptus haemastoma*. Tony Rodd identified this tree as *Eucalyptus racemosa* (these two species of Scribbly Gum are closely related and intergrades between them are common in parts of the Sydney area where their distributions overlap).

The young sapling of *Syzygium paniculatum* reported by Treescan (2010) was confirmed as that species in the current survey (in Transect 2). It has undoubtedly been planted in the lawn here within the last five years or thereabouts. This species has been widely cultivated for its showy fruit for over 100 years, both in Australia and overseas.

From the assessment of significance, using a 7 part test, the proposal to remove the one recorded individual of *Syzygium paniculatum* will have no significant impact on naturally occurring *Syzygium paniculatum*. The individual recorded on the Site is a planted specimen and part of extensive planting of Australian native and exotic species in a park like campus setting of mown lawns.

Part A Whether the endangered ecological community (EEC) Sydney Turpentine-Ironbark Forest occurs on or adjacent to the Site

A1.0 Introduction

The purpose of this part of the report is to determine whether the endangered ecological community (EEC) Sydney Turpentine-Ironbark Forest (STIF) occurs on or adjacent to the Site.

The 1.717 ha "Development Site" is part of the existing Morling College campus at 120-128 Herring Road (the Site, Figure 1). The Site comprises most of the 1.312 ha of Lot B in DP 368446 and parts of the 3.461 ha of Lot 1 in DP876482 (Urbis 2010). The property is located within the City of Ryde Local Government Area.

A2.0 Environmental Setting

The Site has frontage to Herring Road and directly adjoins the southern portion of the Macquarie University campus. There are scattered trees on the Morling College land and the adjacent Macquarie University campus. There is a narrow band of trees along the banks of a mapped creek in the northwest of the Site. There are several existing residential buildings and a chapel, either situated wholly on or straddling the boundary of the Site. Other existing built features include minor internal roadways, parking areas and a levelled playing field to the southeast of the mapped creek near the northwestern boundary (Figures 1, 2).

The Site is bounded (Figures 1, 2):

- To the northeast by the Macquarie University campus, with Macquarie shopping centre and Macquarie University train station about 350 m from the centre of the Site;
- To the southeast by Herring Road with residential unit blocks fronting Herring Road on the opposite side;
- To the southwest by Morling College campus and further to the southwest Willandra Village; and
- To the northwest by the grounds of the Cochlear Building (under construction).

The Site slopes gently down from an elevation of about 67 m AHD at the Herring Road frontage towards University Creek at an elevation of 58 m AHD at the top of the bank (Barrie Green and Associates 6041DET_C.dwg, Rev C, 20 August 2009).

From site inspection and from the 1:25 000 topographic map (Figure 1), it appears that the creek is piped under the aged care village to the southwest of the Morling College land. There is a 47 m length of creek in the northwest of the Site. The mapped creekline is known as "University Creek" (EDAW 2006, Total Earth Care 2010), although this name is not shown on the 1:25 000 topographic map nor is it listed in the Geographical Names Board's Register of Geographical Names (website: http://www.gnb.nsw.gov.au/name_search accessed 8 Aug 2010). The creek flows about 1.5 km northeast across Macquarie University land to join Lane Cove River in Lane Cove National Park.

A2.1 Climate

The nearest meteorological station is Macquarie Park (Willandra Village, Station Number 066156), located approximately 100 m west of the Site.

From the Bureau of Meteorology website (www.bom.gov.au, accessed 4 August 2010), the mean annual daily maximum temperature is 22.8^{o}C and the mean annual

daily minimum temperature is 11.2°C. The highest monthly mean temperature was recorded for January (27.7°C) and the lowest for July (4.9°C).

The mean annual rainfall is 1138.8 mm. The highest monthly mean rainfall is in February (148.1 mm) and lowest in July (51.7 mm). The mean number of days of rain per annum is 87.1.

Prior to the survey on 27 July 2010, the recorded rainfall was above average in May and June 2010. Hence, good representation of the existing groundlayer species diversity was likely to be present.

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003	6.8	106.0	170.6	215.2	345.4	67.0	47.2	37.0	4.4	95.8	108.4	93.6	1297.4
2004	43.8	127.4	85.0	38.6	6.8	3.4	35.4	63.2	52.4	305.6	78.2	64.8	904.6
2005	87.6	103.8	98.2	29.0	40.8	87.0	47.8	2.6	50.8	53.1	140.6	32.4	773.7
2006	95.3	66.9	36.4	7.0	14.8	127.2	74.8	55.8	219.0	9.6	63.2	74.0	844.0
2007	41.6	229.6	51.0	117.0	13.6	430.2	32.0	159.4	34.6	44.8	168.0	149.0	1470.8
2008	81.4	268.0	54.6	148.8	8.4	129.4	41.6	41.9	103.6	30.6	118.2	52.0	1078.5
2009	16.5	186.0	86.0	165.6	109.2	92.4	46.2	7.0	14.6	146.6	9.4	65.7	945.2
2010	67.0	338.5	64.5	26.8	118.8	125.8							
Mean	114.2	148.1	131.3	105.1	87.9	114.7	51.7	57.6	59.3	85.9	92.1	83.8	1138.8

A2.2 Geology, Soil Landscape and site specific soil surveys

A2.2.1 Geology

The Site is mapped at 1:100 000 scale by Herbert and West (1983) as map unit Rwa of the Ashfield Shale Formation in the Wianamatta Group (Figure 3). This unit is described as:

> *Black to dark-grey shale and laminite.*

The Site also closely borders map unit Rh of the Hawkesbury Formation, also in the Wianamatta Group (Figure 3). This unit is described as:

> *Medium to coarse-grained quartz sandstone, very minor shale and laminite lenses.*

A2.2.2 Soil Landscapes

The Site is mapped at a scale of 1:100 000 by Chapman *et al.* (1989) as Glenorie (map unit gn) and Lucas Heights (map unit lh) Soil Landscapes (Figure 4). These map units are described as:

Map Unit	Description
Glenorie	Landscape – *undulating to rolling hills on Wianamatta group shales. Local relief 50 – 80m, slopes 5-20%. Narrow ridges, hillcrests and valleys. Extensively cleared tall open-forest.* Soils – *shallow to moderately deep (<100 cm) red podzolic soils on crests; moderately deep red and brown podzolic soils on upper slopes; deep (>200 cm) yellow podzolic soils on lower slopes and humic gleys, yellow podzolic soils and Gleyed podzolic soils along drainage lines.* Limitations – *high soil erosion hazard, localised impermeable highly plastic subsoil, moderately reactive.*
Lucas Heights	Landscape – *gently undulating crests and ridges on plateau surfaces of the Mittagong Formation (alternating bands of shale and fine-grained sandstone). Local relief to 30m,*

Map Unit	Description
	slopes <10%. Rock outcrop is absent. Extensively or completely cleared, low open-forest and woodland. Soils – *moderately deep (50-150 cm), hardsetting Yellow Podzolic and Yellow Soloth Soils; Yellow Earths on outer edges of crests.* Limitations – *stony soil, low soil fertility, low available water capacity.*

A2.2.3 Site specific soil surveys

Douglas Partners (2009) examined soils and geology in eight boreholes and groundwater from two monitoring wells. The Herbert and West (1983) geological mapping was confirmed. Douglas Partners fieldwork identified residual soils then laminite overlying sandstone bedrock. It was stated that:

> *The laminite may be part of the Mittagong Formation which is a transitional rock unit between Ashfield Shales and Hawkesbury Sandstone.*

Douglas Partners (2009) was submitted as part of the Environmental Assessment by Urbis (2010).

Hazelton (2010) (in Appendix 1) assessed the soils of the Site to determine whether the soils met the listed criteria in the Final Determination for the endangered ecological community Sydney Turpentine-Ironbark Forest.

The geotechnical report by Douglas Partners (2009) was reviewed, and an additional six soil sites (Figure 5) were excavated and inspected by Dr Pam Hazelton on 27 July 2010. Dr Hazelton found:

> *The soil described in the field by me and by Douglas and Partners are indicative of those which occur on areas transitional between the clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed by me show evidence of the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The soils of the Site consistent with the Lucas Heights soil landscape. Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such the soils satisfy the criteria listed in the Final determination for Shale Sandstone Transition Forest.*
>
> *The soils on this site are not derived from Wianamatta Shale and do not satisfy the criteria listed for the Final Determination for the endangered ecological community of Turpentine-Ironbark forest.*

A2.3 Land Use

The current land use is as campus grounds for the Morling College and associated residential houses. The NSW Baptist Theological College was originally established in March 1916 at the premises of the Harris Street Baptist Church in Ultimo. The Morling College is named after Rev GH Morling, who was principal for nearly 40 years (Australian College of Theology website www.actheology.edu.au, accessed 6 August 2010). The College opened at its current location in 1962 (Ron Robb, Baptist Archivist, pers. comm., 6 August 2010).

The adjoining land to the northeast of the site is the 126-hectare park-like campus of Macquarie University. The University was opened in 1964 (Australian Education

Network website: www.australian-universities.com/history-of-australian-universities.php, accessed 6 August 2010).

From a review of the historic aerial photographs (1930, 1943, 1951, 1956, 1961, 1970, 1986 on Figure 6) held by Land and Property Information Sydney, and the most recent Nearmap Image (Figure 2), it is evident that the land use has changed from mainly agricultural prior to the 1930s, to college and University campuses in the 1960s, as indicated in the following table:

Year	On site	Surrounding
1930	Largely cleared for agriculture with clusters of trees and bushland adjoining the NW boundary.	Patches of bushland immediately to NW. Reduced tree cover to N, E and S.
1943	Two buildings constructed near the northern boundary in central part. Paddock in the NW with bushland adjoining to the NW. Growth of trees south of the buildings. The patch of bushland to NW of the Site along the creek has been cleared to a thin strip of remnant trees.	Bushland to NW cleared for paddock. Long rectangular building and paddock to south as well as probable tree plantings or tree growth. Cluster of buildings constructed to the north of the boundary and two houses and paddocks fronting Herring Road. Clearing for paddocks to the east.
1951	Increased density of trees in centre. Paddock in W with increased density of trees along the creek. Scattered trees in E.	Predominantly farming with cleared paddock.
1956	Increased density of trees in centre.	Predominantly farming with cleared paddock. Vegetation in riparian corridor to north and south of site increasing in density.
1961	Increased density of trees in centre.	Still predominantly farming with cleared paddock. Scattered patches of trees increased in density.
1970	Most of the trees in the centre cleared and campus buildings constructed. Soil mounds on the former paddock (northern part probably for levelled playing field). E largely cleared with one building fronting Herring Road. Increased density of trees along the creek.	Still a few scattered farms. Agricultural plots have been largely replaced with early stages of the University to N, clearing of trees, lawns and construction of the college buildings to S, units/retirement village built to SW and road construction for subdivision to SE.
1986	Similar to 1970.	Increased housing and expansion of the University. There appear to be no more farming areas.
2010	More buildings in E than 1986.	Similar to 1986 with additional industrial buildings to W.

A3.0 Flora

A3.1 Previous Vegetation Studies

NPWS (2002) / Tozer (2003) mapped the native vegetation of the Cumberland Plain at a 1:25 000 scale using aerial photograph interpretation and limited ground survey.

There is no vegetation community mapped on the Site. The vegetation communities mapped within 1 km of the Site are <10% Canopy Cover Turpentine-Ironbark Forest and Turpentine-Ironbark Margin Forest, >10% Canopy Cover Turpentine-Ironbark

Forest and Turpentine-Ironbark Margin Forest, <10% Urban Canopy Cover Turpentine-Ironbark Forest and Turpentine-Ironbark Margin Forest, >10% Canopy Cover Western Sandstone Gully Forest, <10% Urban Canopy Unclassified Veg and >10% Canopy Cover Unclassified Veg (Figure 7).

Kubiak (2005) provides lists and descriptions of native plant species recorded in bushland in the Ryde district. There were nine threatened species recorded in Ryde bushland (*Darwinia biflora*, *Diuris bracteata*, *Eparacis purpurascens* var. *purpurascens*, *Genoplesium baueri*, *Persoonia hirsuta*, *Pimelea curviflora* var. *curviflora*, *Tetratheca glandulosa* and *Wilsonia backhousei*) and three endangered ecological communities (Blue Gum High Forest, Sydney Turpentine-Ironbark Forest, Coastal Saltmarsh). These three communities are listed under the NSW Threatened Species Conservation Act 1995 as occurring in Ryde.

EDAW (2006) prepared a preliminary ecological assessment for Macquarie University. It was a qualitative review including NPWS mapping and aerial photography and site inspection. No quantitative data were presented. The basis for the mapping is unclear.

Based on aerial photographic interpretation EDAW produced a map showing "stands of natural vegetation that were present in 1964" which are referred to as "Remnants" (Figure 8). Remnant 3 adjoins the northeast boundary of the Site. These "Remnants" are described as:

"Remnant"	Community	Condition and Extent	Disturbance type
1	Sydney Turpentine-Ironbark Forest transition to Western Sydney Gully Forest	Largest and mostly intact	Minor edge mowing and weed infestation
2	Sydney Turpentine-Ironbark Forest	Small and poor condition	Extensive Mowing
3	Sydney Turpentine-Ironbark Forest	Small and poor condition	Extensive Mowing
4	Sydney Turpentine-Ironbark Forest	Small and poor condition	Extensive Mowing
5	Sydney Turpentine-Ironbark Forest transition to Western Sydney Gully Forest	Representative of various strata, interconnects with Lane Cove National Park	Weed infestation

Comparing EDAW (2006) with NPWS (2002) mapping (Figures 7, 8), Remnant 1 appears to be consistent with NPWS mapping, Remnants 2, 3, 4 are not mapped as native vegetation by NPWS and Remnant 5 is mapped by NPWS as unclassified, namely:

"Remnant"	Community	NPWS (2002)
1	Sydney Turpentine-Ironbark Forest transition to Western Sydney Gully Forest	Turpentine Ironbark margin forest >10% canopy cover
2	Sydney Turpentine-Ironbark Forest	Not mapped
3	Sydney Turpentine-Ironbark Forest	Not mapped
4	Sydney Turpentine-Ironbark Forest	Not mapped

"Remnant"	Community	NPWS (2002)
5	Sydney Turpentine-Ironbark Forest transition to Western Sydney Gully Forest	Unclassified vegetation

Treescan (2010) assessed all trees on and adjoining the Site. It was found that:

> *Site vegetation consists of scattered trees, with an understorey of turfgrass and shrubs. . . . Much of the site is devoid of trees and the grassland is maintained by frequent mowing. Most of the trees appear to have been planted as part of the various landscape plans, although in some areas there are trees of species which are part of the former vegetation community of the area.*

The identified trees are shown on the Tree Management Plan (Turf Design, Project No. 0924, Dwg No. L5 Rev C dated 30/04/10). Treescan (2010) categorises the species recorded as either Native to Australia, Indigenous to the area, or Exotic, with:

Species	Tree Number
Native to Australia	
Corymbia maculata	52
Eucalyptus botryoides	60, 61, 62, 63, 64, 65,
Eucalyptus botryoides/microcorys	19, 20, 54, 55
Eucalyptus cinerea	31
Eucalyptus microcorys	12, 13, 14, 34, 87, 88
Eucalyptus scoparia	25
Eucalyptus sideroxylon	86
Ficus microcarpa var. *hillii*	17
Grevillea robusta	51
Melaleuca armillaris	84
Melia azedarach	42, 45
Indigenous to the area	
Angophora costata	2, 4, 10
Corymbia gummifera	77
Eucalyptus globoidea	32, 58, 59, 82, 83
Eucalyptus haemastoma	28, 30
Eucalyptus pilularis	1, 5, 6, 11, 79, 80, 81,
Eucalyptus punctata	3, 21, 22, 23, 26, 53
Melaleuca sp.	33
Syncarpia glomulifera	15, 16, 35, 36, 37, 38, 39, 40, 41, 70
Exotic	
Cedrus deodara	72
Cinnamonum camphora	68
Cupressus macrocarpa	27

Species	Tree Number
Erythrina x *sykesii*	24
Jacaranda mimosifolia	44, 49, 50, 56, 57, 71
Liquidambar styraciflua	48
*Maple**	75
Quercus robur	69
Category and species not given	7, 8, 9, 18, 29, 43, 46, 47, 66, 67, 73, 74, 76, 78, 85

Treescan (2010) provides required detail for protection of retained trees during construction.

Treescan (2010) was submitted as part of the Environmental Assessment by Urbis (2010).

Total Earth Care (2010) undertook a flora and fauna assessment on and adjoining the Site, recording the abundance of species in three identified vegetation communities. Details of sampling methods, sampling locations and vegetation community mapping are presented. The percentage of number of native species (including uncertain provenance) to total species recorded in three identified communities varied from 37% in the "Cleared and disturbed Woodland/ Grassland" to 70% in "Remnant 3" identified by EDAW (2006), namely:

Unit	Vegetation communities	Total species recorded	Native, including uncertain provenance	Non-local native	Exotic	% native
	Onsite					
CD	Cleared and disturbed Woodland/ Grassland	53	20	16	17	37%
R	Riparian zone along creek	43	24	4	15	56%
	Offsite					
STIF	Sydney Turpentine-Ironbark Forest on the adjoining University Land (Remnant 3 identified by EDAW 2006)	44	31	1	12	70%
	Total	**76**	**38**	**18**	**20**	**50%**

Of the 20 exotic species, eight were listed under the *NSW Noxious Weed Act* for Ryde LGA.

Total Earth Care (2010) concluded that:

> *the endangered ecological community STIF does not occur within the subject site as the subject site resilience is assessed as low, there was no evidence of recovery of STIF species within the subject site and the likelihood of them occurring and recovering from any potential underground seed store is remote…A much higher quality remnant of native vegetation occurs on the adjoining Macquarie University site, and this most closely resembles the Turpentine Ironbark Margin Forest subunit of STIF. The riparian zone of the subject site does contain some canopy trees characteristic of STIF, although in a very much modified form.*

There were two species recorded on the Site that are listed as threatened under the TSC Act and the EPBC Act, namely *Eucalyptus scoparia and Syzygium paniculatum*. Both are considered to be "Non-indigenous species" that do not occur at this locality.

Total Earth Care (2010) was submitted as part of the Environmental Assessment by Urbis (2010),

A3.2 Current assessment

The Site was briefly inspected by Dr Anne Clements and Tony Rodd on 20 July 2010.

The vegetation structure and species composition on and adjoining the Site were assessed from five 0.04 ha transects (Transects 1 to 5), four Spot locations (A to D) (Figure 9) and two planted rows (Rows 1 and 2) by Dr AnneMarie Clements, Polly Simmonds, Lucy Jewell and Phillip Hughes on 27 July 2010. A total of 159 species (63 native, 9 non-local native and 87 exotic) (Table 1) were recorded. The photographs of the sampling locations are provided in Appendix 2.

Tony Rodd revisited the general locations of the two threatened species reported to be present, namely *Eucalyptus scoparia and Syzygium paniculatum,* on 30 July 2010.

Possible remnant trees on the Site were determined by overlaying the plotted trees from the Tree Management Plan (Turf Design, Project No. 0924, Dwg No. L5 Rev C dated 30/04/10) on each of the historical aerial photographs. The possible trees were then reinspected, identifications checked and trees photographed by Tony Rodd, Lucy Jewell and James Woodmansey on 25 August 2010. The photographs of the trees are provided in Appendix 3.

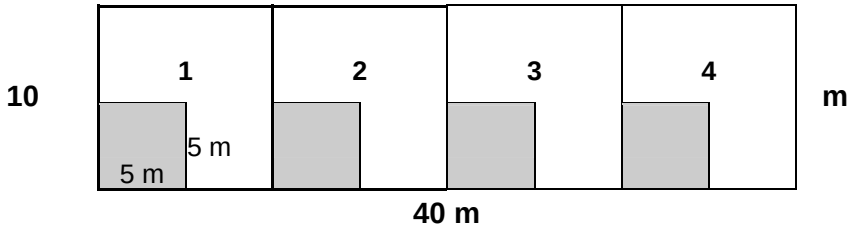
The species composition at the sampling locations consisted largely of exotic species with the number of native species generally less than 60% of the total species recorded, as shown in the following table:

Sampling location	Total number of species recorded	Local native	Non-local native	Exotic	Percent exotic and non-local native species to total recorded
Transect					
1	39	12	1	26	69%
2	41	10	4	27	76%
3	57	19	1	37	67%
4	61	37	1	23	39%
5	23	6	3	14	74%
Spot location					
A	5	1	1	3	80%
B	17	6	0	11	65%

Sampling location	Total number of species recorded	Local native	Non-local native	Exotic	Percent exotic and non-local native species to total recorded
C	27	8	1	18	70%
D	5	2	0	3	60%
Planted Rows					
1	7	3	2	2	57%
2	4	1	3	0	75%
Total	**159**	**63**	**9**	**87**	**60%**

A3.2.1 Methods

The 10 m x 40 m long transects (Figure 9) each consisted of four contiguous 10 m x 10 m quadrats. The layout of the quadrats and subquadrats was as follows:



The relative frequency of plant species was assessed by recording the presence/absence of herb and shrub species in a 5 m x 5 m subquadrat within each of the 10 m x 10 m quadrats (Table 1). The number of subquadrats in which a species was recorded varied from 0 to 4. In each of the four 10 m x 10 m quadrats, the numbers of individuals and heights of all species of trees and shrubs attaining 2 m or more height were recorded (Table 2).

Collected specimens were bagged and verified by Tony Rodd.

The percent projected foliage cover of the following strata was estimated in all sampling locations (see Table 3):

- Native canopy trees
- Native subcanopy trees
- Native shrubs
- Native grasses/graminoids
- Native herbs
- Exotic plants
- Leaf litter, bare ground and rock.

In addition, one 43 m long by 10 m wide transect (Transect 3) was placed at right-angles to University Creek. This transect included 20 m of its length across the existing level playing field, about 15 m across the creek, and finally about 10 m of mown lawn to the northwestern boundary. Plant species present were recorded in nine contiguous 5 m x 5 m subquadrats (0–5 m, 5–10 m, … 40–43 m). Numbers of individuals greater than 2 m in height and maximum tree heights were recorded in

each 10 m x 10 m quadrat (Table 2) and percent projected foliage cover was estimated in each of the four contiguous 10 m x 10 m quadrats.

At the time of survey, all sampling locations were photographed (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. The Royal Botanic Gardens' PlantNET website (plantnet.rbgsyd.nsw.gov.au) incorporating Flora Online is the major source for updated taxonomy.

A3.3.2 Observations

The Site included buildings, the northern section of a sport field and carparks used by the colleges, as well as residential houses (mainly in the southeast) and the 47 m length of creek in the northwest of the Site.

The vegetation sampling locations are shown on Figure 9.

Transect 1 was located parallel to the fenceline of a residence northeast of the church. It consisted of mown lawn dominated by the cosmopolitan native grass *Cynodon dactylon* (Couch) and the exotic grass *Pennisetum clandestinum* (Kikuyu), six large eucalypts including one 24 m tall *Eucalyptus punctata*, one 25 m tall *Eucalyptus tereticornis* (Forest Red Gum), four large *Eucalyptus botryoides* (Bangalay) (to 20 m height), a planted *Elaeocarpus reticulatus* (Blueberry Ash) and two planted shrubs/small trees including *Callistemon salignus* (White Bottlebrush) and the exotic *Metrosideros collina*.

Transect 2 was located adjacent to the northern fenceline. It consisted of mown grass with five large eucalypts, including two non-local native *Eucalyptus microcorys* (Tallowwood) to 18 m high, one 22 m high non-local native *Eucalyptus botryoides,* one 24 m high local native *Eucalyptus notabilis* (Mountain Mahogany) and three *Eucalyptus acmenoides* (White Mahogany), to 25 m high. Planted shrubs present included three non-local native *Hakea salicifolia* (Willow Hakea), one exotic 6 m high *Ficus benjamina* (Weeping Fig) and a 3 m tall non-local native *Syzygium paniculatum* (Magenta Lilly Pilly). The *Syzygium paniculatum* appeared to be generally healthy but was observed to have sooty mould on its leaves. A mound of garden waste was observed at the northwestern end of the transect Exotic weeds, in particular *Chlorophytum comosum,* appeared to be spreading from this mound and colonising a moist depression below the transect.

Transect 3 was located at right angles to the creek and sampled a 20 m length of the level playing field, the narrow band of vegetation adjoining the creek and the mown vegetation to the west of the creek (Table 4).

On the regularly mown playing field (0–20 m) there were only two occurrences of any native species, in this case *Ajuga australis* (Native Bugle), frequent occurrence of the clubmoss *Selaginella uliginosa*; and 23 exotic groundlayer species, recorded in the four contiguous 5 m x 5 m quadrats and in a search of the whole 20 m length and 10 m width. The most common species recorded were *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Pennisetum clandestinum* (Kikuyu) and *Trifolium repens* (White Clover).

The trees on the eastern creek bank included the exotic *Cinnamomum camphora* (Camphor Laurel) about 8 m tall overhanging the edge of the playing field.

Growing on the bank slope, there were two *Angophora costata* (Smooth-barked Apple) up to 16 m, one *Eucalyptus piperita* (Sydney Peppermint) up to 20 m, one *Pittosporum undulatum* up to 8 m, with exotic species including *Ligustrum lucidum* (Broad-leaved Privet) up to 8m as well as *Ochna serrulata* (Mickey Mouse Plant) and *Senna pendula* var. *glabrata.*

In the native groundlayer of the creek bank there were one individual of *Pteridium esculentum* (Bracken), small clumps of *Microlaena stipoides* (Weeping Grass), *Cotula australis* (Common Cotula), *Commelina cyanea* (Blue Spiderwort). Exotic species were more abundant including *Asparagus aethiopicus* (Asparagus Fern), *Aster subulatus* (Wild Aster), *Bidens pilosa* (Cobblers Pegs), *Chlorophytum comosum* (Spider Plant), *Conyza sumatrensis* (Tall Fleabane), *Cyperus eragrostis* (Umbrella Sedge), *Ehrharta erecta* (Panic Veld-grass), *Eragrostis curvula* (African Lovegrass), *Lonicera japonica* (Japanese Honeysuckle), *Osteospermum ecklonis* (Sailor-boy Daisy), *Plantago lanceolata* (Ribwort), *Taraxacum officinale* (Dandelion), *Vicia sativa* subsp. *angustifolia* (Narrow-leaved Vetch).

On the edge of the creek, the species recorded were the native *Cyperus gracilis* (Slender Sedge), *Dichondra* sp. A (Hairy Kidney Weed) and exotic *Ligustrum lucidum*, *Chlorophytum comosum*, *Cyperus eragrostis*, *Modiola caroliniana* and *Pennisetum clandestina*.

The western creek bank was steeper and more eroded. The only tree recorded was an *Angophora costata.* There appeared to have been herbicide control with dead groundlayer plants. Two live native groundlayer species were recorded, *Dichondra* sp. A and possibly *Oxalis* sp.

On the adjoining gentle slope there was a regularly mown groundlayer dominated by *Pennisetum clandestinum* with evidence of herbicide application within about 1–2 m of the base of the 16 m tall *Eucalyptus grandis* growing next to the northwestern boundary.

Transect 4 and planted Rows 1 and 2 are located within the EDAW (2006) identified “Remnant 3” on the Macquarie University campus, with Transect 4 adjacent and parallel to University Creek and Rows 1 and 2 parallel to the boundary fence.

Transect 4 sampled an even-aged stand of trees generally about 15 m tall. The trees included both local native (*Angophora costata*, *Corymbia gummifera*, *Eucalyptus globoidea*, *Eucalyptus pilularis*) and non-local native species (*Eucalyptus microcorys*). Under these semi-regular spaced trees, there had been minor tree/shrub plantings of *Acacia linifolia*, *Acacia longifolia*, *Acacia parramattensis*, *Angophora costata*, *Elaeocarpus reticulatus* (Blueberry Ash), *Bursaria spinosa* (Australian Boxthorn). There was relatively dense planting of the north coast native *Lomandra hystrix* (Spiny-head Mat-rush) and native *Dianella caerulea.* There is a minor and relatively sparsely occurring component of native species that may have germinated from the soil seed bank including *Dichondra* sp. A, *Glycine clandestina* (Twining Glycine), *Microlaena stipoides*, *Oplismenus imbecillis*, *Oxalis* sp. and *Paspalidium* sp. The percent projected foliage cover by exotic species was high (50%) for the planted landscape area with the most common exotic species being *Ipomoea indica* (Blue Morning Glory).

In the creek there was the native *Typha domingensis* (Narrow-leaf Cumbungi).

Row 1 was parallel to the boundary fence and trees were recorded along a tape. The centres of planted trees recorded were *Syncarpia glomulifera* (Turpentine) at 0 m, 1.7 m, 4.3 m, *Casuarina cunninghamiana* (River She-oak) at 10 m, *Eucalyptus grandis* (Flooded Gum), at 14.4 m, 17.7 m, *Eucalyptus tereticornis* (Forest Red Gum) at 19.3

m, 22.8 m, and *Angophora costata* (Smooth-barked Apple) nearer to the fence at 23 m. There was a sparse exotic ground layer (about 1% percent projected foliage cover) of *Asparagus aethiopicus* (Asparagus Fern) and *Ehrharta erecta* (Panic Veld-grass) with 100% soil surface cover by mulch.

Row 2 was located to the north of and parallel to Row 1. The centres of planted trees recorded were *Casuarina cunninghamiana* at 0 m, 3 m, 12.5 m, *Eucalyptus grandis* at 4.5 m, 6.5 m, 8.4 m, *Corymbia maculata* (Spotted Gum) at 17.8 m and *Angophora costata* at 30 m. The planted *Angophora costata* was a component of Transect 4.

Nearby in the same stand of vegetation were planted *Melaleuca quinquenervia* (Broad-leaved Paperbark).

Transect 5 consisted of a row planting on the Site adjoining the fence together with the groundlayer beneath the trees and on the adjoining lawn. The planted trees adjoining the fenced boundary along the 40 m transects were spaced along the tape as follows: *Eucalyptus microcorys* up to 12 m at 35.5 m and 40 m;*, E. punctata* between 12 m and 15 m tall at 18 m, 22.4 m, 26.6 m, 31 m; *Syncarpia glomulifera* 10 m tall at 11.6 m; *Ficus microcarpa var. hillii* 16 m tall at 0 m*.* There was a row of *Syncarpia glomulifera* south of the beginning of the transect at right angles to the boundary fence. There were thirteen exotic groundlayer species recorded, the most common being the cosmopolitan lawn grass *Cynodon dactylon* (Couch) and the lawn grass *Pennisetum clandestinum* (Kikuyu Grass), the weedy grasses *Poa annua* and *Ehrharta erecta* and the herb *Modiola caroliniana*. There were only three native groundlayer species recorded, namely the clubmoss *Selaginella uliginosa*, *Euchiton involucratus* (Star Cudweed) and *Oxalis* sp.

Adjacent to Herring Road in the mown front yard of a residence (sampled in Spot locations A and B), the vegetation recorded consisted mainly of exotic and non-local native planted shrubs and trees, including a large *Cupressus macrocarpa'Brunniana'* (Brunning's Golden Monterey Cypress). No native species were recorded in Spot location A. Spot location B contained a large *Eucalyptus punctata* (Grey Gum) and a large *Angophora costata* (Smooth-barked Apple), with several native ground layer species including *Hardenbergia violacea* (False Sarsaparilla)*, Glycine clandestina* (Twining Glycine)*, Lomandra multiflora* (Many-flowered Mat-rush) and *Lomandra hystrix* (Spiny-head Mat-rush) (possibly planted) and an abundance of garden exotics including *Asparagus aethiopicus* (Asparagus Fern)*, Lantana camara* (Lantana)*, Nephrolepis cordifolia* (Fishbone Fern) and *Olea europaea* (African Olive).

Off site to the north of Spot location A, running between the Site and the building to the north of Spot location A, a row of planted eucalypts and several *Angophora costata* were observed.

Spot location C was also located in a garden bed adjacent to Herring Road. This location contained two large *Eucalyptus saligna* (Sydney Blue Gum) and a mature *Corymbia gummifera* (Red Bloodwood)*,* as well as native grasses *Themeda australis* (Kangaroo Grass) and *Entolasia marginata* (Bordered Panic), and an abundance of planted and naturalised exotics including *Nephrolepis cordifolia, Chlorophytum comosum* (Spider Plant)*, Asparagus aethiopicus, Senna pendula* var. *glabrata* (Easter Cassia) and *Monstera deliciosa* (Fruit-salad Plant)*.*

Spot location D was on Macquarie University land immediately north of the boundary and near soil sampling site 4 (Figure 5). A three-trunked *Syncarpia glomulifera* (Turpentine) was growing in fill with brick waste, sandstone and concrete fragments visible. There was 100% litter cover and a *Pittosporum undulatum* growing within the trunks. The groundlayer species recorded had a total percent projected

foliage cover of about 1% and were all exotic (*Asparagus aethiopicus*, *Ehrharta erecta*, *Tradescantia fluminensis*).

A3.3.3 Likely and possible remnant trees

Likely and possible remnant trees on the Site were determined by overlaying the plotted trees from the Tree Management Plan (Turf Design, Project No. 0924, Dwg No. L5 Rev C dated 30/04/10) on each of the 2010, 1986, 1970, 1965, 1961, 1956, 1951, and 1943 historical aerial photographs.

The likely and possible remnant trees were then re-inspected and identification checked. There were some inconsistencies with Treescan (2010) tree identifications:

- Tree 25, listed as *Eucalyptus scoparia*, was identified as *Angophora costata*;
- Tree 28, listed as *Eucalyptus haemastoma*, was identified as *Eucalyptus racemosa*;
- Tree 11, listed as *Eucalyptus pilularis*, appears to be non-existent or long dead;
- Tree 47 is listed as dead, however it is a *Eucalyptus globoidea* with a dead canopy and a healthy 4 m sucker growing from the trunk base; and
- Tree 16, listed as *Syncarpia glomulifera*, appears to be located out of the Site boundary.

The following trees were identified as being likely remnant or possibly remnant (Figure 10), namely:

Tree Number	Treescan (2010) species	ACA species	Likely remnant	Proposed to be retained
1	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	Yes
2	*Angophora costata*	*Angophora costata*	Yes	Yes
3	*Eucalyptus punctata*	*Eucalyptus punctata*	Possibly	Yes
4	*Angophora costata*	*Angophora costata*	Yes	Yes
5	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	Yes
6	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	Yes
10	*Angophora costata*	*Angophora costata*	Yes	Yes
15	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	Yes
21	*Eucalyptus punctata*	*Eucalyptus punctata*	Possibly	Yes
22	*Eucalyptus punctata*	*Eucalyptus punctata*	Possibly	Yes
23	*Eucalyptus punctata*	*Eucalyptus punctata*	Possibly	Yes
25	*Eucalyptus scoparia*	*Angophora costata*	Yes	Yes
26	*Eucalyptus punctata*	*Eucalyptus punctata*	Yes	Yes
28	*Eucalyptus haemastoma*	*Eucalyptus racemosa*	Yes	Yes
35	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
36	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
37	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
38	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
39	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
40	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No

Tree Number	Treescan (2010) species	ACA species	Likely remnant	Proposed to be retained
41	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
47	Dead	Eucalyptus globoidea	Yes	No
53	*Eucalyptus punctata*	*Eucalyptus punctata*	Possibly	No
58	*Eucalyptus globoidea*	*Eucalyptus globoidea*	Yes	No
59	*Eucalyptus globoidea*	*Eucalyptus globoidea*	Yes	No
70	*Syncarpia glomulifera*	*Syncarpia glomulifera*	Yes	No
77	*Corymbia gummifera*	*Corymbia gummifera*	Yes	No
79	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	No
80	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	No
81	*Eucalyptus pilularis*	*Eucalyptus pilularis*	Yes	No
82	*Eucalyptus globoidea*	*Eucalyptus globoidea*	Yes	No
83	*Eucalyptus globoidea*	*Eucalyptus globoidea*	Yes	No

The grouping of *Syncarpia glomulifera*, tree numbers 35 to 41 from the Tree Management Plan (Turf Design, Project No. 0924, Dwg No. L5 Rev C dated 30/04/10), near the centre part of the northwestern boundary, is growing in fill (500 mm deep near the *Syncarpia glomulifera* south of Transect 5, and 900 mm deep near *Syncarpia glomulifera* sampled at Spot location D). The trees of *Syncarpia glomulifera* are possibly remnant native trees that have survived trunk burial in fill in about 1970. More probably they are stump suckers that have since re-grown to mature size. *Syncarpia glomulifera* is likely to be the only tree species to have withstood the fill on Site. The timber of this species has a high resistance to decay and termites and is the Australian timber most resistant to attack by marine organisms (Boland *et al.* 1984).

Many of the likely indigenous remnant trees on site are part of a larger band of remnant forest extending southward from the Site (*Syncarpia glomulifera, Eucalyptus pilularis*) and northward from the Site onto Macquarie University campus (*Syncarpia glomulifera, Eucalyptus punctata* and *Angophora costata*).

A4.0 Conservation significance

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

- **National level** against the schedules of the Commonwealth Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act). The EPBC Act lists threatened ecological communities and species, and is a Commonwealth assessment and approval system for:
  - Actions that have a significant impact on matters of national environmental significance;
  - Actions that have a significant impact on the environment of Commonwealth land and;
  - Actions carried out by the Commonwealth Government.
- **State level** against the schedules of the Threatened Species Conservation Act 1995 (TSC Act).

A4.1 Communities

A4.1.1 National

From a search of the EPBC Act online database (www.deh.gov.au/epbc, accessed 3 August 2010), one endangered ecological community listed in the EPBC Act is known to occur within a 10 km radius of the Site, namely:

Endangered Ecological Community	Habitat	Likely to occur on Site?
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Turpentine (*Syncarpia glomulifera*) and Ironbarks (*Eucalyptus* spp.) are dominant trees. (Commonwealth Listing Advice on Turpentine-Ironbark Forest of the Sydney Basin Bioregion 26 August 2005).	Possible. *Syncarpia glomulifera* recorded on the Site.

A4.1.1.1 Comparison with the Advice to the Minister

Advice to the Commonwealth Minister for the Environment and Heritage for the listing *Turpentine-Ironbark Forest of the Sydney Basin Bioregion* as a critically endangered ecological community on 26 August 2005 was as follows (from the Commonwealth Department of Environment, Water, Heritage and the Arts website: www.environment.gov.au/biodiversity/threatened/communities/sydney-turpentine-ironbark.html, accessed 20 August 2010):

> *1. Name*
> *A nomination was received for Sydney Turpentine-Ironbark Forest. The nominated ecological community was restricted to the Cumberland Plain in the Sydney Basin Bioregion. Other components in areas within the Sydney Basin Bioregion were also identified. Therefore, to reflect the broader occurrence of the ecological community, the name of the ecological community has been changed to Turpentine-Ironbark Forest of the Sydney Basin Bioregion.*

Macquarie Park is in the Sydney Basin Bioregion. The Site is located near the east boundary of the Cumberland Plain.

> *2. Description*
> *The Turpentine-Ironbark Forest of the Sydney Basin Bioregion originally existed as a forest with either a shrubby or grassy understorey (Benson, 1992; Benson & Howell, 1994; Keith & Benson, 1988; Ryan et al, 1996). The characteristic plant species for the Turpentine-Ironbark Forest of the Sydney Basin Bioregion are summarised below.*

The original vegetation of the Site was likely to be a forest with a shrubby or grassy understorey.

> ***Tree canopy:*** *Turpentine (Syncarpia glomulifera) and Ironbarks (Eucalyptus spp) are dominant. Turpentine occurs throughout the ecological community but the associated tree species varies with local abiotic conditions. Grey Ironbark (Eucalyptus paniculata), Narrow-leaved Ironbark (*E. crebra*), Red Ironbark (E. fibrosa), and Grey Gum (E. punctata) are common tree species in the Cumberland Plain. On the plateaux shale caps, Grey Ironbark and Mountain Mahogany (E. notabilis) may become common in association with*

Turpentine. At the upper end of its rainfall/elevation range the Turpentine-Ironbark Forest of the Sydney Basin Bioregion may be dominated by Blue Gum (E. saligna), Mountain Grey Gum (*E. cypellocarpa), Round-leaved Gum (E. deanei) or Grey Gum (NSW NPWS, 2002, Tozer, 2003).*

The Site is part of Morling College campus with mown lawn and extensive plantings. It is bounded to the north by Macquarie University campus with mown lawn and extensive plantings. Both campuses have been historically cleared and previously used for agricultural use.

Of the likely remnant and possible remnant trees on the Site, determined from overlaying the current surveyed tree locations on the each of the historical aerial photographs and site inspection, *Syncarpia glomulifera* was the most common (9 trees of the 26 likely remnant trees) and no ironbarks were recorded. The presence of *Syncarpia glomulifera* is likely due to its resistance to insect attack in waterlogged environments and its ability to survive despite covering in-fill via stump suckers.

Of the other tree species listed that occur on Site (*Eucalyptus paniculata*, *E. crebra*, *E. fibrosa* and *E. punctata*), only individuals of *Eucalyptus punctata* were recorded as likely or possible remnant trees:

Tree species recorded	Tree numbers	Number of trees
Likely remnant		
Angophora costata	2, 4, 10, 25	4
Corymbia gummifera	77	1
Eucalyptus globoidea	47, 58, 59. 82, 83	5
Eucalyptus pilularis	1, 6, 79, 80, 81,	5
Eucalyptus punctata	26	1
Eucalyptus racemosa	28	1
Syncarpia glomulifera	15, 35, 36, 37, 38, 39, 40, 41, 70,	9
Total number of likely remnant trees		26
Possible remnant		
Eucalyptus punctata	3, 21, 22, 23, 53	5
Total number of likely or possible remnant trees		31

***Midstorey:** A stratum of small trees may occur, including Sweet Pittosporum (*Pittosporum undulatum*), Native Peach (*Trema aspera*), and Parramatta Wattle (*Acacia parramattensis*). Where present, a shrub layer may include Elderberry Panax (*Polyscias sambucifolia*), Mock Olive (*Notelaea longifolia*), Prickly Beard-heath (*Leucopogon juniperinus*), Rough-fruit Pittosporum (*P. revolutum*), Breynia (*Breynia oblongifolia*), Narrow-leaved Orangebark (*Maytenus silvestris*) and White Dogwood (*Ozothamnus diosmifolius*).*

Of the listed small trees, only *Pittosporum undulatum* is likely to naturally occur on the Site:

Species	Recorded in

Acacia parramattensis	Probably planted in Transect 4
Breynia oblongifolia	-
Leucopogon juniperinus	Planted in Transect 4
Maytenus silvestris	-
Notelaea longifolia	-
Ozothamnus diosmifolius	Planted in Transect 4
Pittosporum revolutum	-
Pittosporum undulatum	Transect 1, 2, 3, 4, 5
Polyscias sambucifolia	-
Trema aspera	-

> ***Ground layer:*** *Where present in its natural state, the ground layer may include Basket Grass (*Oplismenus aemulus*), Pastel Flower (*Pseuderanthemum variabile*), Forest Hedgehog-grass (*Echinopogon ovatus*) Weeping Grass (*Microlaena stipoides*) and Kangaroo Grass (*Themeda triandra*).*

Of the listed ground layer species, all five species were recorded with sparse occurrence, with three of the five species recorded in Transect 4 where planting had occurred, namely:

Species	**Recorded in**
Echinopogon ovatus	Transect 4
Microlaena stipoides	Transects 3, 4
Oplismenus aemulus	Transects 1, 3
Pseuderanthemum variabile	Transect 4
Themeda triandra [*T. australis*]	Spot location C

> *The Turpentine-Ironbark Forest of the Sydney Basin Bioregion occurs primarily on clay soils derived from Wianamatta shale, including clay lenses of Wianamatta shale within Hawkesbury sandstone. The ecological community less commonly occurs on transitional areas between soils derived from the Wianamatta shale and Hawkesbury sandstone, or on soils derived from Holocene alluvium, or the Mittagong formation. As the parent geology is confined to the Sydney Basin Bioregion, this ecological community can only be found in this area.*

From the Site soil survey and review of the geotechnical survey borelogs, Hazelton (2010) found that the soils on the Site were not wholly derived from Wianamatta Shale. Rather, the soils were transitional between clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. It stated that "the ecological community less commonly occurs on transitional areas between soils derived from the Wianamatta shale and Hawkesbury sandstone", hence the listed soils criteria are met.

> *The soil on which the ecological community is found is of relatively higher fertility than the sandy soils derived from the Hawkesbury sandstone. For this reason, the Turpentine-Ironbark Forest of the Sydney Basin Bioregion has been selectively cleared for agriculture and urban development (Benson & Howell, 1990; Haworth, 2002).*

The soils on the Site have previously been used for agriculture and are more fertile than sandy soils derived from the Hawkesbury sandstone (Hazelton and Clements).

> *The Turpentine-Ironbark Forest of the Sydney Basin Bioregion is found predominantly in areas with a rainfall between 800–1100 mm/year (Benson & Howell, 1994; NSW NPWS, 2002), but remnant patches do occur in areas receiving rainfall outside of this range (Ryan et al, 1996). On the Cumberland Plain, the ecological community is generally found at elevations less than 320 m (NSW NPWS, 2002). In the hills on the surrounding Woronora, Blue Mountains and Hornsby Plateaux, this ecological community can be found on shale caps at elevations up to 750 m (Keith & Benson, 1988).*

The recorded rainfall is within the specified range of 800–1100 mm/year. The mean annual rainfall recorded at the Macquarie Park meteorological station is 1138.8 mm with annual rainfall for 2003 to 2009 varying between 773.7 mm (in 2005) to 1470.8 mm (in 2007).

The elevation of the Site is as specified, “less than 320 m”. The Site gently slopes down from elevation of about 67 m AHD at the Herring Road frontage towards University Creek at elevation of 58 m AHD at top of bank (Barrie Green and Associates 6041DET_C.dwg, Rev C, 20 August 2009).

> *There have been no detailed studies of the fauna of the Turpentine-Ironbark Forest of the Sydney Basin Bioregion. The interactions between the faunal and floral components are poorly known.*

No additional comments.

> *Throughout its range, the Turpentine-Ironbark Forest of the Sydney Basin Bioregion may intergrade with the Cumberland Plains Woodland that occupies drier areas, Shale/Sandstone Transition Forest where the soil intergrades from shale to sandstone, or Blue Gum High Forest that abuts the higher rainfall ridges. The area of transition (ecotone) between ecological communities is dependent on the transition from one soil type to another. Where the soils change abruptly, there may be no intergradation between adjacent ecological communities. In ecotones, the vegetation can be considered a part of the Turpentine-Ironbark Forest of the Sydney Basin Bioregion where a majority of the species are characteristic of this ecological community, and considered to be a part of the adjacent ecological community where a majority of the species are more closely aligned with the adjacent ecological community.*

No additional comments.

> *All of the ecological communities with which the Turpentine-Ironbark Forest of the Sydney Basin Bioregion intergrades are listed as endangered under the NSW* Threatened Species Conservation Act 1995 *(TSC Act). The Cumberland Plains Woodland and Shale/Sandstone Transition Forest are also listed as endangered, and the Blue Gum High forest is listed as critically endangered, under the* Environment Protection and Biodiversity Conservation Act 1999*.*

No additional comments.

> *3. Condition classes*

Past and current management practices have resulted in the clearing and fragmentation of the Turpentine-Ironbark Forest of the Sydney Basin Bioregion ecological community. Many remnants now exist as isolated patches within a developed, urban environment. The structure of the ecological community also has become modified from that of the original forest with native understorey.

The original vegetation has been extensively cleared as well as soil level changes including filling for the playing field. The likely and possibly remnant trees on the Site (Figure 10) occur as scattered individuals, not as patches of retained native vegetation.

The Turpentine-Ironbark Forest of the Sydney Basin Bioregion ecological community is limited to remnants that are relatively intact in condition, as outlined below.
The vegetation contains some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey).

The likely and possible remnant trees do not occur as a patch of a relative intact community.

Tree canopy cover is greater than 10% and remnant size is greater than one hectare. These areas have the greatest conservation value and their high quality and size makes them most resilient to disturbance.

Tozer (2003) does not map any native vegetation area on the Site, with <10% or >10% canopy cover.

However, remnants with tree canopy cover less than 10% are also included in the ecological community, if the fragments are greater than one hectare in size and occur in areas of native vegetation in excess of 5 hectares in area. These areas enhance the potential for connectivity and viability of the ecological community. They support native flora and fauna species by facilitating gene flow among remnants and buffering against disturbance.

The largest possible patch of vegetation on or adjoining the Site adjoins University Creek. The most optimistic calculation of the area of this patch is less than one hectare, the patch being about 200 m long (from the pipe under the Willandra Village to the bridge on Macquarie University campus) by about 20 m wide.

The ecological community excludes patches where either the native midstorey/understorey or native canopy trees are absent. Occurrences of isolated single trees or shrubs characteristic of the ecological community also are excluded from the ecological community. Although these degraded remnants may have some value as biodiversity reservoirs, the structure of these patches has been so severely modified, that they fall outside the definition of the ecological community.

There is absence of native midstorey/understorey with only scattered likely and possible remnant trees over a mown lawn. The vegetation on the Site does not satisfy this criterion.

4. National context
The Turpentine-Ironbark Forest of the Sydney Basin Bioregion is limited to the Sydney Basin IBRA Bioregion. It is currently known from the local government areas of Auburn, Bankstown, Baulkham Hills, Blue Mountains, Campbelltown, Canada Bay, Canterbury, Hawkesbury, Hornsby, Kogarah,

Ku-ring-gai, Lane Cove, Liverpool, Parramatta, Penrith, Ryde, Sutherland, Wingecarribee, Wollongong and Wollondilly.
The ecological community is listed under the New South Wales Threatened Species Conservation Act 1995 *as two separate endangered ecological communities: the Sydney Turpentine Ironbark Forest (NSW Scientific Committee, 1998) and the Blue Mountains Shale Cap Forest (NSW Scientific Committee, 2000).*

The Site is in the Local Government Area of Ryde.

The ecological community is listed under the New South Wales Threatened Species Conservation Act 1995 *as two separate endangered ecological communities: the Sydney Turpentine Ironbark Forest (NSW Scientific Committee, 1998) and the Blue Mountains Shale Cap Forest (NSW Scientific Committee, 2000).*

No additional comments.

The ecological community has been mapped through several studies (Keith, & Benson, 1988; Benson, 1992; Ryan et al, 1996; Benson, 1992; Benson & Howell, 1994; NSW NPWS, 2002; NSW DIPNR 2004). Information about mapping units equivalent to the ecological community is summarised in Table 1.

Table 1. Identified mapping components for the Turpentine-Ironbark Forest of the Sydney Basin Bioregion

Source	***Mapping units***	***Estimated current extent (ha)*** [1]
NSW NPWS (2002) Endangered ecological communities of the Cumberland Plain.	*15 (Turpentine Ironbark Forest)* plus *43 (Turpentine Ironbark Margin Forest).*	*1116*
NSW DIPNR (2004) Penrith and Wollongong 1:100 000 map sheets	*WSF 87 (Sydney Turpentine-Ironbark Forest)*	*595*
National Vegetation Information System [based on Keith and Benson (1988); Benson (1992); Ryan et al. (1996)] Katoomba, Penrith and St Albans 1:100 000 map sheets.	*9a (Shale Cap Forest)* plus *9c (Ironbark Forest)* plus *9o (Turpentine-Ironbark Forest)*	*587*
Blue Mountains City Council (2002) Vegetation mapping in the Blue Mountains	*2b (Blue Mountains Shale Cap Forest* plus *2c (Turpentine-Ironbark Forest)*	*197*
Total	***All***	***2495***
1. Extent of area known to meet defined condition classes.		

Neither of the Map Units 15 (Turpentine Ironbark Forest) nor 43 (Turpentine Ironbark Margin Forest) of NSW NPWS (2002) has been mapped on the Site.

5. How judged by TSSC in relation to the EPBC Act criteria

*The TSSC judges the Turpentine-Ironbark Forest of the Sydney Basin Bioregion ecological community to be **eligible** for listing as **critically endangered** under the EPBC Act. The justification against the criteria is as follows:*

Criterion 1 - Decline in geographic distribution

The Turpentine-Ironbark Forest of the Sydney Basin Bioregion was originally widespread on the Wianamatta shale of the Cumberland Plain and on shale caps overlying sandstone on the surrounding plateaux (Benson, 1992; Keith and Benson, 1988; Ryan et al, 1996; NSW Scientific Committee, 2000). However, an estimate of the pre-European extent is not available for the entire ecological community. Clearing for agriculture and urban development (Benson and Howell, 1990; Benson, 1999) has impacted considerably on the Turpentine-Ironbark Forest of the Sydney Basin Bioregion. It is estimated that 2 495 ha of this ecological community now remains in good condition (Table 1).

The only data available to estimate decline are for the main occurrence of the ecological community mapped on the Cumberland Plain by NSW NPWS (2002). The pre-European extent here was estimated to be 26 516 ha, of which 1116 ha remains that meet the condition criteria. This indicates a decline in geographic distribution of 95.8%. The Turpentine-Ironbark Forest of the Sydney Basin Bioregion lies within Australia's most populous urban centre covering Sydney, the Blue Mountains and Wollongong. Given this, it is considered likely that occurrences outside the Cumberland Plain for the Turpentine-Ironbark Forest of the Sydney Basin Bioregion have undergone a similarly severe decline in extent.

*Therefore, the ecological community is **eligible for listing as critically endangered** under this criterion.*

Criterion 2 - Small geographic distribution coupled with demonstrable threat

The Turpentine-Ironbark Forest of the Sydney Basin Bioregion has a restricted area of occupancy of approximately 2495 ha.

The loss of this ecological community was originally due to clearing for agriculture. As soils derived from Wianamatta shale are more productive than those derived from the Hawkesbury sandstone, agriculture was concentrated in areas containing shale-derived soils. This resulted in the selective clearing of ecological communities occurring on these soils, including the Turpentine-Ironbark Forest of the Sydney Basin Bioregion (Benson and Howell, 1990; Haworth, 2003; Recher et al, 1993). However, in recent times, the expansion of Sydney and the periurban centres has replaced agriculture as the main reason for clearing remnant vegetation, including the Turpentine-Ironbark Forest of the Sydney Basin Bioregion (Benson, 1999; NSW Scientific Committee, 1988, 2000).

Increased density of housing within Sydney and new developments at the periurban centres threaten the long-term existence of the Turpentine-Ironbark Forest of the Sydney Basin Bioregion in a number of ways. Clearing for development may remove the remaining patches of the ecological community from an area. The ecological community may also be at risk from further clearing, grazing (in agricultural areas), mowing, physical damage from recreational activities, pollution, rubbish dumping or weed invasion. Only 220 ha, or 8.8% of the current extent, of this ecological community is protected in conservation reserves. Consequently, a majority of this ecological community is subject to demonstrable and ongoing threats.

*Therefore, the Turpentine-Ironbark Forest of the Sydney Basin Bioregion is **eligible for listing as endangered** under this criterion.*

Criterion 3 - Loss or decline of functionally important species

There is no information available to assess this ecological community under this criterion.

Criterion 4 - Reduction in community integrity

The Turpentine-Ironbark Forest of the Sydney Basin Bioregion originally occurred as a forest to tall open forest with a number of layers: ground cover, shrubs and mid-storey trees, and upper canopy trees. Each of these strata provided important food or habitat for native fauna as well as maintaining conditions suitable for the plant species within the ecological community.
As a result of clearing, the continuity of the Turpentine-Ironbark Forest of the Sydney Basin Bioregion has become severely fragmented. The remaining patches are widespread, disjunct and generally small, with a high edge to area ratio, leaving them susceptible to invasion by weeds. Other threats to the ecological community, such as lack of genetic diversity in remnants, invasion by feral and domestic animals, and increased effect of wind damage are also typical of small remnants surrounded by an agricultural and urban matrix.
Removal of each structural layer from the native vegetation significantly alters the structural integrity of the forest and also reduces the available habitat for native flora and fauna. Loss of understorey integrity reduces the ability of canopy tree species to regenerate. Without recruitment of canopy species into the ecological community, the existing tree canopies will eventually senesce without replacement. The loss of structural layers has a significant negative impact on the biodiversity of remnants and their ability to continue functioning as a viable forest. The end result would be degradation of existing patches, leading to the eventual loss of the ecological community from these areas.
There is an ongoing pressure to continue the urban development of tracts of land within the Cumberland Plain. Consequently, it is unlikely that there will be any significant regeneration of this ecological community within the medium-term future.
Therefore, the Turpentine-Ironbark Forest of the Sydney Basin Bioregion is ***eligible for listing as vulnerable*** *under this criterion.*
Criterion 5 - Rate of continuing detrimental change
There is no information available to assess this ecological community under this criterion.
Criterion 6 - Quantitative analysis showing probability of extinction
There is no information available to assess this ecological community under this criterion.

No additional comments.

6. Conclusion
The ***Turpentine-Ironbark Forest of the Sydney Basin Bioregion*** *meets criterion one as critically endangered as it has undergone a severe decline; criterion two as endangered as it has a restricted area of occupancy and is subject to ongoing and demonstrable threats; and criterion four as vulnerable as it has suffered a reduction in ecological community integrity. Due to the ongoing nature of the impacts, regeneration is unlikely to occur within the near future, even if these impacts can cease.*

No additional comments.

In conclusion, the vegetation on the Site does not satisfy the condition and size criteria. There are likely and possible remnant trees on the Shale/Sandstone Transition soils of the Site, but the listed critically endangered community Turpentine-Ironbark Forest of the Sydney Basin Bioregion is not recorded on the Site.

A4.1.2 State

A search of the final determinations listed on the NPWS Website (www.nationalparks.nsw.gov.au, accessed 3 August 2010) revealed 14 endangered

ecological communities listed in the TSC Act as previously occurring in the Cumberland CMA sub-region, namely:

Vegetation Community	Habitat	Likely to occur on the Site?
Blue Gum High Forest	Blue Gum High Forest is dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum).	No. *Eucalyptus saligna* and *E. pilularis* were not recorded as dominant canopy trees.
Castlereagh Swamp Woodland	Typically associated with poorly drained depressions and creeklines on clay soils associated with Tertiary alluvium. Characteristic tree species are *Eucalyptus parramattensis* subsp. *parramattensis* and *Melaleuca decora*.	No. The Site does not consist of poorly drained depressions and creeklines on clay soils associated with Tertiary alluvium.
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Occurs on clay soils on Tertiary alluvium, or on shale soils on Wianamatta Shale including the Birrong Soil Landscape and associated shale lowlands. Predominantly of open-forest structure, usually with trees of *Eucalyptus fibrosa* sometimes with *E. moluccana* and *Eucalyptus tereticornis. Melaleuca decora* is frequently present in a small tree stratum.	No. Not on low lying areas.
Cumberland Plain Woodland	Occurs on soils derived from shale on the Cumberland Plain. The canopy is dominated by *Eucalyptus moluccana* and *Eucalyptus tereticornis*.	No. Dominant canopy species not recorded on the Site
River-flat Eucalypt Forest on Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	No. The Site is not low-lying land as associated with coastal floodplain.
Shale Gravel Transition Forest in the Sydney Basin Bioregion	Occurs primarily where shallow deposits from ancient river systems overlay shale soils, but may also occur in association with localised concentrations of iron-indurated gravel.	No. Site is not associated with ancient river systems and there are no areas of iron-indurated gravel.
Shale/Sandstone Transition Forest in the Sydney Basin Bioregion	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.	Likely. Soils mapped as Shale/Sandstone Transition soils.
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils is found within an estimated total extent of less than 45 000 ha, bounded approximately by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. The community is typically associated with sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but	No. Site is not in southern Sydney.

Vegetation Community	Habitat	Likely to occur on the Site?
	where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates.	
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Associated with coastal floodplains. *Casuarina glauca* (swamp oak) is the dominant species.	No. Not on low-lying land.
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Associated with coastal floodplains. 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*.	No. Not on low-lying land.
Sydney Turpentine-Ironbark Forest	Characteristic tree species in the STIF are *Syncarpia glomulifera, Eucalyptus globoidea, E. resinifera, E. paniculata, Angophora costata* and *A. floribunda*. STIF typically occurs on areas with clay soils derived from Wianamatta Shale, or shale layers within Hawkesbury Sandstone. Occurrences of STIF may occur on plateaus and hillsides and on the margins of shale cappings over sandstone.	No. Soils do not meet the description in the Final Determination.
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	WSDR is typically 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.	No. Rainforest species not recorded onsite.

"Remnant 3" to the north on the Macquarie University campus was identified as Sydney Turpentine-Ironbark Forest by Total Earth Care (2010), which concluded that*:*

> *the endangered ecological community STIF does not occur within the subject site as the subject site resilience is assessed as low, there was no evidence of recovery of STIF species within the subject site and the likelihood of them occurring and recovering from any potential underground seed store is remote…A much higher quality remnant of native vegetation occurs on the adjoining Macquarie University site, and this most closely resembles the Turpentine Ironbark Margin Forest subunit of STIF. The riparian zone of the subject site does contain some canopy trees characteristic of STIF, although in a very much modified form.*

It was found by Dr Pam Hazelton based on the geotechnical report by Douglas Partners (2009) and the site specific soil survey that the soils on and adjoining this Site:

- are not derived from Wianamatta Shale and do not satisfy the criteria listed for the Final determination for the endangered ecological community of Turpentine-Ironbark forest; and

- do satisfy the criteria listed in the Final determination for Shale/Sandstone Transition Forest.

The data recorded in the current survey were compared with the Final Determination for Sydney Turpentine-Ironbark Forest and Shale/Sandstone Transition Forest.

A4.1.2.1 Comparison with Final Determination for Sydney Turpentine-Ironbark Forest

> *The Scientific Committee has found that:*
> *1. The Sydney Turpentine-Ironbark Forest (STIF) is the name given to the plant community that is characterised by the following assemblage of species* [the list is given in the Final Determination on website http://www.environment.nsw.gov.au/determinations/SydneyTurpentineIronbarkForestEndComListing.htm, accessed 6 August 2010].

Of the 70 listed characteristic species, 26 were recorded during the survey on and adjoining the Site. There were fewer than 10% of the characteristic species recorded at all of the sampling locations, except in Transect 4 (30% with 21 characteristic species recorded). Transect 4 was in "Remnant 3" identified by EDAW (2006).

Sampling location	Total number of species recorded	Native	Non-local native	Number of STIF characteristic species recorded	% of the 70 listed STIF characteristic species recorded
Transect					
1	39	12	1	4	6%
2	41	10	4	3	4%
3	57	19	1	6	9%
4	61	37	1	21	30%
5	23	6	3	1	1%
Spot location					
A	5	1	1	1	1%
B	17	6	0	3	4%
C	27	8	1	3	4%
D	5	2	0	2	3%
Row planting					
1	7	3	2	2	3%
2	4	1	3	1	1%
Total	**159**	**63**	**9**	**26**	**37%**

> *2. The total species list of the community is considerably larger than that given in 1 (above), with many species present in only one or two sites or in very small quantity. In any particular site not all of the assemblage listed in 1 may be present. At any one time, seeds of some species may only be present in the soil seed bank with no aboveground individuals present. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the aboveground*

composition of species will change with time since fire, and may also change in response to changes in fire frequency.

The soil seed bank on the Site is likely to be limited due to the extent of filling for the level playing field. The soil report by Pam Hazelton determined 500 mm of fill in soil site 3 (Figure 5), near the *Syncarpia glomulifera* (Turpentine) south of Transect 5 (Figure 9), and 900 mm of fill adjoining the boundary fence on the Macquarie University campus in soil pit site 5 (Figure 5) and vegetation sampled at Spot location D (Figure 9) (photographs of soil pit sites in Appendix 1, photographs of vegetation sampling locations in Appendix 2).

The soils of the Site are described by Treescan (2010) (page 1) as "greatly modified in the past by filling and levelling for playing fields and by the construction of roadways and buildings".

3. The structure of the community was originally forest, but may now exist as woodland or as remnant trees.

The current survey found extensive row plantings of mixed local and non-local native species. Based on the historical aerial photographs and onsite observations, the possible remnant trees on and adjoining the Site are likely to be restricted to the narrow band of trees adjoining the creek in the northwest of the Site and in a limited number of isolated patches throughout the Site (Figure 10).

The vegetation of the Site is described by Treescan (2010) (page 1) as *"scattered trees, with an understorey of turfgrass and shrubs…Much of the site is devoid of trees and the grassland is maintained by frequent mowing.".* Treescan's description is consistent with the finding of Total Earth Care (2010) and the current survey.

4. Characteristic tree species in the STIF are Syncarpia glomulifera, Eucalyptus globoidea, Eucalyptus resinifera, Eucalyptus paniculata, Angophora costata *and* Angophora floribunda*.*

Of the six listed characteristic tree species in the STIF, three species (*Syncarpia glomulifera*, *Eucalyptus globoidea*, *Angophora costata*) were recorded as likely remnant trees on the Site (Figure 10):

Tree species recorded	**Tree numbers**	**Number of trees**
Likely remnant		
Angophora costata	2, 4, 10, 25	4
Corymbia gummifera	77	1
Eucalyptus globoidea	47, 58, 59. 82, 83	5
Eucalyptus pilularis	1, 6, 79, 80, 81,	5
Eucalyptus punctata	26	1
Eucalyptus racemosa	28	1
Syncarpia glomulifera	15, 35, 36, 37, 38, 39, 40, 41, 70,	9
Total number of likely remnant trees		26
Possible remnant		
Eucalyptus punctata	3, 21, 22, 23, 53	5
Total number of likely or possible remnant trees		31

Recorded In the current survey:

Characteristic tree species	Sampling location
Syncarpia glomulifera	Transects 3, 5, Spot location D, Row 1
Eucalyptus globoidea	Transect 4
Eucalyptus resinifera	-
Eucalyptus paniculata	-
Angophora costata	Transect 3, 4, Rows 1, 2
Angophora floribunda	-

Total Earth Care (2010) recorded five of the six listed characteristic tree species. These five species were generally given local species status but at least some specimens are of uncertain provenance (planted/naturalised). The five species were recorded within three identified Plant Communities, with abundance varying from uncommon to common:

Characteristic tree species	Onsite Cleared and disturbed Woodland/ Grassland	Onsite Riparian zone along creek	Offsite Sydney Turpentine-Ironbark Forest on the adjoining University Land (Remnant 3 identified by EDAW 2006)
Syncarpia glomulifera	Occasional	Occasional	Occasional
Eucalyptus globoidea	Occasional	Uncommon	Uncommon
Eucalyptus resinifera	-	-	-
Eucalyptus paniculata			Uncommon
Angophora costata	Uncommon	Common	Common
Angophora floribunda			Uncommon

5. Species composition varies between sites depending on geographical location and local conditions (e.g. topography, rainfall, exposure).

No additional comments.

6. STIF occurs within the local government areas Ashfield, Auburn, Canterbury, Concord, Drummoyne, Leichhardt, Marrickville, Bankstown, Ryde, Hunters Hill, Baulkham Hills, Ku-ring-gai, Hornsby, Parramatta, Bankstown, Rockdale, Kogarah, Hurstville, Sutherland. The area is within the County of Cumberland and entirely within the Sydney Basin Bioregion.

STIF is listed as occurring in the Ryde LGA.

7. In many of these LGAs particularly in the inner western suburbs, only remnant trees may remain. These may have particular ecological and genetic significance and may be important sources of propagation material for use in rehabilitation projects.

Local and non-local native and exotic species have been extensively planted on and adjoining the Site. This occurred especially during the 1960s, associated with the opening of Morling College in 1962 and Macquarie University in 1964.

> *8. STIF typically occurs on areas with clay soils derived from Wianamatta Shale, or shale layers within Hawkesbury Sandstone.*

It was found by Dr Pam Hazelton that:

> *The soil described in the field by me and by Douglas and Partners are indicative of those which occur on areas transitional between the clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed by me show evidence of the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The soils of the Site consistent with the Lucas Heights soil landscape. Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such the soils satisfy the criteria listed in the Final determination for Shale Sandstone Transition Forest.*

> *9. Occurrences of STIF may occur on plateaus and hillsides and on the margins of shale cappings over sandstone.*

The Site is located on undulating topography that gently grades to University Creek. From advice from Dr Pam Hazelton (Appendix 1):

> *The soils on this site are not derived from Wianamatta Shale.*

> *10. STIF is referred to in Benson & Howell 1990 and in UBBS (1997). It includes vegetation described as map unit 9o of Benson (1992) and Benson & Howell (1994).*

From Benson and Howell (1994), map unit 9o is not mapped on or adjoining the Site. The nearest mapped vegetation to the Site shown on the Benson & Howell (1994) mapping is downslope on Hawkesbury Sandstone and associated with the sandstone vegetation of Lane Cove River, namely:

Map units	**Description**	**Geology**
10 ag	Sydney Sandstone Gully Forest	Hawkesbury Sandstone
10 ar	Sydney Sandstone Complex	Hawkesbury Sandstone

> *11. STIF provides habitat for a number of plant species recognised as being of regional conservation significance in UBBS (1997).* [the list is given in the Final Determination on website http://www.environment.nsw.gov.au /determinations/SydneyTurpentineIronbarkForestEndComListing.htm, accessed 6 August 2010]

Of the 24 listed species, two species (*Acacia stricta* and *Leucopogon juniperinus*) were recorded by Total Earth Care (2010).

In the current survey, *Acacia stricta* was recorded at Spot location C in a garden bed adjacent to Herring Road. *Leucopogon juniperinus* was recorded in Transect 4 as a probable planting. Neither of these plantings is likely to be of local provenance, and hence they are unlikely to be of conservation significance.

12. STIF has an understorey that may be either grassy and herbaceous or of a shrubby nature. STIF can have a dense understorey in areas that have not been burnt for an extended period of time.

The understorey on the Site is largely mown with vegetation at edges of mown areas treated with herbicide, including under trees and adjoining the creek (see photographs in Appendix 2). Offsite on the adjoining Macquarie University, mulch has been used around plantings. The understorey is managed. Transect 4 adjoining the Site has an understorey that is dominated by the NSW north coast landscape species *Lomandra hystrix* and exotic species *Ipomoea indica.*

13. Adjacent communities on sandstone soils are generally part of the Sydney Sandstone Complex (see Benson & Howell 1990).

The vegetation downslope in Lane Cove National Park on sandstone-derived soils is part of the Sydney Sandstone Complex (Benson and Howell 1994).

14. It is estimated that only 0.5 % of the original area of STIF exists in the form of a number of remnants.

No additional comments.

15. Only small areas of STIF are presently included in conservation reserves.

No additional comments.

16. Large areas of STIF have been cleared for agriculture and urban development. Remnants are small and scattered. Identified threats include: clearing, physical damage from recreational activities, rubbish dumping, grazing, mowing, weed invasion.

The vegetation on and adjoining the Site has been modified. The understorey has been intensively managed during past agricultural land use and currently as part of the campuses for Morling College and Macquarie University

17. In view of the small size of existing remnants, the threat of further clearing and other known threats, the Scientific Committee is of the opinion that Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion is likely to become extinct in nature unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that listing as an endangered community is warranted.

No additional comments.

In conclusion, the soils on and adjoining the Site fail to satisfy the listed criteria. All of the sampling locations have less than 10% of the characteristic species recorded, except the landscaped area (sampled in Transect 4, and Rows 1, 2). Despite some of the characteristic tree species being present, they are likely to have been planted in the 1960s. The trees recorded in Transect 4 included both local native (*Angophora costata*, *Corymbia gummifera*, *Eucalyptus globoidea*, *Eucalyptus pilularis*) and non-local native species (*Eucalyptus microcorys*).

Under these semi-regularly spaced trees, there have been minor tree/shrub plantings of *Acacia linifolia*, *Acacia longifolia*, *Acacia parramattensis*, *Angophora costata*, *Bursaria spinosa* and *Elaeocarpus reticulatus*. There was relatively dense planting of the north coast native *Lomandra hystrix* and native *Dianella caerulea.*

The trees of *Syncarpia glomulifera* near the centre part of the northwestern boundary are growing in fill (500 mm deep near the *Syncarpia glomulifera* south of Transect 5, and 900 mm deep near *Syncarpia glomulifera* sampled at Spot location D). The trees of *Syncarpia glomulifera* are possibly remnant native trees that have survived trunk burial in fill in about 1970. More probably they are stump suckers that have since grown to a mature size. The vegetation sampled and the associated soils on and adjoining the Site do not meet the listed criteria for Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion.

A4.1.2.2 Comparison with Final Determinations for Shale/Sandstone Transition Forest

> *The Scientific Committee has found that:*
> *1. Shale/Sandstone Transition Forest (SSTF) is the name given to the plant community characterised by the species assemblage listed in paragraph 4* [the list is given in the Final Determination on website http://www.environment.nsw.gov.au/determinations/ShaleSandstoneTransitionForestEndComListing.htm accessed 6 August 2010]*, which 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. All sites are within the Sydney Basin Bioregion.*

Dr Pam Hazelton identified the soils (Appendix 1):

> *The soil described in the field by me and by Douglas and Partners are indicative of those which occur on areas transitional between the clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed by me show evidence of the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The soils of the Site consistent with the Lucas Heights soil landscape. Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such the soils satisfy the criteria listed in the Final determination for Shale Sandstone Transition Forest.*

> *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 is located in an LGA not listed in the Final Determination. The Site is in the Ryde 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 structure of the vegetation on or adjoining the Site is not forest or woodland, except possibly on the adjoining Macquarie University land sampled in Transect 4 and Rows 1 and 2. This vegetation appeared to have been planted with trees semi-regularly spaced or in straight rows.

> *4. SSTF is characterised by an assemblage of species* [the list is given in the Final Determination on website http://www.environment.nsw.gov.au/determinations/ShaleSandstoneTransitionForestEndComListing.htm accessed 6 August 2010]. *Not all these species will be present in every single stand, and the total species list from all stands of the community is considerably larger than that listed above. Depending on*

the disturbance history of a particular site a proportion of the species may be present only in the soil seed bank.

Of the 106 listed characteristic species, 21 (19%) were recorded during the current survey on or adjoining the Site, with 3 or fewer characteristic species recorded in each sampling location, except in Transect 4 (15 listed characteristic species).

Sampling location	Total number of species recorded	Native	Non-local native	Number of SSTF characteristic species recorded	% of the 106 listed SSTF characteristic species recorded
Transect					
1	39	12	1	2	2%
2	41	10	4	1	1%
3	57	19	1	3	3%
4	61	37	1	15	14%
5	23	6	3	2	2%
Spot location					
A	5	1	1	-	-
B	17	6	0	3	3%
C	27	8	1	2	2%
D	5	2	0	1	1%
Row planting					
1	7	3	2	3	3%
2	4	1	3	2	2%
Total	**159**	**63**	**9**	**21**	**19%**

5. Characteristic tree species in SSTF are; Eucalyptus punctata*,* Eucalyptus resinifera*, one of the stringybarks (*Eucalyptus globoidea*,* Eucalyptus eugenioides*,* Eucalyptus sparsifolia*,* Eucalyptus agglomerata*). One or more ironbarks (*Eucalyptus fibrosa*,* Eucalyptus crebra*,* Eucalyptus paniculata*,* Eucalyptus beyeriana*) may be locally important.*

Of the listed characteristic tree species, *Eucalyptus punctata* was recorded:

- In Transect 1 located parallel to the fenceline of a residence northeast of the church with planted non-local native *Eucalyptus botryoides*, a planted *Elaeocarpus reticulatus* and two planted shrubs (*Callistemon salignus* and the exotic *Metrosideros collina*);
- In Transect 5 within a planted row of trees adjoining the northeastern fence boundary of the Site; and
- In Spot location B along fencelines in the mown front yard of a residence adjacent to Herring Road.

Eucalyptus globoidea was recorded as a semi-regularly spaced tree in Transect 4. The trees of Transect 4 included both local native (*Angophora costata*, *Corymbia gummifera*, *Eucalyptus globoidea*, *Eucalyptus pilularis*) and non-local native species (*Eucalyptus microcorys*).

Of the characteristic trees the following were recorded:

Characteristic tree species	Recorded in
Eucalyptus punctata	Transects 1, 5, Spot location B
Eucalyptus resinifera	-
Stringybarks	
Eucalyptus globoidea	Transect 4
Eucalyptus eugenioides	-
Eucalyptus sparsifolia	-
Eucalyptus agglomerata	-
Ironbarks	
Eucalyptus fibrosa	-
Eucalyptus crebra	-
Eucalyptus paniculata	-
Eucalyptus beyeriana	-

6. SSTF has an understorey which may be either grassy and herbaceous or of a shrubby nature. In areas that have not been burnt for an extended period of time the understorey may be dense.

Understorey on the Site consists predominantly of exotic grasses, which are regularly mown. Offsite in Transect 4, the understorey was predominantly exotics and planted *Lomandra hystrix* under the rows of planted trees, with a layer of mulch covering the soil surface.

7. Species composition varies between sites depending on geographical location and local conditions (e.g., topography, relative influence of sandstone or shale).

No additional comments.

8. SSTF provides habitat for a number of plant species recognised as being of national, state or regional conservation significance in UBBS (1997) (list in Final Determination).

No additional comments.

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

Dr Pam Hazelton found that (Appendix 1):

The soil described in the field by me and by Douglas and Partners are indicative of those which occur on areas transitional between the clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed by me show evidence of the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The soils of the Site are consistent with the

Lucas Heights soil Landscape. Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such the soils satisfy the criteria listed in the Final determination for Shale Sandstone Transition Forest.

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

The Site is located on undulating topography that gently grades to University Creek. From advice from Dr Pam Hazelton:

The soils on this Site are not derived from Wianamatta Shale.

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.

12. Adjacent communities on shale soils are generally Cumberland Plain Woodland, while adjacent communities on sandstone soils are generally part of the Sydney Sandstone Complex (sensu Benson & Howell 1990).

The nearest mapped native vegetation by NPWS (2002)/Tozer (2003) is Sydney Turpentine-Ironbark Forest west of Mars Creek about 700 m from the Site and unclassified vegetation about 1 km to the northeast from the Site (Figure 7).

The nearest mapped vegetation to the Macquarie Park site shown on the Benson and Howell (1994) mapping is downslope on Hawkesbury Sandstone and associated with sandstone vegetation of Lane River, namely:

Map units	Description	Geology
10 ag	Sydney Sandstone Gully Forest	Hawkesbury Sandstone
10 ar	Sydney Sandstone Complex	Hawkesbury Sandstone

13. Small areas of SSTF are presently included in only three conservation reserves, Blue Mountains National Park, Cattai National Park and Gulguer Nature Reserve.

No additional comments.

14. A large proportion of the area where SSTF occurred in the past has been cleared for agriculture and urban development. Remnants are small and scattered. Identified threats include: clearing, physical damage from recreational activities, rubbish dumping, grazing, mowing and weed invasion.

From the historical aerial photographs, the Site and adjoining land were extensively cleared for agriculture. The existing land use on and adjoining the Site is campus buildings of Morling College and Macquarie University with extensive mown lawns.

15. In view of the small size of existing remnants the threat of further clearing and other threatening processes, the Scientific Committee is of the opinion that SSTF in the Sydney Basin Bioregion is likely to become extinct in nature

unless the circumstances and factors threatening its survival cease to operate and that listing as an endangered ecological community is warranted.

No additional comments.

In conclusion, the vegetation fails to satisfy the criteria listed in the Final determination for Shale/Sandstone Transition Forest on the grounds that:

- The Site is located in an LGA not listed in the Final Determination. The Site is in the Ryde LGA;
- The structure of the community is not forest or woodland, with the possible exception of the vegetation adjoining Macquarie University land sampled in Transect 4 and Rows 1 and 2. This vegetation appeared to have been planted with trees semi-regularly spaced or in straight rows;
- Three or fewer characteristic species were recorded in each of the sampling locations, except in Transect 4 which contained 15 listed characteristic species;
- Only two of the characteristic tree species were recorded. *Eucalyptus punctata* was recorded:
    - In Transect 1 located parallel to the fenceline of a residence northeast of the church with planted non-locally native *Eucalyptus botryoides*, a planted *Elaeocarpus reticulatus* and two planted shrubs (*Callistemon salignus* and the exotic *Metrosideros collina*);
    - In Transect 5 within a planted row of trees adjoining the northeastern fence boundary of the Site; and
    - In Spot location B along fencelines in the mown front yard of a residence adjacent to Herring Road.

  Eucalyptus globoidea was recorded as a semi-regularly spaced tree in Transect 4. The trees of Transect 4 included both local native (*Angophora costata*, *Corymbia gummifera*, *Eucalyptus globoidea*, *Eucalyptus pilularis*) and non-local native species (*Eucalyptus microcorys*).
- Understorey on the Site was neither grassy and herbaceous nor of a shrubby nature. It consisted predominantly of exotic grasses that are regularly mown. Offsite in Transect 4, the understorey was predominantly exotics and planted *Lomandra hystrix*, and under the rows of planted trees a layer of mulch covered the soil surface.

A4.2 Species

Two species listed under the Commonwealth EPBC Act and NSW TSC Act were recorded in previous surveys, namely:

Species	Listing under EPBC Act	Listing under TSC Act
Eucalyptus scoparia	Vulnerable	Endangered
Syzygium paniculatum	Vulnerable	Endangered

To verify the identifications, locations and health of the two threatened species recorded on the Site, Tony Rodd revisited each of the general locations on 30 July 2010. Tony Rodd found that the tree identified by Treescan (2010) as *Eucalyptus scoparia* is not *E. scoparia*. It is in fact the local native species *Angophora costata* (Smooth-barked Apple). The opposite leaves and fallen ribbed fruits allowed positive identification.

The young sapling of *Syzygium paniculatum* reported by Treescan (2010) is confirmed as that species. It has undoubtedly been planted in the lawn within the last five years. This plant was recorded in the current survey in Transect 2.

A4.2.1 National

There are 10 plant species listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) (www.deh.gov.au/epbc, accessed 9 August 2010) as occurring within a 10 km radius of the Site, namely:

Species	Status	Habitat (Harden 1990 – 1993, 2002)	Likely to occur on the Site?
Apatophyllum constablei	E	Known from a rocky hillside at the base of sandstone cliffs near Glen Davis.	No. Site is remote from known occurrences
Caladenia tessellata	V	Grows on clay loam or sandy soils; south from Swansea.	Unlikely
Cryptostylis hunteriana	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Ra.	No
Darwinia biflora	V	Grows in heath on sandstone or in the understorey of woodland on shale-capped ridges; Cheltenham to Hawkesbury R., rare.	Unlikely
Deyeuxia appressa	E	Grows on wet ground in the Hornsby area.	No
Melaleuca biconvexa	V	Grows in damp places, often near streams; coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district.	Unlikely
Melaleuca deanei	V	Grows in wet heath on sandstone; uncommon, in coastal districts from Berowra to Nowra.	No
Pimelea curviflora var. *curviflora*	V	Confined to coastal areas around Sydney on sandstone.	No
Prostanthera marifolia	Ex	Grows in woodland dominated by *Eucalyptus sieberi* and *Corymbia gumnifera*. In deeply weathered clay soil with ironstone nodules.	No
Tetratheca glandulosa	V	Grows in sandy or rocky heath or scrub, from Mangrove Mtn to the Blue Mtns and Sydney.	No

E = Endangered, V = Vulnerable, Ex = Extinct

None of these species were recorded on the Site. Neither *Eucalyptus scoparia* nor *Syzygium paniculatum* are listed as occurring within a 10 km radius of the Site.

A4.2.2 State

The following 28 species are scheduled in the TSC Act and have been recorded in the Cumberland Catchment Management Area according to NPWS Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au, accessed 4 August 2010):

Species	Status	Habitat (Harden 1990–1993, 2002)	Likely to occur on the Site?
Acacia bynoeana	E	Grows mainly in heath and dry sclerophyll forest, in sandy soils.	No. Not sandy soils.

Species	Status	Habitat (Harden 1990–1993, 2002)	Likely to occur on the Site?
Acacia pubescens	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; rare.	No. Site well east of known occurrences
Caladenia tessellata	E	Grows on clay loam or sandy soils; south from Swansea.	Unlikely
Callistemon linearifolius	V	Grows in dry sclerophyll forest on the coast and adjacent ranges, chiefly from Georges R. to the Hawkesbury R.	No
Chamaesyce psammogeton	E	On sand dunes near the sea.	No
Cynanchum elegans	E	Rare, recorded from rainforest gullies scrub and scree slopes; from the Gloucester district to the Wollongong area and inland to Mt Dangar.	No
Darwinia biflora	V	Grows in heath on sandstone or in the understorey of woodland on shale-capped ridges; Cheltenham to Hawkesbury R., rare.	Unlikely
Deyeuxia appressa	E	Grows on wet ground; in the Hornsby area.	Unlikely
Dillwynia tenuifolia	V	Grows in dry sclerophyll woodland on sandstone, shale or laterite; from Cumberland Plain, Blue Mtns to Howes Valley area.	No
Epacris purpurascens var. *purpurascens*	V	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts.	Possible
Eucalyptus camfieldii	V	Rare and localized, in coastal shrub heath on sandy soils on sandstone, often of restricted drainage; from Gosford to Royal N.P.	No
Genoplesium baueri	V	Grows in sparse sclerophyll forest and moss gardens over sandstone; from the Hunter Valley to Nowra district.	No
Grammitis stenophylla	E	Grows on rocks in rainforest and in wet sclerophyll forest.	No
Grevillea parviflora subsp. *parviflora*	V	Grows in heathy associations or shrubby woodland, in sandy or light clay soils usually over shale substrates. Prospect area (where probably now extinct) and lower Georges R. to Camden, Appin and Cordeaux Dam area . . . near Putty, Cessnock and Cooranbong.	No
Gyrostemon thesioides	E	Confined to the Georges and Nepean Rivers	No
Haloragodendron lucasii	E	Grows in dry sclerophyll open forest on sheltered slopes near creeks on sandstone; confined to Sydney area, rare.	No. Species known from a single locality near St Ives

Species	Status	Habitat (Harden 1990–1993, 2002)	Likely to occur on the Site?
Hibbertia superans	E	Known chiefly from the northwest Sydney region between Baulkham Hills and Wisemans Ferry and from a disjunct occurrence near Mt Boss (inland from Kempsey) on the mid north coast of NSW.	No
Leucopogon exolasius	V	Grows in woodland on sandstone, restricted to the Woronora and Grose Rivers and Stokes Creek, Royal N.P.	No
Maundia triglochinoides	V	Grows in swamps or shallow freshwater on heavy clay; north from southern Sydney.	No
Melaleuca deanei	V	Grows in wet heath on sandstone; uncommon, in coastal districts from Berowra to Nowra.	No
Persoonia nutans	E	Grows in woodland to dry sclerophyll forest on laterite and alluvial sand; confined to the Cumberland Plain.	No
Pimelea curviflora var. *curviflora*	V	Confined to coastal areas around Sydney on sandstone.	Possible
Pimelea spicata	E	Grows on the coast from Lansdowne to Shellharbour and inland to Penrith; rare.	No
Pterostylis saxicola	E	Grows in shallow soil over sandstone sheets, often near streams; rare, from Picnic Point to Picton area.	No
Pultenaea pedunculata	E	Grows in dry sclerophyll forest and disturbed sites on a variety of soils on the South Coast and edge of the Southern Tableland, but with disjunct restricted populations on Wianamatta Shale on the Cumberland Plain in N.S.W.	No
Syzygium paniculatum	E	Grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea; widely separated localities between Bulahdelah and Jervis Bay.	No
Tetratheca glandulosa	V	Grows in sandy or rocky heath or scrub, from Mangrove Mtn to the Blue Mtns and Sydney.	No
Wilsonia backhousei	V	Grows in coastal saltmarshes; chiefly in the Sydney district, also common at Jervis Bay.	No. Not a saltmarsh.

E = Endangered, V = Vulnerable

Kubiak (2005) lists nine species recorded in Ryde bushland that are listed in schedules of the NSW Threatened Species Conservation Act 1995, namely *Darwinia biflora*, *Diuris bracteata*, *Epacris purpurascens* var. *purpurascens*, *Genoplesium baueri*, *Melaleuca deanei*, *Persoonia hirsuta*, *Pimelea curviflora* var. *curviflora*, *Tetratheca glandulosa* and *Wilsonia backhousei*.

Syzygium paniculatum was recorded in Transect 2 of the current survey as a planted tree. The species is not among those returned by a search of the NPWS Wildlife Atlas online with Ryde LGA entered for the search area.

Eucalyptus scoparia is not listed as having been recorded in the Cumberland CMA nor in Ryde LGA according to NPWS Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au, accessed 4 August 2010).

A5.0 Noxious Weeds

The NSW Agriculture Noxious Weeds List (www.agric.nsw.gov.au/noxweed, accessed 4 August 2010) identifies 109 noxious weeds for the Ryde Local Government Area. Eleven of the 96 exotic species recorded in the current survey of the Site are declared Noxious Weeds in the Ryde LGA, namely:

Botanical name	Common name	Control category	Sampling location recorded
Asparagus aethiopicus	Asparagus Fern	4	Transect 3 and 4 Spot B, C and D Row 1
Cinnamomum camphora	Camphor-laurel	4	Transect 3 and 4
Ipomoea indica	Blue Morning Glory	4	Transect 4
Lantana camara	Lantana	4	Transect 4 Spot B
Ligustrum lucidum	Broad-leaved Privet, Glossy Privet	4	Transect 1, 2, 3 and 4
Ligustrum sinense	Small-Leaved Privet, Chinese Privet	4	Transect 3 and 4
Ochna serrulata	Mickey Mouse Plant	4	Transect 3
Oxalis debilis	Pink Oxalis	5	Transect 1 and 2
Romulea rosea	Onion Grass	5	Transect 2
Senna pendula var. glabrata	Easter Cassia	4	Transect 3 and 4 Spot C
Tradescantia fluminensis	Wandering Jew	4	Transect 4 Spot D

Control categories:

Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Class 5	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State. There are no requirements to control existing plants of Class 5 weeds. However, the weeds are "notifiable" and a range of restrictions on their sale and movement exists.

A6.0 Water Management Act

There is a 47 m length of a mapped creek close to the northwest boundary of the Site (Figure 1). The mapped creek is known as University Creek (EDAW 2006, Total Earth Care 2010). From site inspection and from the 1:25 000 topographic map (Figure 1), the creek is piped under the aged care village to the southwest of Morling College land. “University Creek” flows about 1.5 km northeast across Macquarie University land to join Lane Cove River in Lane Cove National Park.

The Site is within the Sydney Harbour Catchment Management Area. There are environmental protection provisions under the Water Management Act that identify:

> *zones in which development should be controlled in order to minimise any harm to water sources in the area or to minimise any threat to the floodplain management provisions of the plan.*

Office of Water NSW has issued requirements for a riparian corridor for the 47 m length of mapped creek in the northwest of the Site.

A7.0 Conclusions

From the current flora assessment, geotechnical and soil surveys, the endangered ecological community Sydney Turpentine-Ironbark Forest does not occur on or adjacent to the Site.

It was found that:

- The Site and adjoining land had been largely cleared for agriculture prior to 1930;
- By 1970, the campuses of Morling College and Macquarie University with buildings, car parks, tree planting and mown lawn were present;
- The soils on and adjoining to the northeast of the Site were Shale/Sandstone Transition soils;
- A total of 159 species (63 native, 9 non-local native and 87 exotic) were recorded in five 0.04 ha transects, four Spot locations and two planted tree rows;
- No National- or State-listed endangered ecological community (EEC) was recorded;
- One National- and State-listed threatened species *Syzygium paniculatum* was recorded as a garden planting;
- Eleven listed Noxious Weeds were recorded; and
- Office of Water NSW has issued requirements for a riparian corridor for the mapped creek on the northwest of the Site.

The extensive planting of Australian native and exotic species on and adjoining the Site are not of conservation significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995.

A total of 31 likely or possible remnant trees (26 remnant, 5 possible remnant) were identified from the review of historical aerial photographs and from site inspection of the trees. With proposed development of the Site (Figures 10, 11):

- 14 (10 remnant, 4 possible remnant) are to be retained; and
- 17 (16 remnant, 1 possible remnant) are to be removed.

A8.0 Recommendations and biodiversity offsetting

It is recommended that as many as practicable of the possible remnant trees be retained in situ. If likely or possible remnant trees are to be cleared, their loss should be offset by planting a greater number of tubestock grown from local native seed than the number of trees to be removed as part of a biodiversity offset.

Biodiversity offsets are undertaken to compensate for the tree loss and the native component of the predominantly exotic mown ground layer. A biodiversity offset is one or more appropriate actions that are taken to counterbalance specific impacts on biodiversity. Appropriate offset actions are long-term management activities to improve biodiversity conservation. This can include legal protection of land to ensure security of management actions and remove threats.

There is Commonwealth and NSW biodiversity offsetting legislation, namely:

2007. Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999 from Commonwealth Department Environment, Water, Heritage and the Arts (website: www.environment.gov.au/epbc/publications/pubs/draft-environmental-offsets.pdf, accessed 18/05/10)

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	Objective	**Met by the proposal**
1.	Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted.	No matters protected by the EPBC Act are recorded on the Site. The Nationally listed *Turpentine-Ironbark Forest of the Sydney Basin Bioregion* includes native forest on transitional areas between soils derived from the Wianamatta shale and Hawkesbury sandstone, or on soils derived from Holocene alluvium, or the Mittagong formation. Hence, conserving, enhancing, restoring and re-establishing native vegetation of Shale/Sandstone Transition soils is targeted to the matter protected by the EPBC Act that may have been the original flora of the Site.
2.	A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.	A riparian corridor is required by the Office of Water NSW for “University Creek”. Conserving, enhancing, restoring and re-establishing the local native vegetation of Shale/Sandstone Transition soils using tubestock planting and direct seeding from seed collected from nearby stands would be of similar or equivalent cost to landscaping.
3.	Environmental offsets should deliver a real conservation outcome.	Conserving, enhancing, restoring and re-establishing local native vegetation of Shale/Sandstone Transition soils in the riparian corridor and elsewhere on site is a real outcome.

	Objective	Met by the proposal
4.	Environmental offsets should be developed as a package of actions - which may include both direct and indirect offsets.	Direct offsets are conserving, enhancing, restoring and re-establishing local native vegetation of the riparian corridor using tubestock planting and direct seeding from seed collected from nearby stands. This will create an indirect offset of enhancing ecological connectivity between catchments.
5.	Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.	The outcome is a "like for like" tree replacement at a ratio greater than 1:1 gain to loss.
6.	Environmental offsets should be located within the same general area as the development activity.	The environmental offset is on the same Site.
7.	Environmental offsets should be delivered in a timely manner and be long lasting.	A time period and standards are set by Office of Water NSW for the riparian corridor.
8.	Environmental offsets should be enforceable, monitored and audited.	The Office of Water NSW requires the conservation works in the riparian corridor to be monitored and audited.

In conclusion, no matters protected by the EPBC Act are recorded on the Site. Conserving, enhancing, restoring and re-establishing local native vegetation of Shale/Sandstone Transition soils is targeted to the matter protected by the EPBC Act that may have been the original flora of the Site, but not currently on the Site.

2008. Principles for the use of biodiversity offsets in NSW from the NSW Department of Environment and Climate Change (website: www.environment.nsw.gov.au/biocertification/offsets.htm, accessed 13/05/10).

Principle		Met by the proposal
1.	Impacts must be avoided first by using prevention and mitigation measures.	As many trees as practicable are to be retained on the Site.
2.	All regulatory requirements must be met.	The riparian corridor is required by the Office of Water NSW as part of the proposal.
3.	Offsets must never reward ongoing poor performance.	No additional comments.
4.	Offsets will complement other government programs.	The riparian corridor is likely to be required by the Office of Water NSW for nearby proposals.
5.	Offsets must be underpinned by sound ecological principles.	A riparian corridor is specified by the Office of Water NSW. The proposed offset area (excluding the riparian zone) is about 1353m^2.
6.	Offsets should aim to result in a net improvement in biodiversity over time.	The outcome of the offset for tree replacement is net improvement. It complement the conservation works proposed in the riparian corridor
7.	Offsets must be enduring, i.e. they must offset the impact of the development for the period that the impact occurs.	The riparian corridor and the proposed approximately 1353m^2 offset area (in addition to the riparian zone) is an enduring conservation area.

Principle		Met by the proposal
8.	Offsets should be agreed prior to the impact occurring.	Conserving, enhancing, restoring and re-establishing local native vegetation of Shale/Sandstone Transition soils in the riparian corridor forms part of the development. The proposed approximately 1353m^2 offset area (in addition to the riparian zone) is also part of the proposal.
9.	Offsets must be quantifiable i.e. the impacts and benefits must be reliably estimated.	The Office of Water NSW requires the conservation works in the riparian corridor to be monitored and reports lodged with the Office of Water NSW. The proposed approximately 1353m^2 offset area is shown on plan.
10.	Offsets must be targeted.	The offset is targeted to conserving, enhancing, restoring and re-establishing native vegetation of Shale/Sandstone Transition soils in the riparian corridor
11.	Offsets must be located appropriately.	The offset is located on the Site.
12.	Offsets must be supplementary.	The offset supplements the other conservation works on the Site of the riparian corridor and retaining as many trees as practicable.
13.	Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	Conserving, enhancing, restoring and re-establishing local native vegetation of Shale/Sandstone Transition soils in the offset area and the riparian corridor forms part of the requirement for a Part 3A proposal.

The proposed conserving, enhancing, restoring and re-establishing local native vegetation of Shale/Sandstone Transition soils in the offset area (in addition to the riparian corridor) is consistent with the Principles for the use of biodiversity offsets in NSW 2008. The main requirements of an offset are met with:

- the proposal resulting in a **net improvement** – equal to or greater than the loss from the development
- the offset being **secure** – legally protected from future development
- the offset being **targeted** to a like-for-like outcome in the same locality as the loss
- the offset being **measurable** –the losses from the development can be compared with the gain from the offset through quantitative assessment
- the offset being **enforceable** – through consent conditions, conservation agreements, etc. The offset will be monitored to determine its effectiveness.

Part B Assessment of significance for Sydney Turpentine-Ironbark Forest

B1.0 Introduction

From the Flora Assessment, it was found that the presence of Sydney Turpentine-Ironbark Forest was not possible as the soil and vegetation criteria are not met.

Site specific field soil investigation by Dr Pam Hazelton (in Appendix 1) and the geotechnical investigation by Douglas Partners (2009) indicate that the soils are those which occur on areas transitional between clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed are close to the geological boundary, often evidenced by the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such, the soils satisfy the criteria listed in the Final determination for Shale/Sandstone Transition Forest. The vegetation fails to satisfy the criteria listed in the Final Determination for Shale/Sandstone Transition Forest on the following grounds:

- The Site is located in an LGA not listed in the Final Determination. The Site is in the Ryde LGA;
- The structure of the community is not forest or woodland, with the possible exception of the vegetation adjoining Macquarie University land sampled in Transect 4 and Rows 1 and 2. This vegetation appeared to have been planted with trees semi-regularly spaced or in straight rows;
- Three or fewer characteristic species were recorded in each of the sampling locations, except in Transect 4 which contained 15 listed characteristic species;
- Only two of the characteristic tree species were recorded. *Eucalyptus punctata* was recorded:
    - In Transect 1 located parallel to the fenceline of a residence northeast of the church with planted non-locally native *Eucalyptus botryoides*, a planted *Elaeocarpus reticulatus* and two planted shrubs (*Callistemon salignus* and the exotic *Metrosideros collina*);
    - In Transect 5 within a planted row of trees adjoining the northeastern fence boundary of the Site; and
    - In Spot location B along fencelines in the mown front yard of a residence adjacent to Herring Road.

  Eucalyptus globoidea was recorded as a semi-regularly spaced tree in Transect 4. The trees of Transect 4 included both local native (*Angophora costata*, *Corymbia gummifera*, *Eucalyptus globoidea*, *Eucalyptus pilularis*) and non-local native species (*Eucalyptus microcorys*).
- Understorey on the Site was neither grassy and herbaceous nor of a shrubby nature. It consisted predominantly of exotic grasses which are regularly mown. Offsite in Transect 4, the understorey was predominantly exotics and planted *Lomandra hystrix*, and under the rows of planted trees a layer of mulch covered the soil surface.

The soils do not satisfy the criteria listed for the Final determination for Sydney Turpentine-Ironbark Forest.

As it was concluded that there are no endangered ecological communities present on or adjoining the Site, an assessment of significance is not required for either of the endangered ecological communities Sydney Turpentine-Ironbark Forest or Shale/Sandstone Transition Forest under the NSW Threatened Species Act 1995.

Hence, the proposal does not lead to direct loss of areas of STIF or to indirect impact on STIF on site and on the adjacent site. The assessment of significance for Sydney Turpentine-Ironbark Forest is not required.

Part C Assessment of significance for *Eucalyptus scoparia* and *Syzygium paniculatum*

C1.0 Introduction

In DECCW comments on Major Project Application MP09_0195, MP09_0217 and MP09_0218 at 120-128 Herring Road, Macquarie Park (Appendix 1) it is stated that:

> *The Flora and Fauna Assessment (FFA) notes that two threatened flora species,* Syzygium paniculatum *and* Eucalyptus scoparia*, occur on site. DECCW agrees with the comments in the FFA that these plants are likely to have been planted. However, assessments of significance of the impacts on these species will still need to be prepared given their listed status.*

Total Earth Care (2010) prepared the Flora and Fauna Assessment. It states that:

> *There were 2 threatened plant species listed under the TSC Act, both of which are listed under the EPBC Act, recorded on the subject site in the current investigation.*
>
> *One individual of* Eucalyptus scoparia *Wallangarra White Gum was recorded during the current survey in the far eastern corner area of the site. It is a planted specimen associated with the garden of a single storey dwelling. Additionally it is well outside of its natural range and habitat . . . . . This single planted specimen was identified as Eucalyptus punctata Grey Gum in the arborist's report. . . . . .*
>
> *One individual of* Syzygium paniculatum *Magenta Lilly Pilly was recorded during the current survey, located along the central part of the boundary running NW to SE. . . . . Additionally it is a planted specimen and growing outside its natural habitat (i.e. non-indigenous to the area) . . . . .*

The arborist report was prepared by Treescan (dated March 2010). Treescan (2010) recorded *Eucalyptus scoparia* (Wallangarra White Gum) as a non-local native tree on the Site. On the Tree Management Plan (Turf Design, Project No. 0924, Dwg No. L5 Rev C dated 30/04/10), Tree No. 25 in the northeast corner was identified as *Eucalyptus scoparia* (Figure 10).

To verify the identifications, locations and health of the two threatened species recorded on the Site, Tony Rodd revisited each of the general locations on 30 July 2010. Tony Rodd identified the recorded *Eucalyptus scoparia* as *Angophora costata.*

C2.0 *Eucalyptus scoparia* recorded on the Site

Tree No. 25 in the northeast corner identified by Total Earth Care (2010) and Treescan (2010) as *Eucalyptus scoparia* appeared to have been misidentified. Tony Rodd found the tree was *Angophora costata,* not *E. scoparia*.

From PlantNET (website: http://plantnet.rbgsyd.nsw.gov.au, accessed 9 August 2010) the two eucalypt species are described as:

Eucalyptus scoparia

Description: Tree to 15 m high. Bark smooth throughout, powdery, white or grey.

Juvenile leaves disjunct, linear, glossy green, sessile, to 10 cm long, 6 mm wide. Adult leaves disjunct, linear to narrow-lanceolate, glossy green, concolorous, to 15 cm long, 1 cm wide.

Inflorescence simple, axillary, 7-flowered; peduncles 5–10 mm long. Buds ovoid or cylindrical, 4–5 mm long, 1.5–2 mm diam. Calyptra conical, shedding early, as long as hypanthium, as wide as hypanthium; smooth. Flowers white, or cream.

Fruits ovoid, 5–7 mm long, 5–8 mm diam. Disc raised. Valves exserted.

Distribution and occurrence:
NSW subdivisions: NT
Other Australian states: Qld

Angophora costata

Description: Tree to 30 m high; bark smooth, shedding in small scales, pink, grey or cream.

Juvenile leaves ovate or elliptic, to 12.5 cm long, 6.5 cm wide.

Adult leaves lanceolate, 9–17 cm long, 2–3.5 cm wide, apex acute or acuminate, base acute, ± glabrous, discolorous, regularly penniveined; petiole 10–25 mm long. Peduncles 7–18 mm long, glabrous or hispid; pedicels 4–10 mm long, glabrous or hispid. Buds ovoid or globose, 5–7 mm long, 5–6 mm diam. Petals 3–4 mm wide, 3–4 mm long. Hypanthium strongly ribbed.

Fruit ovoid or campanulate, sometimes apically narrowed, 9–15 mm long, 12–15 mm diam.; disc depressed.

Distribution and occurrence: Widely scattered and locally abundant, on deep sandy soils or sandy soils on sandstone; chiefly on the coast from Coffs Harbour to Bodalla and west into the Blue Mtns.
NSW subdivisions: NC, CC, SC, CT

C2.1 *Syzygium paniculatum* recorded on the Site

The young sapling of *Syzygium paniculatum* reported by Treescan (2010) was confirmed as that species in Flora Survey (Part A of this report).

Syzygium paniculatum was an isolated individual about 3 m tall existing as a non-local native planting adjacent to the northern fenceline (recorded in Transect 2, location on Figure 9). The *Syzygium paniculatum* appeared to be generally healthy but was observed to have sooty mould on its leaves. It has undoubtedly been planted in the lawn within the last five years.

Syzygium paniculatum is endemic to New South Wales; with a highly fragmented distribution along the coast between Bulahdelah and Jervis Bay (Harden 2002). It grows in subtropical and littoral rainforest and riparian habitat on nutrient poor, deep

sandy soils or stabilized dunes near the sea (Payne 1997, Harden 2002). Within littoral rainforest *Syzygium paniculatum* is often confined to floodplain swales subject to inundation in high rainfall (Payne 1997). *Syzygium paniculatum* is uncommon in the wild and is listed as a threatened species under the *New South Wales Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. *Syzygium paniculatum* is also widely cultivated and has become naturalised in some places (Wilson 2007).

On the Australian Native Plant Society (Australia) website http://asgap.org.au, accessed 30 July 2010), it is stated that:

> Syzygium paniculatum *is a shrub or small tree with flaky bark. The leaves are opposite (each pair emerges from the stem at the same location but on opposing sides), lance-shaped or elliptical in shape and bright, glossy green. White flowers appear in summer and are followed by large, fleshy, magenta-coloured fruits. These are ovoid in shape and around 20 mm long with a large seed. The fruits are edible and are often made into jams.*
>
> S. paniculatum *is a reliable species in most temperate and subtropical climates. It prefers rich soils and assured moisture. An attractive form with variegated foliage is in cultivation. The species can be grown successfully in a large tub.*
>
> *Propagation is usually carried out from fresh seed, either by sowing the fruits whole or after removing the flesh. Germination may be slow and spasmodic. The species can also be grown from cuttings of firm, current season's growth.*

In the current survey, it was found that the *Syzygium paniculatum* growing in Transect 2 on the Site was a single planted shrub about 3 m in height (Figure 9).

C3.0 The proposal

The proposal is the redevelopment of a 1.7ha portion of the Morling College Site located at 128 Herring Road Macquarie Park. This includes the subdivision of the site and the construction of an 8-stage development including the construction of five residential apartment buildings, access road, car parking, landscaping and riparian corridor (Figure 11).

Of the total 32 likely or possible remnant trees (26 likely, 6 possible) (Figure 10):

- 14 (10 likely remnant, 4 possible remnant) are to be retained; and
- 17 (16 likely remnant, 1 possible remnant) are to be removed.

The planted *Syzygium paniculatum* is also proposed to be removed. The proposal includes conserving, enhancing, restoring and re-establishing the local native vegetation of Shale/Sandstone Transition soils in the approximately 1353 m^2 offset area, and in the approximately 1880 m^2 (47 m long and about 40 m wide) riparian corridor.

C4.0 Assessment of impact

C4.1 New South Wales Threatened Species Conservation Act 1995

In the Threatened Species Assessment Guidelines dated August 2007, it is stated that:

> *Under the Threatened Species Conservation Amendment Act 2002, factors to be considered when determining whether an action, development or activity is*

likely to significantly affect threatened articles s5A of the Environmental Planning and Assessment Act 1979 (EP&A Act), s94 Threatened Species Conservation Act 1995 and s220zz Fisheries Management Act 1994 (FM Act) have been revised.

The Assessment of Significance under the TSC Act, known previously as the Eight Part Test, is now known as the Assessment of Significance.

The objective of an Assessment of Significance is to:

> *improve the standard of consideration afforded to threatened species, populations and ecological communities, and their habitats through the planning and assessment process, and to ensure this consideration is transparent* (Threatened Species Assessment Guidelines, dated August 2007).

The revised factors for the Assessment of Significance maintain the same intent as the Eight Part Test but focus on:

> *consideration of likely impacts in the context of the local rather than the regional environment as the long-term loss of biodiversity at all levels arises primarily from the accumulation of losses and depletions of populations at a local level.*

The Threatened Species Assessment Guidelines (2007) are to facilitate:

> *a consistent and systematic approach when determining whether an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats in a direct or indirect manner ... Where there is any doubt regarding the likely impacts, or where detailed information is not available, a Species Impact Statement should be prepared.*

An Assessment of Significance has been completed for the species *Syzygium paniculatum*, listed as Endangered under the NSW *Threatened Species Conservation Act 1995.*

C4.2 Application of the Assessment of Significance for *Syzygium paniculatum*

a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

Syzygium paniculatum was an isolated individual about 3 m tall existing as a non-local native planting adjacent to the northern fenceline (recorded in Transect 2, location on Figure 9). The *Syzygium paniculatum* appeared to be generally healthy but was observed to have sooty mould on its leaves. It has undoubtedly been planted in the lawn within the last five years.

The proposal is to remove the planted individual of this species on the Site. This individual is not part of a viable, local population but rather a planted species that is not naturally represented in any community on the Site or in any community contiguous with the vegetation on site. There are no known viable local populations or habitat of this species reported in the Ryde LGA (distribution given on PlantNET website, Kubiak 2005). A single planted individual recorded on the Site is outside its natural range and is not part of a viable population with expected interchange of genetic material between other *Syzygium paniculatum* individuals. Hence the

removal of the individual is not likely to adversely affect the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction, given that:

> ***Life cycle*** is defined as the series or stages of reproduction, growth, development, ageing and death of an organism.
>
> ***Viable*** is defined as having the capacity to successfully complete each stage of the life cycle under normal conditions.
>
> ***Local population*** is defined as that which occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
>
> The *local population* of a threatened *plant* species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
>
> ***Risk of extinction*** is defined as the likelihood that the local population will become extinct either in the short-term *or* in the long-term as a result of direct or indirect impacts on the viability of that population.

b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable. *Syzygium paniculatum* is listed as an Endangered species.

c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    1. *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    2. *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable. *Syzygium paniculatum* is listed as an Endangered species.

d) *in relation to the habitat of a threatened species, population or ecological community:*
    1. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The natural habitat of *Syzygium paniculatum* is described by NPWS (2001a) as:

- At Jervis Bay on the south coast *Syzygium paniculatum* occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest; and
- On the central coast, *S. paniculatum* occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.

The tree is an isolated planted individual and not in a remnant stand of littoral rainforest nor in riverside gallery rainforest. Furthermore, the species is not known to occur in bushland in the Ryde LGA (Kubiak 2005). Hence no natural habitat of

Syzygium paniculatum on or adjoining the Site or in the Ryde LGA will be removed or modified as a result of the action proposed.

2. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

As there is no natural habitat of *Syzygium paniculatum* on or adjoining the Site or in the Ryde LGA, an area of habitat is not likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

3. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The tree is an isolated planted individual with no naturally occurring habitat on the Site. The removal of the individual on the Site does not remove, modify, fragment or isolate natural habitat of *Syzygium paniculatum,* hence the proposal does not affect the long-term survival of the species.

e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat has been declared for *Syzygium paniculatum* (NPWS 2001b).

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

No recovery plan or threat abatement plan has been prepared for *Syzygium paniculatum* (NPWS 2001b).

g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

Of the 31 key threatening processes listed on the NSW Threatened Species Conservation Act 1995, none are relevant to the removal of the planted *Syzygium paniculatum*.

In conclusion, the proposal is not likely to significantly impact naturally occurring *Syzygium paniculatum*, particularly as the individual on the Site is a planted specimen as part of extensive planting of Australian native and exotic species in a park like campus setting of mown lawns.

C5.0 Mitigating the impacts of the proposal

As there is a 47 m length of mapped creek, known as University Creek, in the northwest of the Site, Office of Water NSW require a riparian corridor of local native species to be established.

It is recommended that the vegetation of the required riparian corridor be re-established using seed from local sources to form a living seed bank of the local shale sandstone native flora.

The re-establishment of the local Shale/Sandstone native flora in the approximately 1353 m^2 offset area and in the approximately 1880 m^2 riparian corridor offsets the loss of likely remnant or possible remnant trees in accord with the *Principles for the use of biodiversity offsets in NSW.*

Acknowledgments

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- Judy Henderson of Morling College for granting permission to inspect the Morling College campus.

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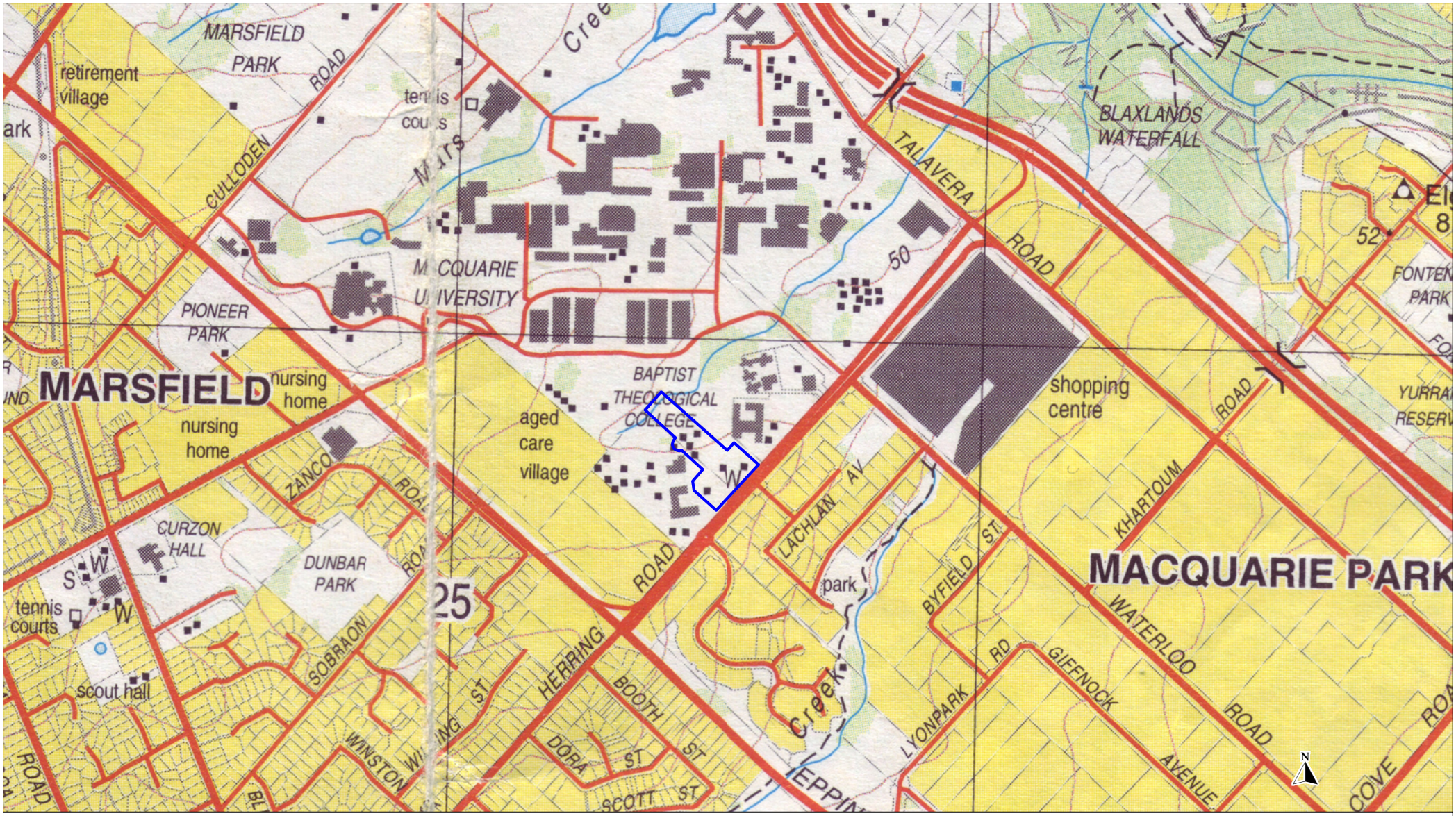
Figures



Legend

Site Boundary

Metres

0 200 400

Figure 1:
Location of the Site overlaid on the Parramatta River 1:25 000 topographic map (Land and Property Information 2002)

Legend

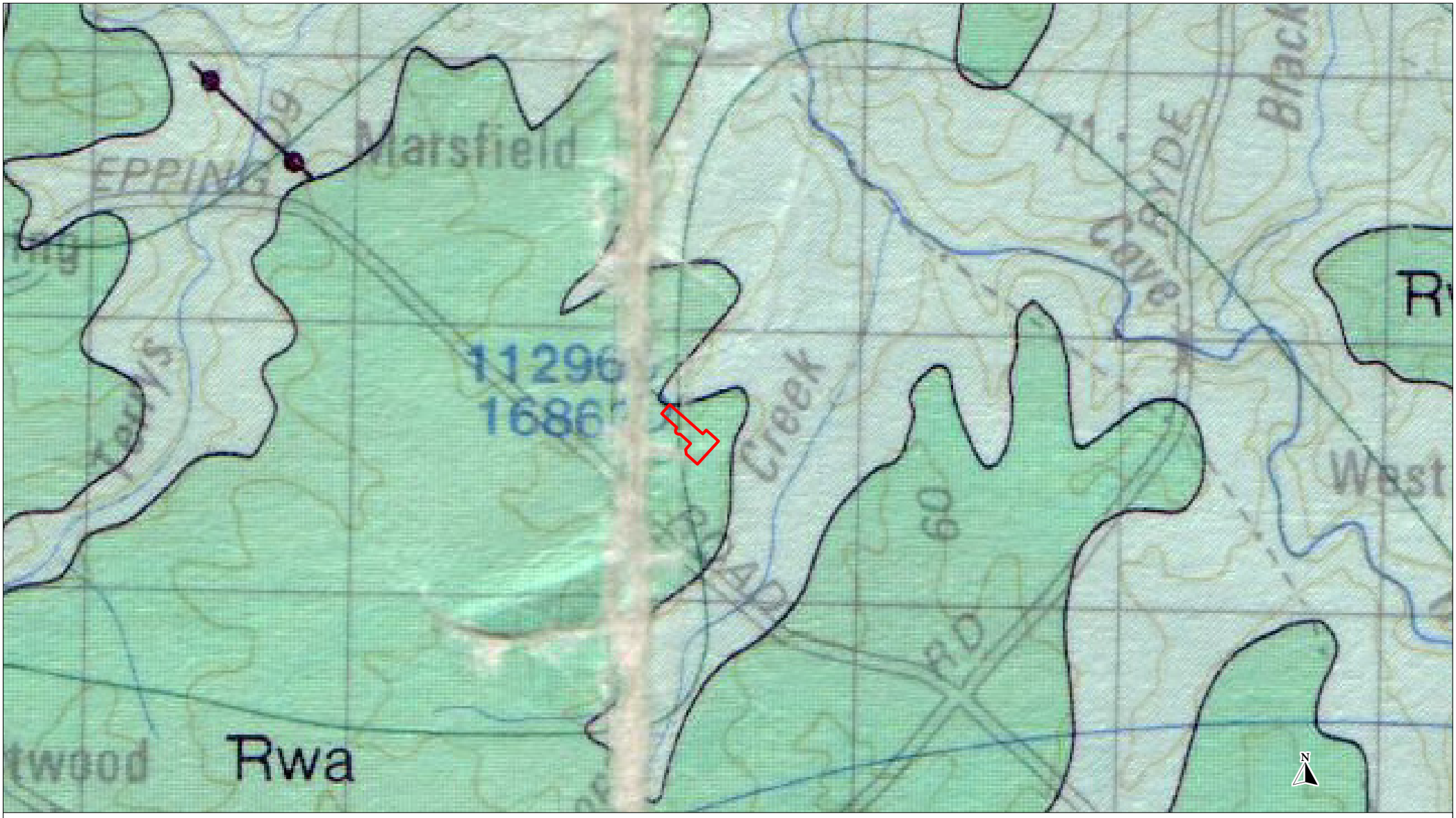
- Macquarie University Train Station
- University Creek
- Site Boundary

Metres

0 90 180

N

Figure 2:
Location of the Site overlaid on Nearmap Image (accessed August 2010)



Legend

Rh = Hawkesbury Sandstone

Rwa = Ashfield Shale

Site Boundary

Metres

0 400 800

Figure 3:
Geological mapping with the site boundary overlaid (Herbert and West 1983)

Legend

- Site Boundary
- gn = Glenorie
- lh = Lucas Heights
- xx = disturbed

Metres

0 200 400

Figure 4:
Soil landscape mapping with site boundary overlaid (Chapman et al 1989)

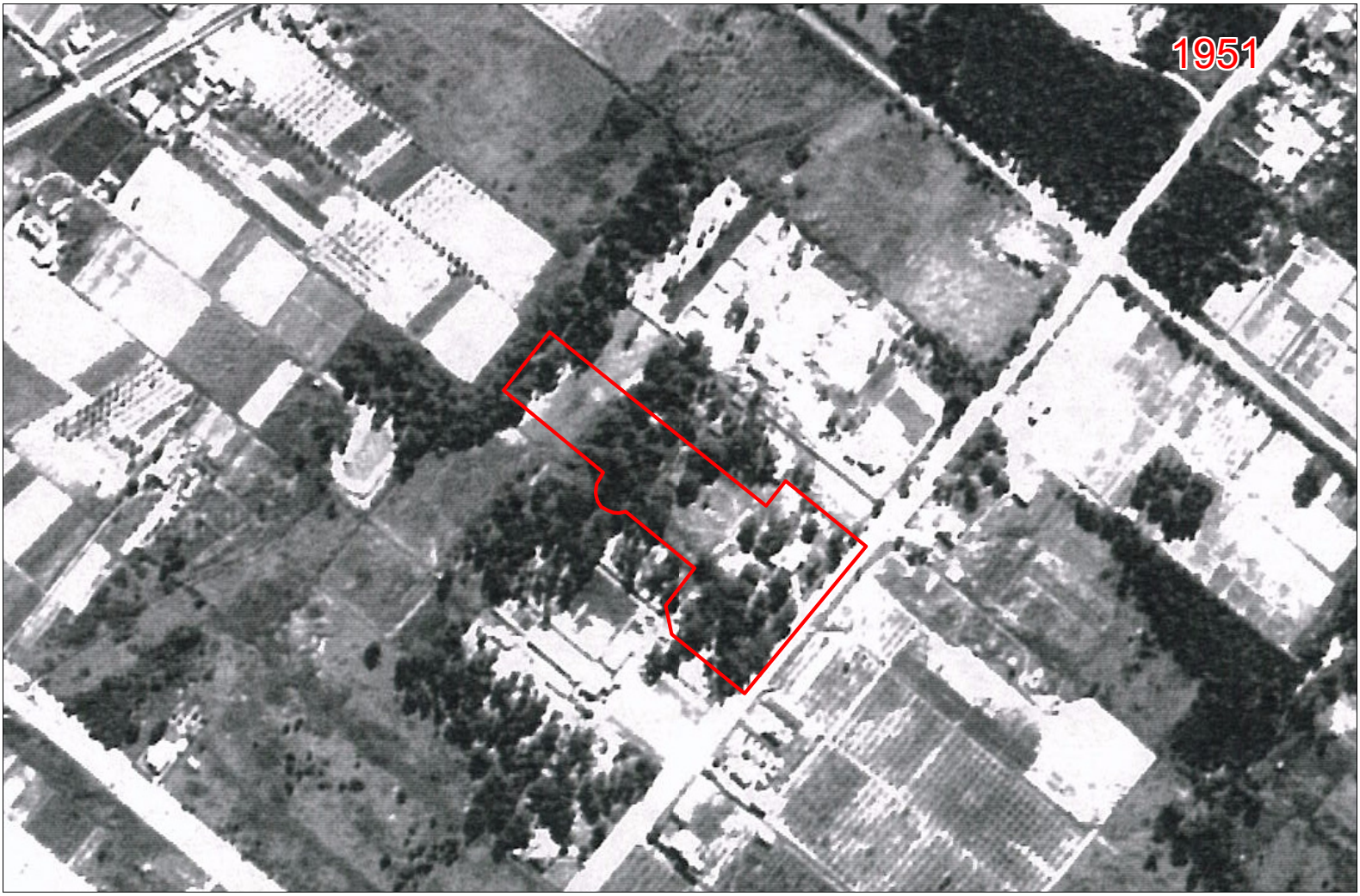
Legend

Soil survey pits (Pam Hazelton)

Site Boundary

Figure 5:
Soil sampling sites overlaid on Nearmap Image (Pam Hazelton 2010)

Figure 6a:
1930 and 1943 aerial photographs



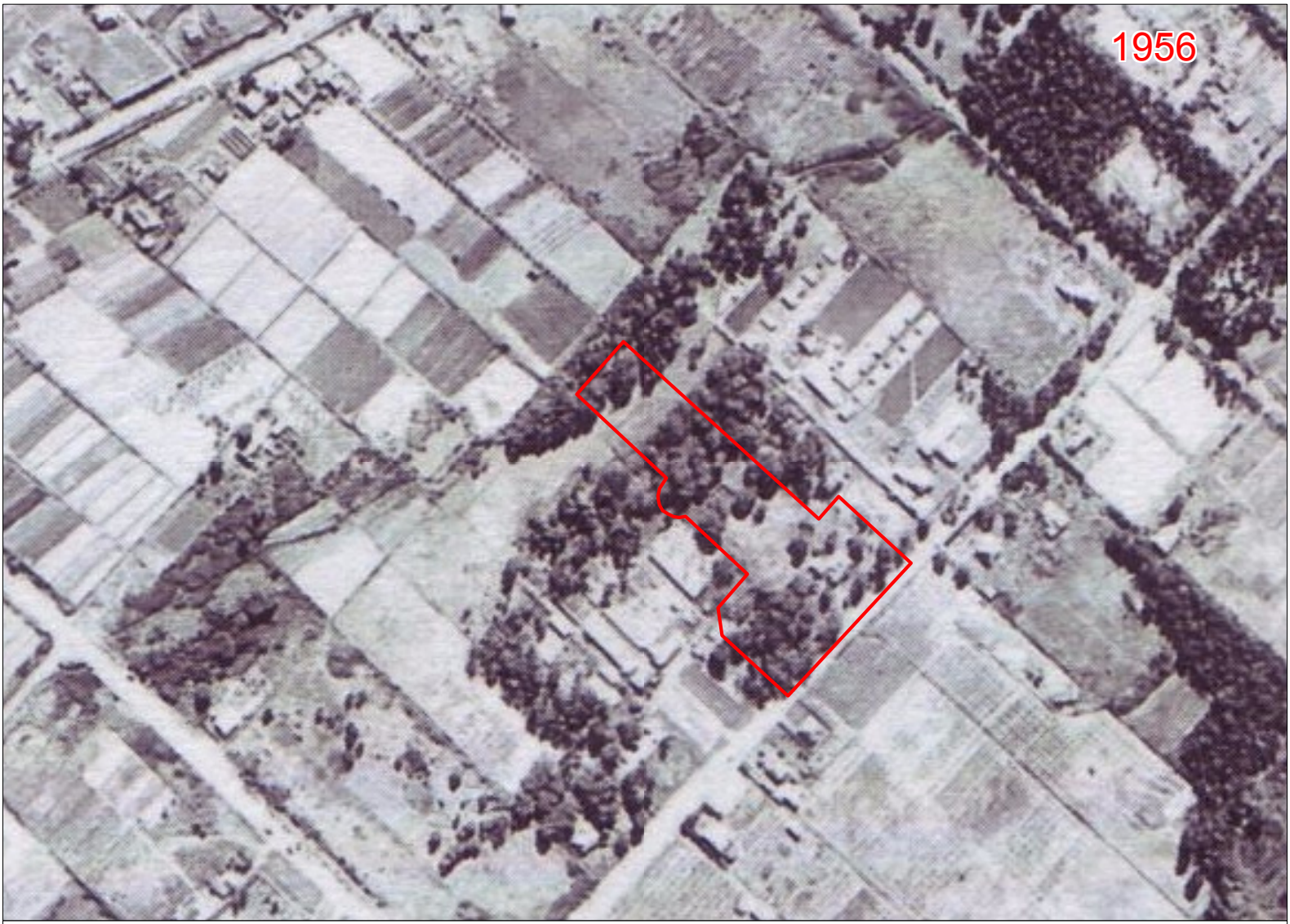
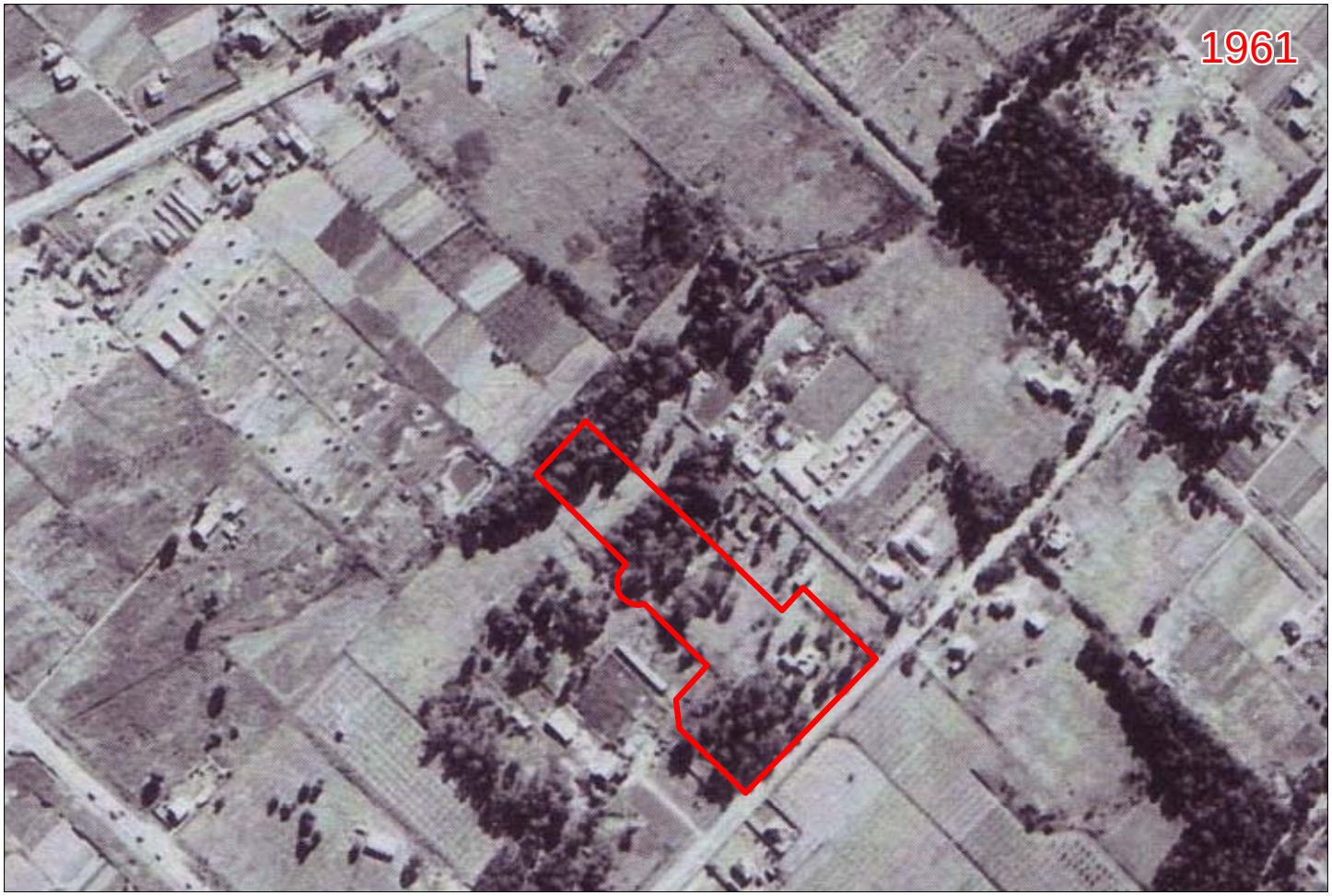


Figure 6b:
1951 and 1956 aerial photographs



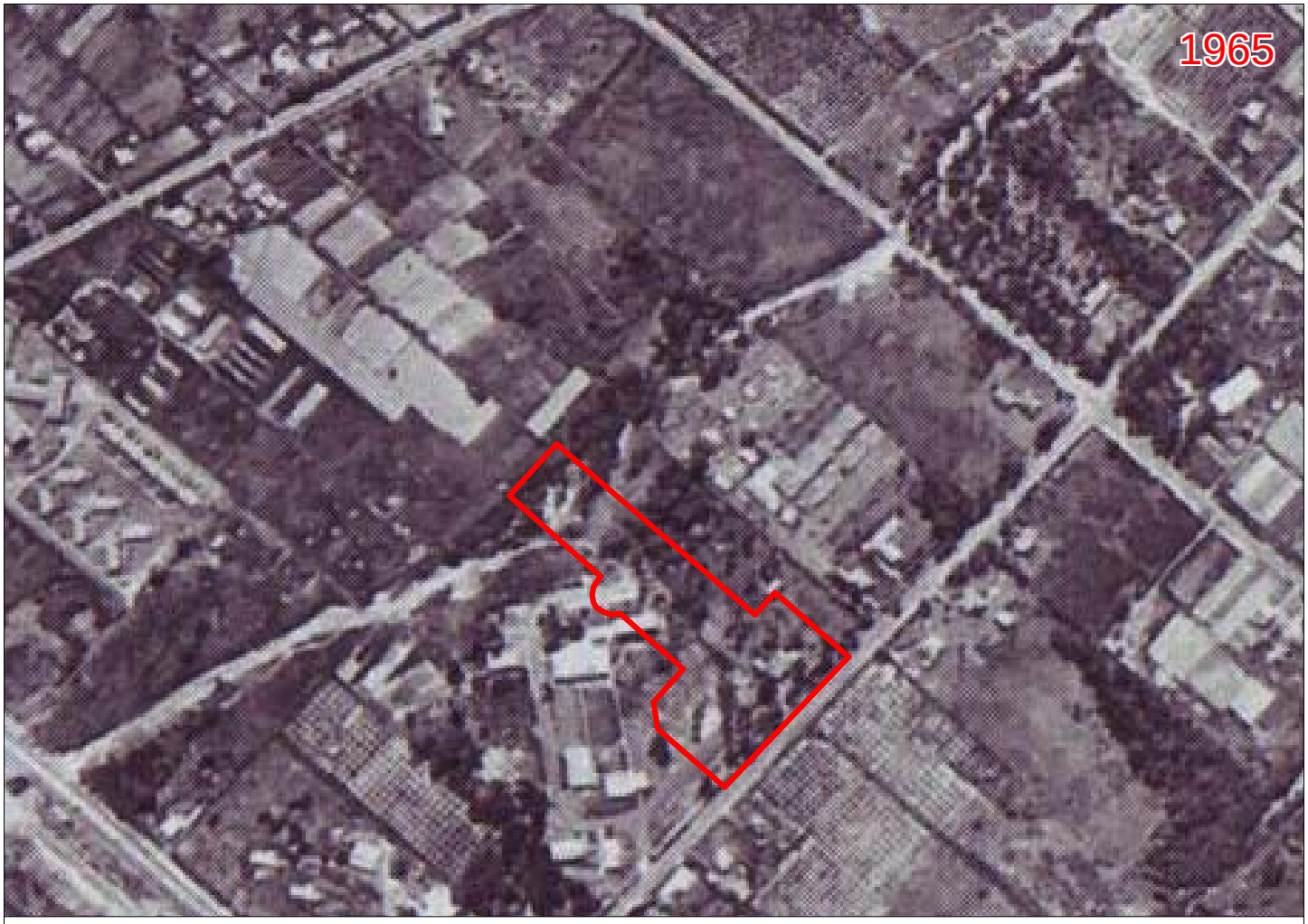


Figure 6c:
1961 and 1965 aerial photographs

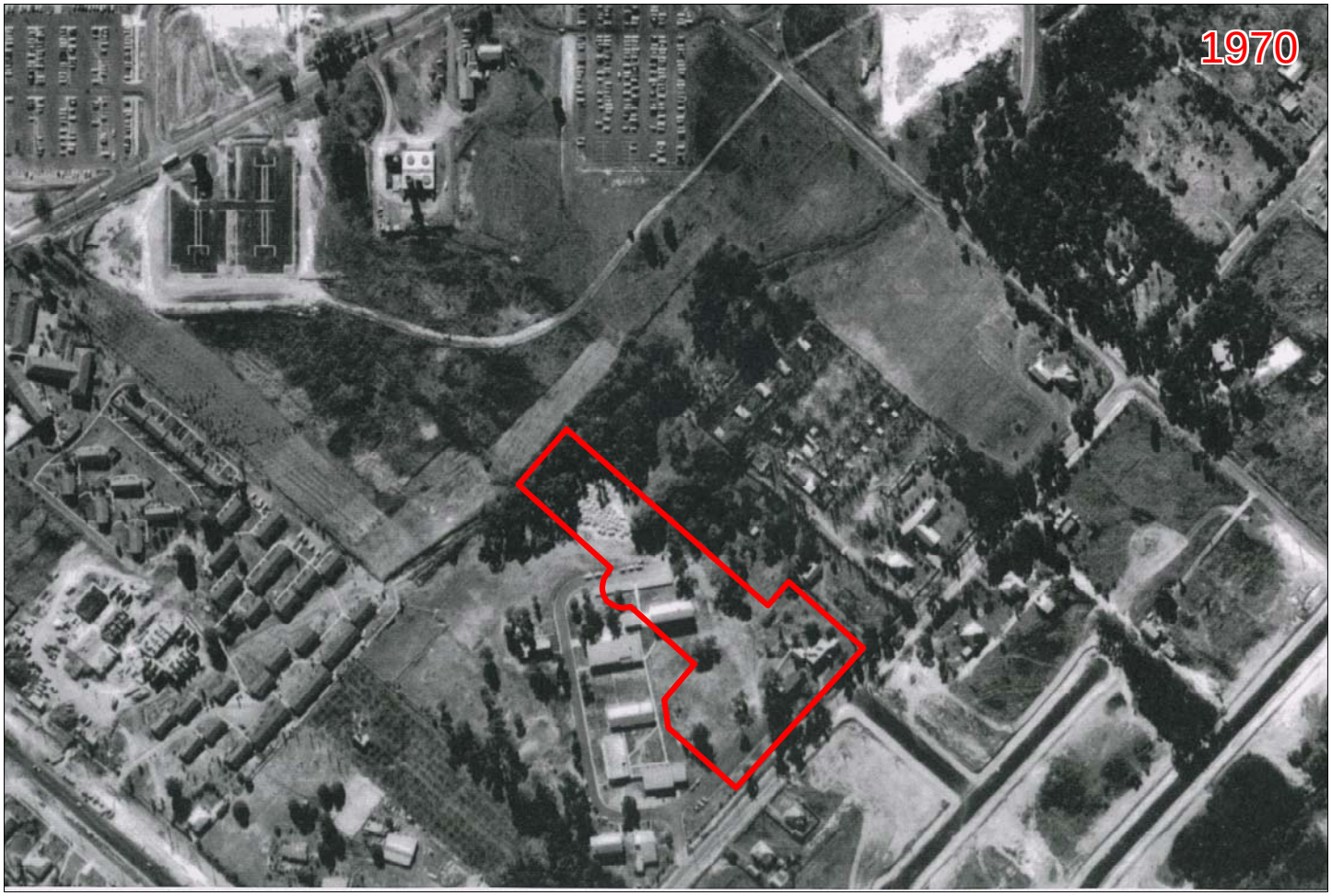


Figure 6d:
1970 and 1986 aerial photographs

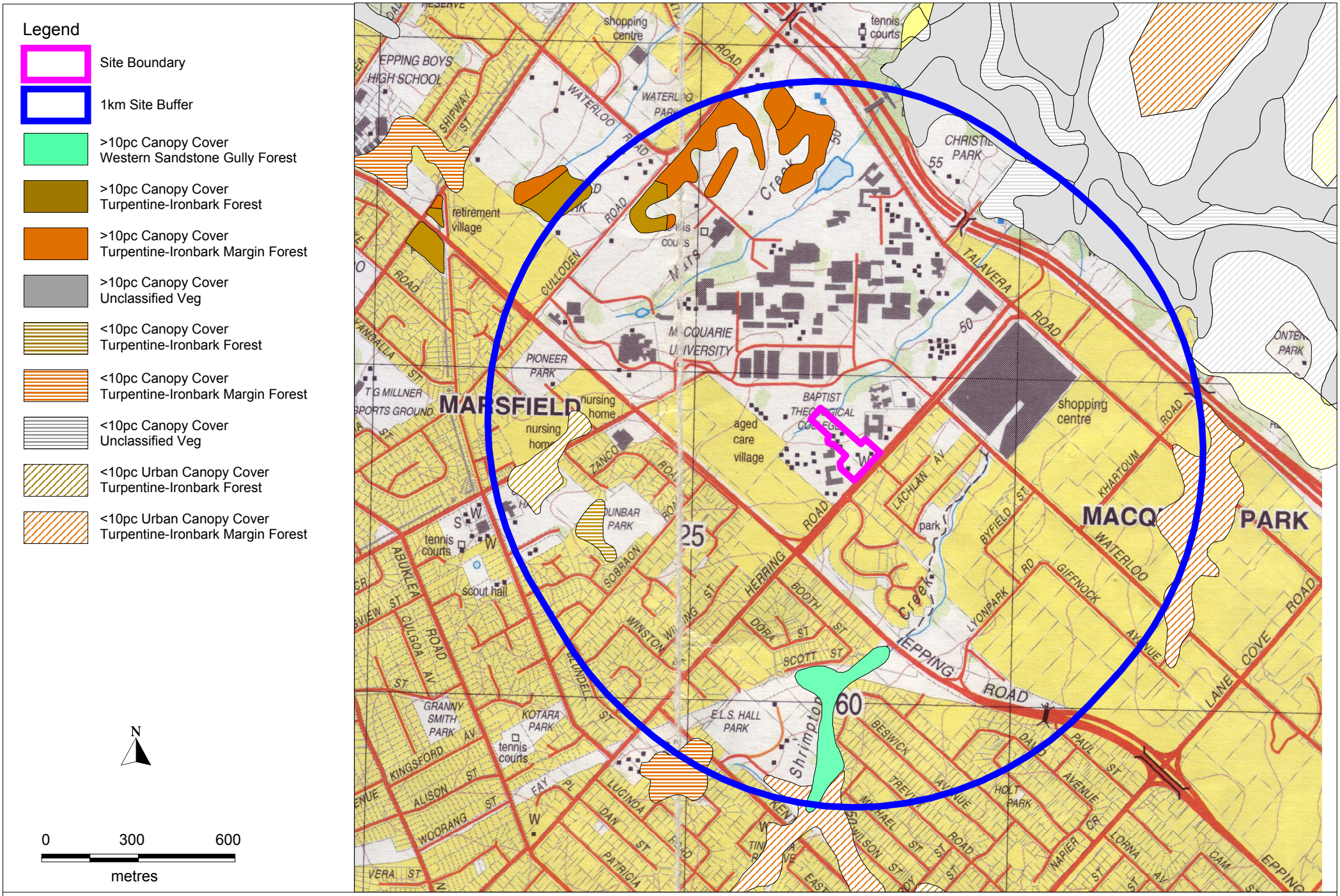


Figure 7: Vegetation Mapping (NPWS 2002/Tozer 2003)

Figure 8:
Vegetation Mapping (EDAW 2006)

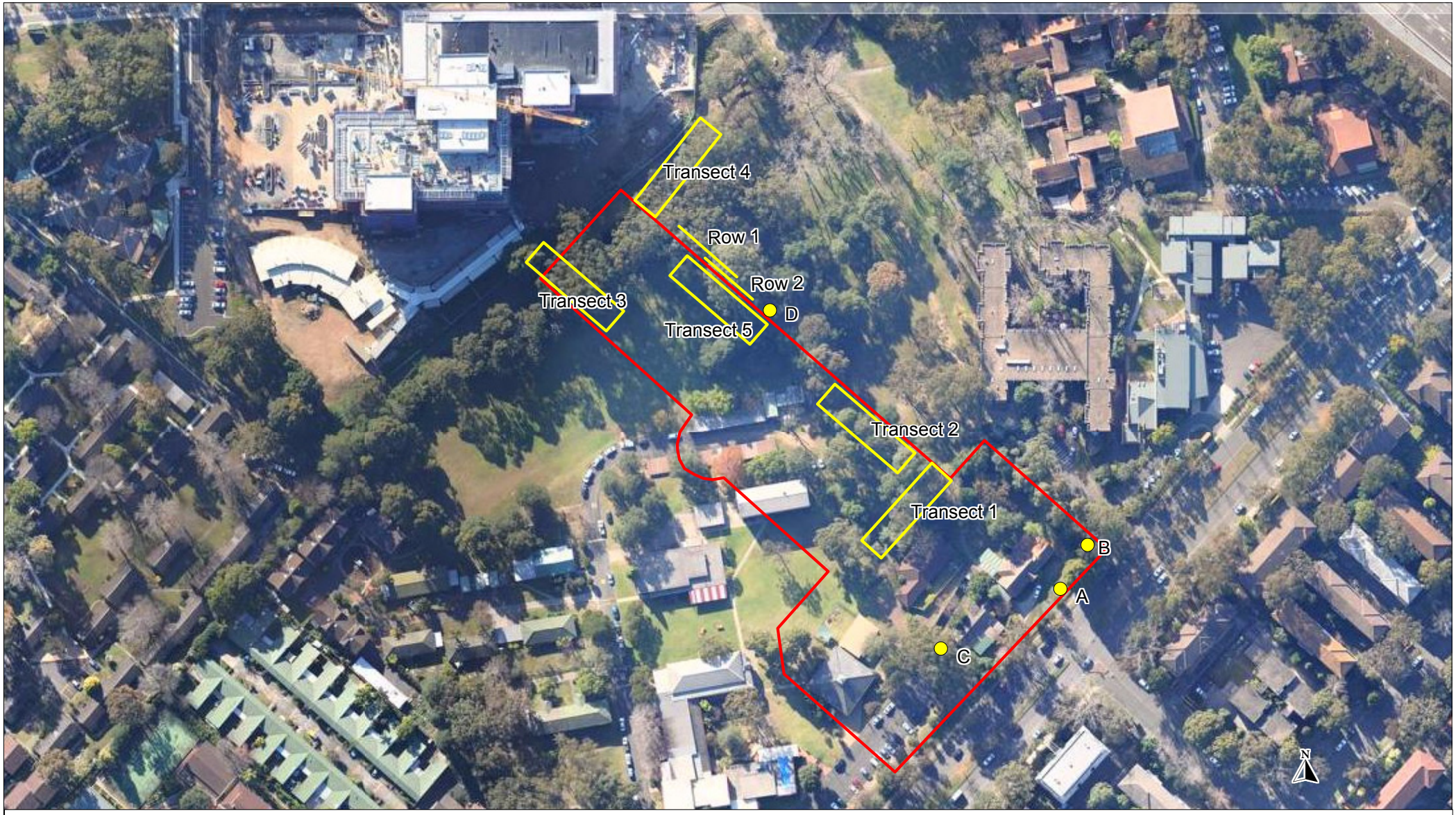


Figure 9:
Sampling locations overlaid on Nearmap Image (accessed August 2010)

Figure 10:
Location of likely and possible remnant trees with the boundaries of the proposal overlaid on the Nearmap Image

Tables

Table 1. Species recorded in sampling locations at Macquarie Park

Notes:

1. Asterisk (*) before botanical name signifies exotic species. Hash symbol (#) signifies a non-local native, planted or naturalised species.
2. Families are grouped under headings 1. Pteridophytes, 2. Gymnosperms, 3. Dicotyledons, 4. Monocotyledons. One or more of these plant groups may be absent from this site.
3. The numbers in the columns for Transects show frequency, being the number (from 1 to 4) of 10m x 10m quadrats in which the species occurs in the 40m x 10m Transect. For Spot locations and Rows presence only is indicated.

Botanical name	Common name	Transects					Spots				Rows	
		1	2	3	4	5	A	B	C	D	1	2
1. Pteridophytes												
Davalliaceae												
* Nephrolepis cordifolia	Fishbone Fern							X	X			
Dennstaedtiaceae												
Pteridium esculentum	Bracken			1								
Selaginellaceae												
Selaginella uliginosa				2		1						
2. Gymnosperms												
Cupressaceae												
* Cupressus macrocarpa 'Brunneana'	Brunning's Golden Monterey Cypress						X					
Pinaceae												
* Cedrus deodara	Deodar, Deodar Cedar							X				
3. Dicotyledons												
Acanthaceae												
Pseuderanthemum variabile	Pastel Flower				1							
Apiaceae												
Centella asiatica	Indian Pennywort		2		1							
* Petroselinum crispum	Parsley				1							
Asteraceae												
* Aster subulatus	Wild Aster			1								
* Bidens pilosa	Cobblers Pegs			1	3							
* Cirsium vulgare	Black Thistle, Spear Thistle	3			1							
* Conyza sp.	Fleabane	1	1									
* Conyza sumatrensis	Tall Fleabane			1		1						
Cotula australis	Common Cotula			1								
Euchiton involucratus	Star Cudweed		1	2		2						
* Facelis retusa	Annual Trampweed			1								
* Gamochaeta spicata	Spike Cudweed	1		2								
* Hypochaeris radicata	Catsear, False Dandelion	2	3	1					X			
* Osteospermum ecklonis	Sailor-boy Daisy			1				X				
Ozothamnus diosmifolius	White Dogwood				2							
* Soliva sessilis	Bindi-eye, Jo-Jo	3	2	1								
* Sonchus oleraceus	Common Sow-thistle, Milk-thistle		2									
* Taraxacum officinale	Dandelion	4	4	4	1							
Bignoniaceae												
* Jacaranda mimosifolia	Jacaranda				3							
Brassicaceae												
* Brassica sp.	a Wild Mustard	2										

Botanical name	Common name	Transects					Spots				Rows	
		1	2	3	4	5	A	B	C	D	1	2
* Cardamine hirsuta	Common Bittercress	2	1			1						
* Coronopus didymus	Lesser Swinecress	1										
Caprifoliaceae												
* Lonicera japonica	Japanese Honeysuckle			2								
Caryophyllaceae												
* Cerastium glomeratum	Mouse-ear Chickweed	2	1	1		1						
* Paronychia brasiliana	Chilean Whitlow-wort	1	2									
* Polycarpon tetraphyllum	Four-leaf Allseed	2										
* Stellaria media	Chickweed	1		2	2	2						
Casuarinaceae												
# Casuarina cunninghamiana	River Oak, River She-oak										X	X
Chenopodiaceae												
Einadia trigonos	Fishweed	1										
Cistaceae												
* Cistus sp.									X			
Convolvulaceae												
Dichondra sp. A	Hairy Kidney Weed	3	3	3	1							
* Ipomoea indica	Blue Morning Glory				4							
Dilleniaceae												
Hibbertia aspera	Rough Guinea-flower				2							
Elaeocarpaceae												
Elaeocarpus reticulatus	Blueberry Ash	1			2							
Ericaceae Styphelioideae												
Leucopogon juniperinus	Long-flowered Beard-heath				1							
Euphorbiaceae												
* Euphorbia peplus	Petty Spurge, Radium Plant	4	2									
Fabaceae Caesalpinioideae												
* Senna pendula var. glabrata	Easter Cassia			2	2				X			
Fabaceae Faboideae												
* Genista monspessulana	Montpelier Broom				1							
Glycine clandestina	Twining Glycine				4			X				
Hardenbergia violacea	False Sarsaparilla				3			X				
* Lotus sp.	Birds-foot Trefoil			1								
* Medicago sp.	Medic			2								
* Genista monspessulana	Montpelier Broom				1							
* Trifolium repens	White Clover			3		2						
* Vicia sativa subsp. angustifolia	Narrow-leaved Vetch			1								
* Vicia tetrasperma	Slender Vetch	1			1							
Fabaceae Mimosoideae												
Acacia floribunda	White Sally Wattle			1								
Acacia linifolia	Flax-leaved Wattle				1							
Acacia longifolia	Sydney Golden Wattle				2							
Acacia parramattensis	Parramatta Green Wattle				1							
Acacia stricta	Hop Wattle								X			
Fumariaceae												
* Fumaria sp.	Fumitory		1									
Lamiaceae												
Ajuga australis	Native Bugle, Australian Bugle			1								
* Plectranthus amboinicus	Five Seasons Herb, Spanish Thyme								X			

Botanical name	Common name	Transects					Spots				Rows	
		1	2	3	4	5	A	B	C	D	1	2
Lauraceae												
* Cinnamomum camphora	Camphor-laurel			1	2							
Lobeliaceae												
Pratia purpurascens	Whiteroot				3							
Malaceae												
* Cotoneaster sp.							X					
Malvaceae												
* Modiola caroliniana	Red-flower Mallow	4	3	4		4						
* Sida rhombifolia	Paddy's Lucerne	1	3	1								
Meliaceae												
Melia azedarach	White Cedar, Persian Lilac		1									
Moraceae												
* Ficus benjamina	Weeping Fig		1									
# Ficus microcarpa var. hillii	Weeping Fig, Hill's Weeping Fig					1						
Myrtaceae												
Angophora costata	Sydney Red Gum, Smooth-barked Appl			2	4						X	X
Callistemon salignus	White Bottlebrush, Pink-tips	1										
Corymbia gummifera	Red Bloodwood				1				X			
# Corymbia maculata	Spotted Gum											X
Eucalyptus acmenoides	White Mahogany		1									
# Eucalyptus botryoides	Bangalay	1	1									
Eucalyptus globoidea	White Stringybark				1							
# Eucalyptus grandis	Flooded Gum			1		1					X	X
# Eucalyptus microcorys	Tallowwood		2		1	1						
Eucalyptus notabilis	Mountain Mahogany		1									
Eucalyptus pilularis	Blackbutt				2							
Eucalyptus piperita	Sydney Peppermint			1								
Eucalyptus punctata	Grey Gum	1				3		X				
Eucalyptus saligna	Sydney Blue Gum								X			
Eucalyptus tereticornis	Forest Red Gum	1									X	
* Metrosideros collina		1										
Syncarpia glomulifera	Turpentine			1		2				X	X	
# Syzygium paniculatum	Brush Cherry		1									
Nandinaceae												
* Nandina domestica	Sacred Bamboo				2							
Ochnaceae												
* Ochna serrulata	Mickey Mouse Plant			2								
Oleaceae												
* Ligustrum lucidum	Broad-leaved Privet, Glossy Pribet	1	3	1	3							
* Ligustrum sinense	Small-Leaved Privet, Chinese Privet			1	1							
* Olea europaea			1					X				
Oxalidaceae												
* Oxalis debilis	Pink Oxalis	4	4									
Oxalis sp.				1	2	3						
Pittosporaceae												
Bursaria spinosa	Australian Boxthorn				1							
Pittosporum undulatum	Pittosporum		1	1	4		X	X		X		
Plantaginaceae												
* Plantago lanceolata	Plantain, Ribwort	4	2	3		2						
* Veronica arvensis	Wall Speedwell		1	1		1						
Veronica plebeia	Creeping Speedwell	2										

Botanical name	Common name	Transects					Spots				Rows	
		1	2	3	4	5	A	B	C	D	1	2
Plumbaginaceae												
* Plumbago auriculata	Blue Plumbago								X			
Polygonaceae												
Persicaria decipiens	Slender Knotweed				2							
Rumex brownii	Slender Dock	2	1	1								
* Rumex conglomeratus	Clustered Dock				2							
Proteaceae												
# Grevillea (hybrid cultivar) 'Red Hooks'							X		X			
# Hakea salicifolia	Willow Hakea		2									
Rosaceae												
* Duchesnea indica	Indian Strawberry			1								
* Rosa sp. (unidentified)	Wild Rose							X				
Solanaceae												
* Lycopersicum esculentum	Tomato		1									
* Solanum nigrum	Blackberry Nightshade		1									
Theaceae												
* Camellia japonica cv. (unidentified)	Camellia						X					
Verbenaceae												
* Lantana camara	Lantana				1			X				
Violaceae												
Viola hederacea	Native Violet, Ivy-leaved Violet				1							
4. Monocotyledons												
Alliaceae												
* Agapanthus praecox subsp. orientalis	Agapanthus							X				
Anthericaceae												
* Chlorophytum comosum	Spider Plant		1	1					X			
Araceae												
* Monstera deliciosa	Fruit-salad Plant, Ceriman, Imbe								X			
Arecaceae												
* Phoenix canariensis	Canary Island Date					1			X			
Asparagaceae												
* Asparagus aethiopicus	Asparagus Fern			2	3			X	X	X	X	
* Asparagus plumosus	Climbing Asparagus Fern								X			
Asphodelaceae												
* Aloe maculata	Common Soap Aloe		1									
* Kniphofia sp. (unidentified)	Red-hot Poker								X			
Asteliaceae												
* Cordyline australis	New Zealand Cabbage Tree								X			
Bromeliaceae												
* Aechmea gamosepala	Matchstick Bromeliad								X			
* Billbergia pyramidalis	Red-flowered Billbergia								X			
Commelinaceae												
Commelina cyanea	Blue Spiderwort	1		1	1							
* Tradescantia fluminensis	Wandering Jew				2					X		
Cyperaceae												
Carex breviculmis					1							
* Cyperus eragrostis	Drain Flat-sedge, Umbrella Sedge			2								
Cyperus gracilis	Slender Sedge			2								

Botanical name	Common name	Transects					Spots				Rows	
		1	2	3	4	5	A	B	C	D	1	2
Cyperus mirus		3	4									
Iridaceae												
* Freesia alba x leichtlinii	Common White Freesia		1					X	X			
* Romulea rosea	Onion Grass		1									
Juncaceae												
* Juncus capillaceus		1	1									
Juncus usitatus	Common Rush								X			
Lomandraceae												
Lomandra filiformis subsp. filiformis	Wattle Mat-rush				3							
Lomandra hystrix	Spiny-head Mat-rush, Sagg				4			X	X			
Lomandra multiflora	Many-flowered Mat-rush				2			X				
Phormiaceae												
Dianella caerulea	Blue Flax-lily				4							
Dianella revoluta	Blue Flax-lily, Spreading Flax-lily				1							
Poaceae												
* Agrostis sp.	Bent Grass			1								
* Axonopus fissifolius	Narrow-leaved Carpet Grass			2								
* Bromus catharticus	Prairie Grass			3		1						
Cynodon dactylon	Couch, Bermuda Grass	4	3	1		4			X			
Echinopogon ovatus	Forest Hedgehog Grass				1							
* Ehrharta erecta	Panic Veld-grass	3	4	2	2	4		X	X	X	X	
Entolasia marginata	Bordered Panic				3				X			
Entolasia stricta	Wiry Panic				2							
* Eragrostis curvula	African Lovegrass			1								
Imperata cylindrica	Blady Grass				1							
* Lolium perenne	Perennial Ryegrass			1								
Microlaena stipoides	Weeping Grass, Meadow Rice-grass			2	1							
Oplismenus aemulus	Broad-leaved Basket Grass	1		1								
Oplismenus imbecillis	Narrow-leaved Basket Grass				1							
Panicum effusum	Hairy Panic			1								
Paspalidium sp.					1							
* Paspalum dilatatum	Paspalum	2			3				X			
* Paspalum urvillei	Vasey Grass				1							
* Pennisetum clandestinum	Kikuyu Grass	3	1	3	1	4		X				
* Poa annua	Winter Grass			2		4						
* Stenotaphrum secundatum	Buffalo Grass	3				1						
Themeda australis	Kangaroo Grass								X			
Typhaceae												
Typha domingensis	Narrow-leaf Cumbungi, Bulrush				3							

Table 2. Maximum height and number of individuals for species ≥ 2 m tall in the 10 x 10 m subquadrats.

Botanical name	**Subquadrat 1**		**Subquadrat 2**		**Subquadrat 3**		**Subquadrat 4**	
	Number	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Transect 1								
Callistemon salignus							1	7 m
Elaeocarpus reticulatus					1	11 m		
Eucalyptus botryoides			4	20 m				
Eucalyptus punctata	1	24 m						
Eucalytus tereticornis	1	25 m						
Metrosideros collina							1	5 m
Botanical name	**Subquadrat 1**		**Subquadrat 2**		**Subquadrat 3**		**Subquadrat 4**	
	Number	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Transect 2								
Eucalyptus acmenoides					2	25 m	1	15 m
Eucalyptus botryoides	1	22 m						
Eucalyptus microcorys	1	8 m	1	18 m				
Eucalyptus notabilis					1	24 m		
Ficus benjamina	1	6 m						
Hakea salicifolia					2	7 m	1	5 m
Syzygium paniculatum					1	5 m		
Botanical name	**Subquadrat 1**		**Subquadrat 2**		**Subquadrat 3**		**Subquadrat 4**	
	Number	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Transect 3								
Angophora costata					2	16 m	1	18 m
Cinnamomum camphora					1	8 m		
Eucalyptus grandis							1	16 m
Eucalyptus piperita					1	20 m		
Ligustrum lucidum					1	8 m		
Pittosporum undulatum					1	8m		

Botanical name	Subquadrat 1		Subquadrat 2		Subquadrat 3		Subquadrat 4	
	Number	Height	Number	Height	Number	Height	Number	Height
Transect 4								
Angophora costata	1	7 m	3	15 m	4	15 m	4	20 m
Cinnamomum camphora	3	9 m						
Corymbia gummifera					2	14 m		
Eucalyptus globoidea					1	15 m		
Eucalyptus microcorys			1	14 m				
Eucalyptus pilularis	1	15 m			1	12 m		
Botanical name	**Subquadrat 1**		**Subquadrat 2**		**Subquadrat 3**		**Subquadrat 4**	
	Number	**Height**	**Number**	**Height**	**Number**	**Height**	**Number**	**Height**
Transect 5								
Eucalyptus microcorys							2	12 m
Eucalyptus punctata	1	12 m	2	12 m	1	15 m		
Eucalyptus grandis					1	18 m		
Syncarpia glomulifera	1	10 m						
Ficus microcarpa var. hillii	1	16 m						

Table 3. Percent projected foliage cover

Sampling Location	Native canopy	Native subcanopy	Native Shrubs	Native Grasses /Graminoids	Native Herbs	Exotic plants	Leaf litter	Bare ground	Rock
T1	35%	0%	5%	50%	15%	60%	2%	1%	0%
T2	45%	0%	0%	40%	10%	60%	2%	2%	0%
T3	5%	0%	0%	2%	<1%	90%	2%	2%	<1%
T4	15%	0%	2%	5%	<1%	50%	40%	10%	0%
T5	10%	0%	0%	5%	<1%	80%	10%	10%	0%
Spot A	25%	0%	0%	3%	>1%	60%	20%	10%	0%
Spot B	0%	0%	0%	0%	0%	95%	1%	4%	0%
Spot C	70%	0%	2%	7%	0%	60%	30%	3%	0%
Spot D	80%	0%	5%	0%	0%	5%	100%	0%	0%
Row 1	20%	0%	0%	0%	0%	1%	100%	0%	0%
Row 2	15%	0%	0%	0%	0%	1%	100%	0%	0%

Table 4 - Species in 5 m x 5 m contiguous quadrats in Transect 4

Species	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**	**30-35**	**35-40**	**40-45**
	Mown				Trees		Creek	Trees	Mown
Precent projected foliage cover									
Native trees		0%		0%		40%		20%	
Native shrubs		0%		0%		2%		0%	
Native grasses		0%		<1%		<1%		<1%	
Native herbs		<1%		2%		<1%		<1%	
Exotic tree/shrub						30%		0%	
Exotic grasses		80%		50%		5%		1%	
Exotic herbs		2%		2%		5%		1%	
Moss		20%		35%		0%		0%	
Bare ground		2%		2%		20%		20%	
Trees/shrubs									
Native									
Acacia floribunda						X			
Angophora costata						X		X	
Eucalyptus grandis (planted)									X
Eucalyptus piperita						X			
Pittosporum undulatum						X			
Syncarpia glomulifera						X			
Exotic									
Cinnamomum camphora					X				
Ligustrum lucidum						X	X		
Ligustrum sinense						X			
Ochna serrulata					X				
Senna pendula var. glabrata					X				
Ground layer									
Native									
Ajuga australis	X								
Commelina cyanea						X			
Cotula australis						X			
Cynodon dactylon				X					
Cyperus gracilis							X		
Dichondra sp. A			X	X			X	X	X
Euchiton involucratus				X					
Microlaena stipoides				X		X			
Oplismenus aemulus								X	
Oxalis sp.								X	
Panicum effusum					X				
Pteridium esculentum						X			
Rumex brownii				X					
Selaginella uliginosa	X		X	X					
Exotic									
Agrostis sp.				X					
Asparagus aethiopicus				X	X				
Aster subulatus						X			
Axonopus fissifolius	X	X	X	X					

Bidens pilosa						X			
Bromus catharticus	X								X
Cerastium glomeratum	X	X							
Chlorophytum comosum							X		
Conyza sumatrensis						X			
Cyperus eragrostis						X	X		
Duchesnea indica								X	
Ehrharta erecta				X	X				
Eragrostis curvula					X				
Facelis retusa				X					
Gamochaeta spicata	X	X	X						
Hypochaeris radicata			X	X					X
Lolium perenne	X								
Lonicera japonica				X	X				
Lotus sp.			X						
Medicago sp.	X	X	X						
Modiola caroliniana	X	X					X		X
Osteospermum ecklonis					X	X			
Pennisetum clandestinum	X	X	X				X		X
Plantago lanceolata	X	X	X	X		X			
Poa annua	X	X	X	X					
Sida rhombifolia				X					
Soliva sessilis	X	X							
Stellaria media	X	X						X	
Taraxacum officinale	X	X	X	X		X			
Trifolium repens	X	X	X						
Veronica arvensis								X	
Vicia sativa subsp. *angustifolia*					X				

Appendices

Appendix 1.

Soil Report by Dr Pam Hazelton

MACQUARIE PARK

FIELD SITE

The site at 128 Herring Road, Macquarie Park was inspected on the 27 July 2010 and six soil pits were examined (Figure 1 Soil Pit location Map) to determine whether the soils were as those described in the Final Determination for Sydney Turpentine-Ironbark Forest an Endangered Ecological Community.

Methodology

To describe and examine the soil profiles at Sites 1, 3, 4, 5, 6, the five sites were excavated using a pick. Description of field properties such as colour and texture was undertaken using the international Munsell Colour Chart, Munsell (1975) and the Northcote Classification for field texture Northcote (1979).

RELEVANT REFERENCE MATERIAL FOR THE SITE

- Chapman G A and Murphy CL (1989) Soil Landscapes of the Sydney 1:100 000 sheet. Soil Conservation Service of New South Wales
- Herbert C (ed) (1983) Geology of Sydney 1:100 000 Sheet 9130, New South Wales, Department of Mineral Resources, Sydney
- Munsell Soil Colour Charts 1975 edition
- Northcote N H (1979) A Factual Key for the Recognition of Australian Soils CSIRO 4th edition Rellim Technical Publications Adelaide, South Australia.

REVIEW OF GEOTECHNICAL REPORT

All of the 8 boreholes described by Douglas and Partners on the 10 November 2009 show evidence of silt in the upper layers and evidence of ironstone bands and ironstone gravels overlying sandstone at depth.

SITE LOCATION AND SYDNEY 1: 100 000 SOIL LANDSCAPE MAP

Reviewing soil landscape mapping the site the site appears to be on the boundary of two soil landscapes ,Glenorie and Lucas Heights (Chapman and Murphy 1989). The underlying geology of Glenorie Soil Landscape is Wianamatta Group Ashfield shale and Bringelly Shale formations which weathers to a soil different from the soil in Lucas Heights Soil Landscape where the underlying geology is Mittagong Formation-interbedded shale, laminate and fine to medium grained quartz sandstone.

FIELD OBSERVATIONS

SITE 1 **03255362 6260849**

Depth in cm	Colour	Texture and comments
0-5	5YR3/4 dark reddish brown	silty clay loam
5-60	5YR 6/4 dull orange	sandy loam
60-100	5YR 6/8 orange with grey and red mottles	sandy clay loam to fine sandy clay loam - sticky (no stones)
100-160	5YR 5/8 bright reddish brown with grey mottles	light medium clay-sticky
160+	5YR 4/8 reddish brown some evidence of grey mottles	light sandy clay small rounded iron stones (pisoliths)

SITE 1

SITE 2

Photo 1 Mottled sandy clay loam to sandy clay at depth. Soil profile similar to Site 1

SITE 3 **0325447 6260848**

Depth in cm	Colour	Texture and comments
0-50+		Fill

SITE 3

SITE 4 **0325447 6260848**

Depth in cm	Colour	Texture and comments
0-5	5YR4/1 greyish brown	silt loam (topsoil)
5-15	5YR 4/3 dull reddish brown	silty clay
15-40	5YR 5/6 bright reddish brown	silty clay
40-50	5YR 6/8 orange with red mottles	sandy clay
50-65+	5YR 4/8 reddish brown some evidence of grey mottles	light clay to sandy with small rounded iron stones (pisoliths) and gravel

SITE 4

SITE 5 PRIOR TO EXCAVATION

SITE 5 **0325461 6260844**

Depth in cm	Colour	Texture and comments
0-90		fill-pieces of concrete
		Unable to accurately determine top soil depth
10-15	5YR 4/4 dull yellowish brown	silty clay
15-25+	5YR 5/6 bright reddish brown	silty clay with fine sand

SITE 5 SOIL PROFILE AFTER EXCAVATION

SITE 6 **0325484 6260816**

Depth in cm	Colour	Texture and comments
0-10	5YR4/4 dull reddish brown	silt clay loam (topsoil)
10-25	5YR 5/4 dull reddish brown	sandy clay
25-45	5YR 5/8 bright reddish brown	sandy clay
45-50	5YR 6/6 orange with red mottles	light medium clay
50+	5YR 6/8 orange	light medium clay - iron gravel

Conclusions

The soil described in the field by me and by Douglas and Partners are indicative of those which occur on areas transitional between the clay soil derived from Wianamatta Shale (reddish brown silty clay) and sandy soil derived from Hawkesbury Sandstone. The soils observed by me show evidence of the presence of ironstone bands, pisoliths and gravels of the Mittagong Formation (passage beds) (Herbert 1983). The soils of the Site consistent with the Lucas Heights soil lanscape. Mittagong Formation is interbedded shale, laminite and fine to medium-grained quartz sandstone. As such the soils satisfy the criteria listed in the Final determination for Shale Sandstone Transition Forest.

The soils on this site are not derived from Wianamatta Shale and do not satisfy the criteria listed for the Final determination for the endangered ecological community of Turpentine-Ironbark forest.

Dr Pam Hazelton BSc U Syd, PhD UNSW, Dip Ed UNE, CPSS stage 3

Appendix 2.

Photographic Record – Macquarie Park

Photographic Record – Macquarie Park

Transect 1

Transect 2

Transect 3

Transect 3 – Drainage pipe into creek

Transect 3 – Across creek

Transect 3 – Across creek

Transect 3 – Herbicide usage

Transect 3 – Herbicide usage

Transect 3 – Herbicide usage

Transect 4

Transect 4

Transect 4 – Soil

Transect 5

Spot A

Spot B

Spot C

Spot D

Spot D – Dumped rubble

Row 1 and 2 (Looking left to right) - Planted

Row 2 and 1 (Looking left to right) - Planted

Appendix 3.

Photographic Record – Remnant and Possible Remnant Trees

Photographic Record – Remnant and Possible Remnant Trees

Tree number 1 - close up

Tree number 1 – far out

Tree number 2 - close up

Tree number 2 – far out

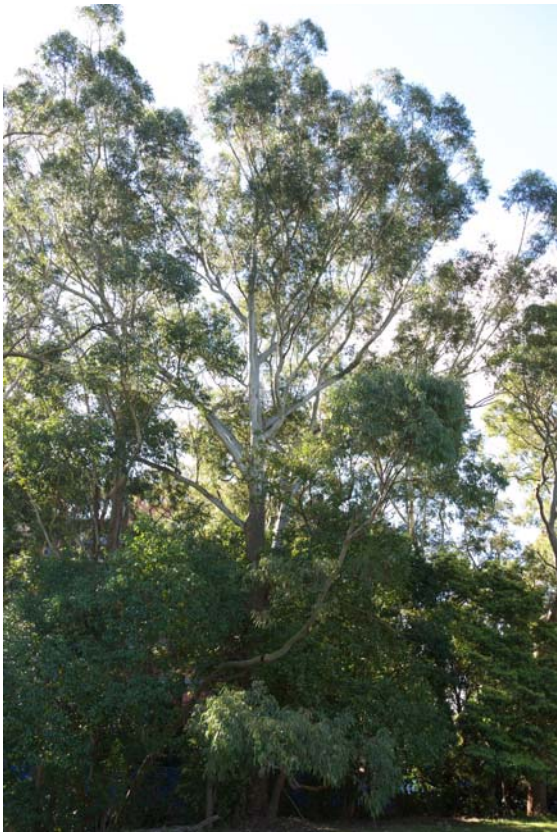
Tree number 3 - close up

Tree number 3 – far out

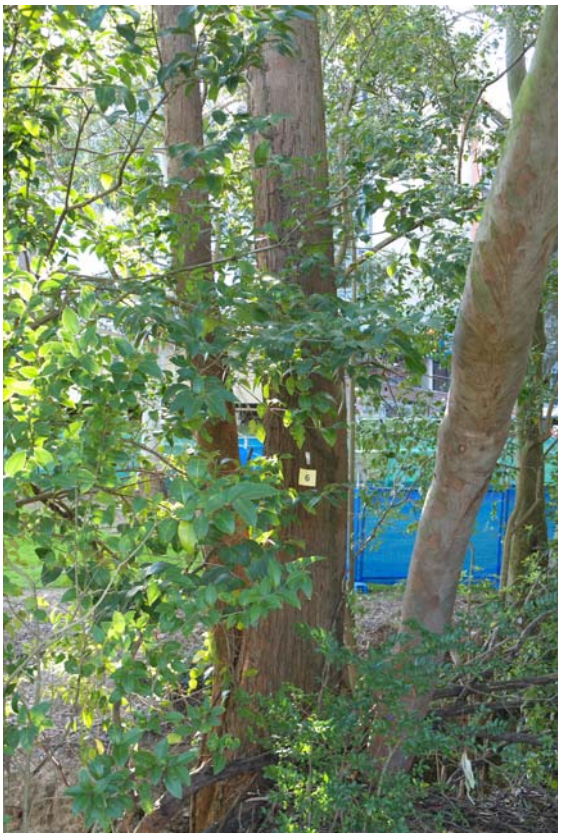
Tree number 4 - close up

Tree number 4 – far out

Tree number 5 - close up



Tree number 5 – far out

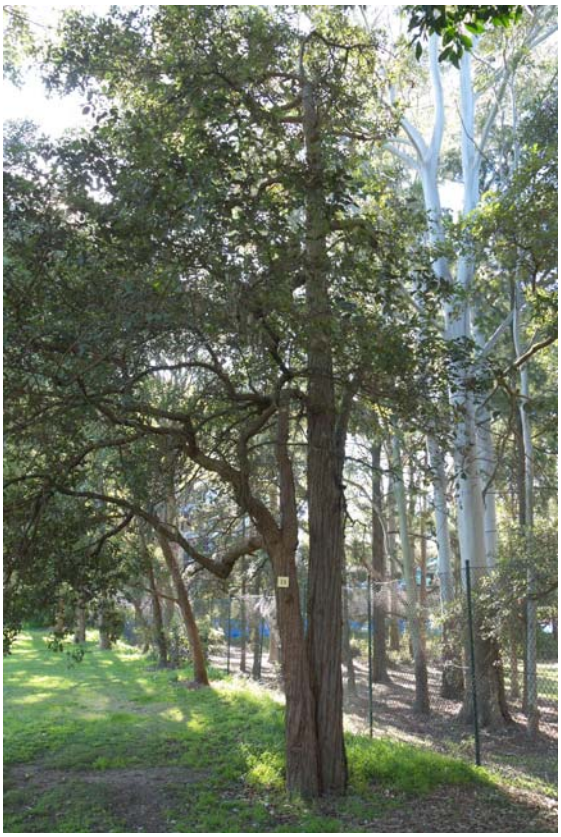


Tree number 6 - close up

Tree number 6 – far out

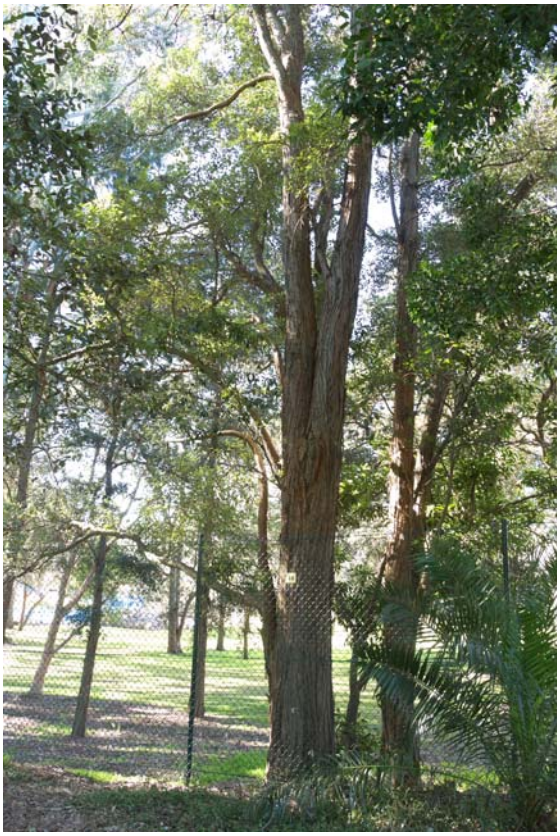
Tree number 11 - close up

Tree number 15 - close up



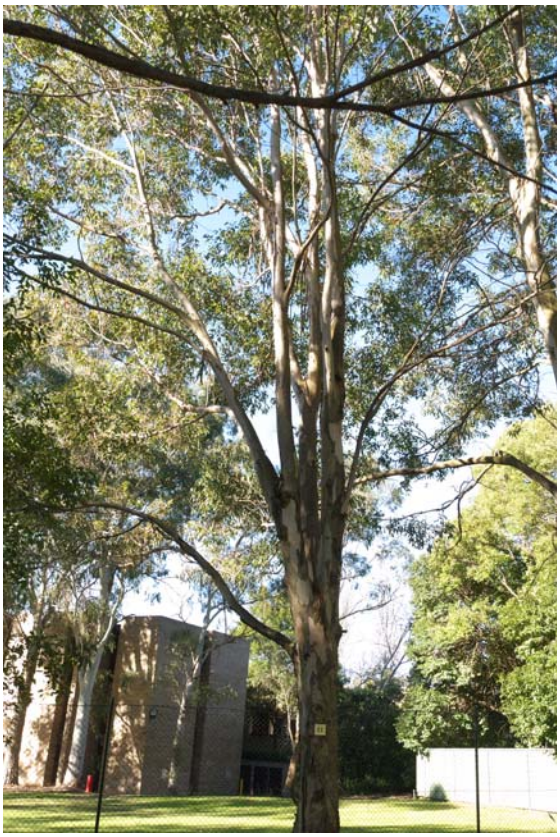
Tree number 15 – far out

Tree number 16 - close up



Tree number 16 – far out

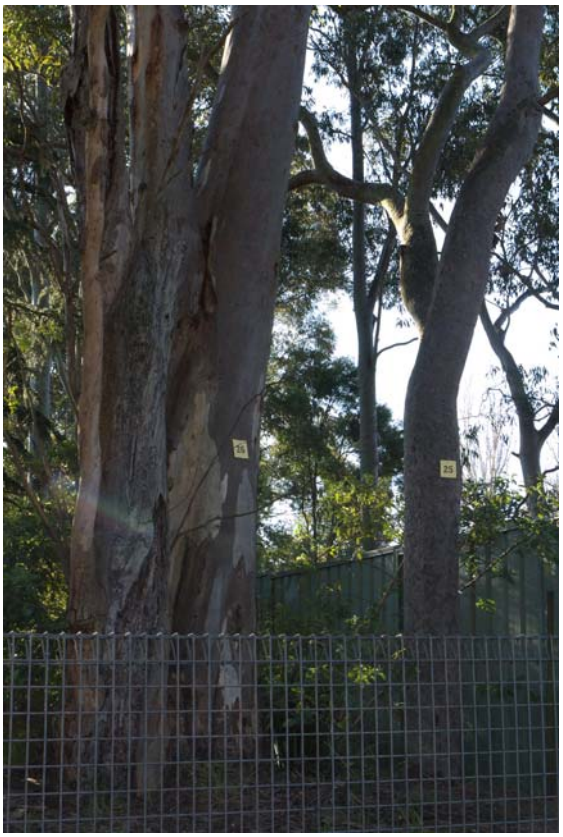
Tree number 21 - close up



Tree number 21 – far out

Tree number 22 and 23 - close up

Tree number 22 and 23 – far out



Tree number 25 and 26 - close up

Tree number 25 and 26 – far out

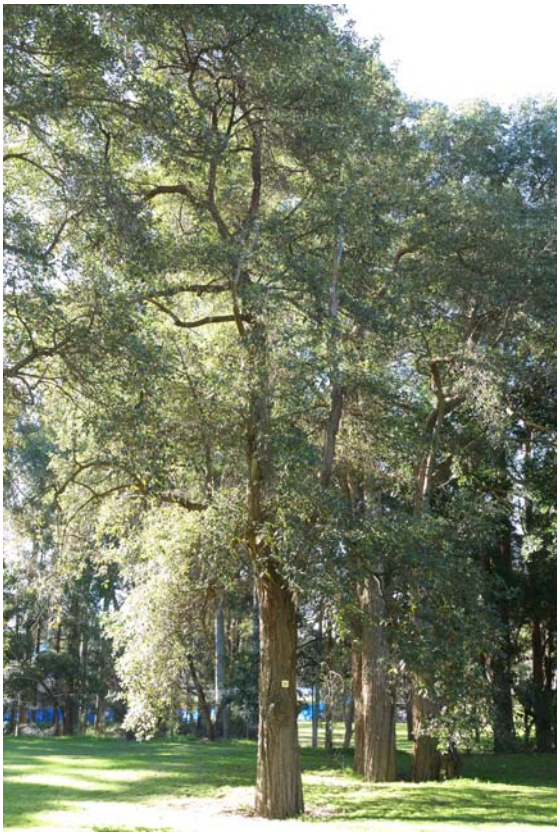
Tree number 28 - close up

Tree number 28 – far out

Tree number 35, 37 and 37 - close up

Tree number 35, 36 and 37 – far out

Tree number 38 – close up



Tree number 38 – far out

Tree number 39, 40 and 41 – close up

Tree number 39, 40 and 41 – far out

Tree number 47 - close up

Tree number 47 – far out

Tree number 53 - close up

Tree number 53 – far out

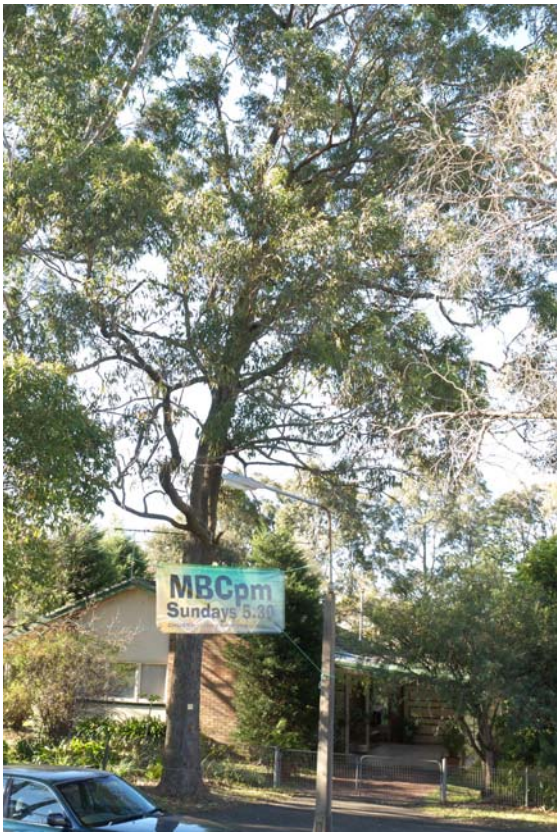
Tree number 58 and 59 - close up

Tree number 58 and 59– far out

Tree number 70 - close up

Tree number 70 – far out

Tree number 77 - close up



Tree number 77 – far out

Tree number 79 - close up

Tree number 79 – far out

Tree number 80 - close up

Tree number 80 – far out

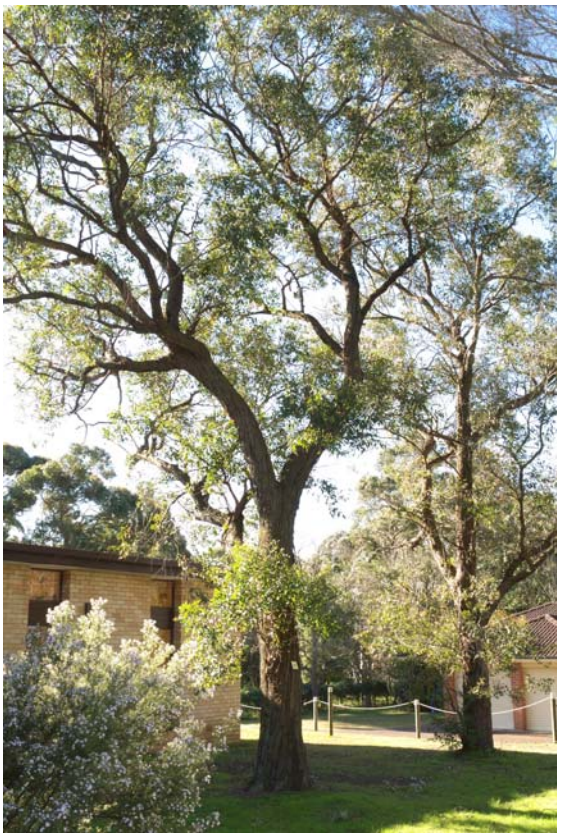
Tree number 81 - close up

Tree number 81 – far out

Tree number 82 - close up

Tree number 82 – far out

Tree number 83 - close up



Tree number 83 – far out