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Vegetation Management Plan:
Thomas Hogan Reserve, Francis Street, Bondi 2026

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Vegetation Management Plan (including Turf Management Plan)

1.0 Introduction

This Vegetation has been prepared for Waverley Council to assist in the long-term management of the approximately 1.3 ha Thomas Hogan Reserve, Francis Street, Bondi, near corner of Old South Head Road (Figures 1a to 1c).

The aim of the Vegetation Management Plan (VMP) for Thomas Hogan Reserve is to meet Council's required outcomes as follows:

1. *Develop a tree management plan for the Reserve:*
   - *Identify individual trees, assess condition and locate using GPS for insertion into MapInfo.*

2. *Develop a planting and weed management plan for the vegetated slopes that:*
   - *Outlines a staged approach to recreating a diverse native vegetation structure in the park*
   - *Contains and continually reduces weeds in the park*
   - *Maintains and enhances slope stability*
   - *Creates high quality habitat for a wide range of avian species.*

3. *Develop turf management plan for the central clearing that:*
   - *Provides recommendations for improving turf performance, including species selection and soil amelioration.*

To achieve the Council's required outcomes, the assessment of Thomas Hogan Reserve and nearby reserves was used to identify environmental constraints and opportunities (see details in Attachment A).

The VMP has been prepared with reference to the Department of Infrastructure, Planning and Natural Resources "Guideline for Preparation of Environmental Management Plans" (2004), and the "NSW National Parks and Wildlife Service - General Guidelines for Environmental Management Plans.

The VMP has:
- clear aims and objectives;
- realistic targets associated with each objective; and
- reporting and checking implementation of any corrective action requests issued.

Brief CVs and major projects are given in Appendix 1. The principal author has experience in rehabilitation of highly degraded sites utilising onsite equipment, as well as supervision of bush regeneration of more intact sites.

It should be noted in the VMP that the term "weed" refers to all exotic and non-local native species.

2.0 Thomas Hogan Reserve

Thomas Hogan Reserve is located in a gully and surrounded by residential buildings. The reserve is zoned RE1 Public Recreation and is surrounded by land zoned R3 Medium Density Residential with R4 High Density Residential to the south under the Waverley Local Environment Plan 2012 (LEP 2012) (maps available on Council's website www.waverley.nsw.gov.au, accessed 28 August 2015) (Figure 2a).

There are steep slopes to the north, south and west and an approximately 100 m wide (east to west) central flat area at the base of the slopes. This central flat area is not only overshadowed by the landform, but by the dense *Cinnamomum camphora* up to 20 m in height to the north and north-west. There is a community hall in the east of the flat area and playground equipment on lawn in the north close to Francis Street.

The Reserve is overlooked by surrounding residential buildings, mainly apartment blocks, including 1930s Art Deco buildings. From the 1943 historic aerial photograph (Figure 1d), the residential buildings were built prior to 1943, with some of buildings replaced by high-rise apartments in the past 20 years (Figure 1b-2). It was observed during the 2015 flora surveys, that the more recent development adjoining the steep slopes have generally included the construction of high retaining walls on the reserve boundary, often with loose rubble slopes. Some of the older buildings have gated access to the reserve.

Given that Thomas Hogan Reserve is now surrounded by development, increases in soil moisture levels, soil nutrient content and mesomorphic plant species, from that of the original low-nutrient sandy and sandstone-derived soils and associated vegetation, are expected (Clements 1983, Hazelton and Clements 2014).

2.1 Existing native biodiversity

Thomas Hogan Reserve is not mapped on the Biodiversity Map in the LEP 2012 (Figure 2b). The nearest area of mapped Biodiversity in Waverley Local Government Area (LGA) is 1.2 km to the south-east in Tamarama Park.

The Biodiversity objective for RE1 Public Recreation is:

> *to protect and enhance the natural environment for recreational purposes*.

The objective of Clause 5.9 Preservation of trees or vegetation in the LEP 2012 is:

> *to preserve the amenity of the area, including biodiversity values, through the preservation of trees and other vegetation.*

Biodiversity is discussed in section B3 of Development Control Plan 2012 as follows:

> *Waverley contains 5.9 hectares of remnant bushland, occurring as scattered pockets on cliff edges, in parklands, road reserves and within private property, providing habitat and food for native wildlife. Since European Settlement, Waverley has lost over 99% of its original vegetation. Due to their local significance, these remnants must be protected. These areas also contain the threatened plant species, Sunshine Wattle, and the threatened ecological community, Eastern Suburbs Banksia Scrub.*
>
> *Areas of introduced native and non-native vegetation have also been recognised as providing important habitat for native wildlife. Habitat corridors link areas of remnant vegetation with recognised habitat areas.*
>
> *Council acknowledges the intrinsic value of remnant vegetation or bushland, as well as the habitat and other environmental values of revegetated areas and the need to protect them from the degrading influences of surrounding development.*

Biodiversity is discussed in the Tree Management Policy as:

Maintaining biodiversity is one of the major aims of the Waverley Together 2 Strategic Plan. One way of achieving this is to create a linking network of green corridors within the Woollahra, Waverley, Randwick and Botany Local Government Areas. For example, Centennial Park, Moore Park and Queens Park are habitats that can be linked to remnant vegetation sites near the coast in neighbouring Randwick and Woollahra Councils.

With tree management, part of the selection criteria for existing and proposed trees involves assessing the contribution they make to local biodiversity and maintaining habitat corridors within and beyond the boundaries of the Waverley LGA. A range of tree species from shrubs to large trees will support a greater variety of native fauna, as will planting and preserving trees in parks and private properties to retain and enhance urban habitat. However, a holistic approach is required in open space planning to achieve effective habitat corridors through the use of layers of vegetation from trees to shrubs to groundcovers.

3.0 Identified issues

3.1 Previously identified issues and management plans

Waverley Council (not dated probably 1998) related to the activities of Waverley Council from 1995 to 1998 and their plans for Thomas Hogan Reserve (Figure 5a).

Waverley Council (2011) in the Plan of Management for Thomas Hogan Reserve identified:

- the lack of remnant vegetation;
- a high percent projected foliage cover by weeds;
- a series of informal walking tracks across the steep slopes adding to the risk of soil erosion;
- drainage into the gully from surrounding residential properties;
- many of the trees were over mature or in declining health; and
- dense tree canopy was limiting solar access.

The planned improvements are shown on Figure 5b.

Australian Museum Business Services (2011) in the Biodiversity Study for the Waverley LGA assessed the vegetation of Thomas Hogan Reserve as exotic dominated. The Reserve was identified as:

- part of a biodiversity corridor connecting to the larger green spaces of Bellevue Park and Cooper Park to the north-west;
- avifauna habitat; and
- part of a broader migratory bird path.

3.2 Identified issues in the 2015 assessment

The 2015 assessment identified the following:

Risk of soil erosion (see details of climate, geology soil landscape mappings, onsite soil survey, flora findings in Attachment A, with soil report by Dr Pamela Hazelton in Appendix 2):

- at time of survey (26 August 2015), there was white sand erosion down the sandy slopes to the central flat area, especially in the north-west and south, indicating

that a rainfall event of 62 mm (recorded on 24 August 2015) was sufficient to trigger erosion on these slopes;
- the geology and soil landscape mappings indicate that some of Thomas Hogan Reserve may be on an aeolian sand deposit overlying Hawkesbury Sandstone (Figures 3a, 3b);
- from onsite soil assessment (soil sampling sites shown on Figure 3c, Appendix 2), moderately steep slopes in the north and south had loose fine-grained sand, consistent with wind-blown aeolian sands as described in Newport Soil Landscape (Chapman and Murphy 1989). Aeolian sands are characteristic of the endangered ecological community *Eastern Suburbs Banksia Scrub*;
- the western slope is dominated by a cliff line of sandstone with sandstone "floaters" which have moved downslope. The soils on this slope have a clayey sand topsoil overlying a fine to coarse sand subsoil, consistent with weathered in-situ from underlying Hawkesbury Sandstone;
- in the soil samples, there was a low occurrence of fungal hyphae, indicating a lack of soil hyphae binding the sand grains. Fungal hyphae are commonly associated with low nutrient soils; and
- low occurrence of local native plant species adapted to low nutrient sandy soils.

Historic land uses from records held at the Waverley Library

The Reserve was part of a larger landholding with records dating back to 1839, with:
- landscape garden of Adolph Schneider. The records include Figs planted by Schneider in 1883 (likely to be *Ficus macrophylla* near the community hall);
- Glen-Roona tennis court onsite in the 1920s;
- construction of the surrounding Art Deco apartments in 1938; and
- stairs built and tubestock plantings in the south in 1983.

From previous vegetation studies
- **Benson and Howell (1990)** describe landforms and original vegetation of Waverley LGA as mainly a Hawkesbury Sandstone plateau cut in two by the low lying sand-filled valley between Bondi Beach and Rose Bay. The sands between Bondi and Rose Bay appear to have been naturally unstable, and conspicuous to ships at sea. The original vegetation of Thomas Hogan Reserve is on the mapped boundary of "Eastern Suburbs Banksia Scrub" and "Sandstone Heath, Woodlands and Forest" (Figures 4a, 4b). The observation of unstable sand is consistent with the onsite soil assessment.
- **Department of Environment and Conservation (DEC 2004)** mapped the current distribution of Eastern Suburbs Banksia Scrub. Thomas Hogan Reserve was not mapped as currently supporting Eastern Suburbs Banksia Scrub (Figure 4c).
- **NSW Office of Environment and Heritage (2013)** mapped the vegetation of the Reserve at a scale of 1:5,000 as mostly plantation (native/exotic), except for Coastal Sandstone Foreshore Forest in the north-west (Figures 4d-1, 4d-2).

From onsite 2015 flora survey

A total of 80 species (14 native, 13 non-local native, and 53 exotic) were recorded (details, photographs in Appendix 3a). The 14 local native species (18% of the 80 species recorded) generally had sparse cover (sampling locations on Figure 6, data in Table A1, A2 in Attachment A). There were three possible remnant trees of *Eucalyptus botryoides* recorded on the slopes with two individuals in the north and one individual in the east.

The central lawn was on sandy soil and overshadowed by the canopy trees, mainly *Cinnamomum camphora* up to 20 m in height. In the lawn there were bare sandy

patches. It appeared to have been recently sown with *Lolium perenne* (Perennial Rye Grass). There were scattered patches of the exotic grass *Ehrharta erecta* and of the native grass *Microlaena stipoides* (Weeping Grass).

Of the landscape plantings associated with the Waverley Council project for the stairway to Thomas Hogan Reserve (completion date May 1983), the only species recorded in the 2015 survey was *Eucalyptus botryoides*. From the locations of *Eucalyptus botryoides*, these trees are more likely remnant trees than derived from the 1983 plantings.

From the onsite 2015 tree survey
Russel Kingdom of Advanced Treescape Consulting (Kingdom 2016 in Appendix 4 of Attachment A) assessed the 303 tagged trees, stumps or groups of trees recorded in Thomas Hogan Reserve (Figure 7a, Table A3 in Attachment A). For each of the tagged numbered trees, the following were recorded:

- Visual Tree Assessment VTA
- Health vigour
- Structural condition
- Age
- Height
- Canopy spread
- Trunk diameter at 1.4m (Diameter at Breast Height, DBH)
- Trunk diameter at ground level (DGL)
- Radius of Tree Protection Zone (TPZ)
- Radius of Structural Root Zone (SRZ)
- Hazard rating
- Safe and Useful Life Expectancy (SULE)
- Recommendation for action
- General comments and observations

Tree species recorded
Of the 45 tree species recorded, five species are listed weeds under Waverley Council Weed Management Policy, with:

Two listed as Noxious Weeds for the Waverley LGA

Species	**Tree number**	**Number of individuals**
Celtis sinensis	176, 215, 227	3
Ligustrum lucidum	145, 266, 288	3
Total		**6**

Two listed as Urban Environmental Weed

Species	**Tree number**	**Number of individuals**
Celtis sinensis	176, 215, 227	3
Phoenix canariensis	75, 110, 130, 127, 141, 147, 183, 239, 275	9
Total		**12**

Two listed as Environmental Weeds

Species	**Tree number**	**Number of individuals**
Bamboo Clump	158	1 (clump of *50x*)
Cinnamomum camphora	6, 36, 37, 38, 40, 45, 47, 48, 50, 51, 52, 59, 60, 61, 63, 64, 65, 68, 70, 78, 80, 82, 83, 86, 88, 89, 90, 92, 93, 94, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 107, 112, 113, 114, 115, 116, 117, 118, 119, 123, 124, 128,	75

Species	Tree number	Number of individuals
	129, 131, 157, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 180, 171, 195, 199, 208, 212, 279, 285, 287	
Total		**76**

Of the five most frequently recorded tree species, two are listed under the Waverley Council Weed Management Policy (*Cinnamomum camphora* and *Phoenix canariensis*)

These five species account for 196 (63%) of the total 312 (63%) individual trees onsite (Figures 7b to 7f, Table A3). There is a pattern in the distribution of these trees that may assist in the future planning for the Reserve, with:

Number of individual trees	Tree species	Classified as	Located
75	*Cinnamomum camphora* (Camphor Laurel)	Environmental Weed	• mostly on the slopes in the north-west • straight line of 11 planting on the central flat area near the community hall and • scattered individuals on the slope in the south-east
60	*Archontophoenix cunninghamiana* (Bangalow Palm)	Non-local native palm	• recorded on the slopes in the south and south-west
39	*Lophostemon confertus* (Brush Box)		• mainly on the upper slopes in the north-west • three along the entrance walk from Francis Street • three north of the community hall • six on the slope in the south
13	*Brachychiton acerifolius* (Illawarra Flame Tree)	Non-local native	• scattered occurrence in the west and the centre
9	*Phoenix canariensis* (Canary Island Date Palm)	Urban Environmental Weed	• two on the flat lawn (one near the community hall and one at the base of the slope in the west) • younger individuals are mostly scattered on the slopes

Safe & Useful Life Expectancy (SULE)
SULE is a categorical method for the assessment of tree viability. The SULE categories indicate the safe and useful life expectancy of an individual tree and the necessity of remedial action or removal. During the assessment the qualified Arboriculturist (AQF 3) evaluates the location, age, condition, health, impacts on local trees and costs of maintenance for each specimen.

The categories and Subgroups of SULE are:

1 = Long SULE of >40 years						
A. Structurally Sound in suitable location	B. Suitable to retain with some remedial care	C. Significant status - requires special care to preserve				
2 = Medium SULE of 15 - 40 years						
A. Lifespan limit	B. Eventual removal for safety or nuisance	C. Remove for adjacent trees or replanting	D. Requires extensive remedial care			
3 = Short SULE of 5 - 15 years						
A. Lifespan limit	B. Eventual removal for safety or nuisance	C. Remove for adjacent trees or replanting	D. Requires extensive remedial care			
4 = Remove tree within 5 years						
A. Dead, dying or diseased	B. Unstable or exposed by new clearing	C. Structurally defective	D. Damaged and unsafe	E. Remove for adjacent trees or replanting	F. Damaging existing structures	G. Clearing will affect stability
5 = Trees suitable for transplant						
A. Less than 5 m high	B. Young trees over 5m high	C. Height/width contained by pruning				

Trees rated as SULE 1

16 individual trees were classed as SULE 1, indicating a sound tree, suitable for retention with SULE 1B requiring some remedial care. The majority of these trees were natives, namely:

Species	**Status**	**Tree number**		**Number of tree to total recorded**
		SULE 1	**SULE 1B**	
Angophora costata	Native	135		1 of 2
Araucaria bidwillii	Non-Local Native		291	1 of 1
Araucaria columnaris	Exotic	188		1 of 2
Archontophoenix cunninghamiana	Non-Local Native		39	1 of 60
Backhousia myrtifolia	Native	139		1 of 3
Cupaniopsis anacardioides	Native		10, 11	2 of 2
Elaeocarpus reticulatus	Native	140		1 of 1
Eucalyptus botryoides	Native	198		1 of 7
Ficus rubiginosa	Native	201	7, 225	3 of 3
Livistona chinensis	Exotic	137		1 of 7
Livistona chinensis var. *subglobosa*	Exotic	143, 144		2 of 2
Podocarpus elatus	Native		300	1 of 2
Total		**10**	**6**	**90**

Trees rated as SULE 4

26 trees (including 4 dead) were classed as SULE 4, indicating the need for removal. All of these were exotic or non-local natives, namely:

Species	Status	Tree number			SULE 4 of total recorded
		SULE 4	SULE 4A	SULE 4C	
Celtis sinensis	Noxious Weed, Urban Environmental Weed		215		1 of 3
Cinnamomum camphora	Environmental Weed	6, 128, 129, 131, 168, 195, 196, 208, 212	101, 115, 279, 283, 287	82, 102, 124	17 of 75
Dead stump	-		76, 77, 100		3 of 3
Erythrina X *sykesii*	Exotic	250		91	2 of 4
Ligustrum lucidum	Noxious Weed	145			1 of 3
Lophostemon confertus	Non-local native	179			1 of 39
Palm Stump	-		26		1 of 1
Total		**12**	**10**	**4**	**26 of 128**

Trees recommended for removal

A total of 67 trees (or clumps) have been identified for early stage removal (Figure 8a). These trees for earlier stage removal fall within three categories of priority. The priority for removal is based primarily upon the SULE classifications.

Priority 1, SULE 4 Dangerous	Tree
Cinnamomum camphora	279
Dead Stump	76, 77
Erythrina X *sykesii*	91, 250
Total	**5**
Priority 2 SULE 4	
Celtis sinensis	215
Cinnamomum camphora	6, 82, 101, 102, 115, 124, 128, 129, 131, 168, 195, 196, 208, 212, 285, 287
Dead Stump	100
Ligustrum lucidum	145
Lophostemon confertus	179
Palm Stump	26
Total	**21**
Priority 3, SULE 3	
Bamboo clump (50x)	158
Cinnamomum camphora	48, 51, 52, 60, 61, 63, 64, 68, 70, 83, 86, 90, 94, 96, 99, 116, 117, 118, 119, 157, 160, 161, 162, 163, 164, 165, 166, 167, 169, 170
Erythrina X sykesii	67, 79
Grevillea robusta	35, 136, 177, 260
Ligustrum lucidum	288
Lophostemon confertus	3, 185
Pinus radiata	8

Syzygium oleosum	122
Total	**41**
Total priority trees	**67**

Progressive stage removal is required of the listed weed trees (*Celtis sinensis, Cinnamomum camphora, Ligustrum lucidum, Phoenix canariensis,* and Bamboo Clump).

Trees for retention based on flora findings and arborist data
The trees to be retained include the palms (not *Archontophoenix cunninghamiana* nor seedlings of *Phoenix canariensis*) and the likely local remnant trees *Eucalyptus botryoides* and the *Ficus* spp (Figures 8b-N, 8b-S).

Eucalyptus botryoides was identified as a likely local native remnant tree species in the 2015 flora survey. Trees of *Eucalyptus botryoides* have been rated as SULE 1 to SULE 2B. SULE 1 (tree 198) indicates that the tree is sound, with an expected lifespan of over 40 years within a suitable location. SULE 2 (trees 186, 197, 203, 206) and SULE 2B (57, 62) indicates that these trees have a limited lifespan, potentially requiring eventual removal.

	Tree Number							
	SULE 1	**SULE 2**	**SULE 2B**	**Height (m)**	**DBH (mm)**	**DGL (mm)**	**Haz***	**Rec****
Eucalyptus botryoides	198	186,197, 203, 206	57, 62	15 - 29	220 - 500	300-850	3 - 5	Save (all)
*Hazard rating: 3 = low *hazard,* 12 = *dangerous*. ** Recommendation								

The six *Ficus* trees of likely heritage conservation have been rated as SULE 1 (tree 201), SULE 2 (82, 134), and SULE 2B (258). The trees in SULE 2, 2B are projected to have a limited life span (15 - 40 years) and may require remedial action given the recommendation for their retention.

	Tree Number								
	SULE 1	**SULE 1B**	**SULE 2**	**SULE 2B**	**Height (m)**	**DBH (mm)**	**DGL (mm)**	**Haz***	**Rec****
Ficus macrophylla			82, 134		4 - 20	140-3000	180-5000	3-5	Save
Ficus rubiginosa	201	7,225			12 - 24	120-2500	200-4000	3-4	Save
Ficus spp.				258	4	140	180	4	Save
*Hazard rating: 3 = low *hazard,* 12 = *dangerous*. ** Recommendation									

All of the palm species of likely heritage conservation have been rated as SULE 1 or SULE 2B.

	Tree Number							
	SULE 1	**SULE 2**	**SULE 2B**	**Height (m)**	**DBH (mm)**	**DGL (mm)**	**Haz***	**Rec****
Butia spp.			33	10	350	520	5	Save
Livistona chinensis	137	142, 146, 148, 152	24, 229	8 - 30	200 - 450	420 - 700	3 - 4	Save

	Tree Number							
	SULE 1	**SULE 2**	**SULE 2B**	**Height (m)**	**DBH (mm)**	**DGL (mm)**	**Haz***	**Rec****
Livistona chinensis var. subglobosa	143, 144			2 – 3.5	240 - 370	200	3	Save
Livistona spp.			30, 31, 85	8 - 25	160 - 360	220 - 500	3 - 4	Save
Phoenix reclinata		149		10	300	480	3	Save
Podocarpus elatus			23	15	200	280	3	Save
Palm species			238, 240	14 - 16	240 - 250	360 - 450	4	Save
*Hazard rating: 3 = low *hazard,* 12 = *dangerous*. ** Recommendation								

Tree 47, despite being *Cinnamomum camphora*, a listed Environment Weed, is not recommended for removal as it is used as (see Appendix 3 of Kingdom 2016 in Appendix 4):

Tree No 47 exercise tree for residents (rope on tree).

Conservation significance
Conservation significance of the vegetation was rated as low.

Heritage significance
The vegetation of likely heritage significance are:

- less common planted palms persisting on the sandstone slope on the slope in the west; and
- figs likely to be associated with 19th Century landscaping. The *Ficus macrophylla* (Morton Bay Fig) near the community hall may be part of the original Schneider landscaping.

Local parks in the eastern suburbs
In order to understand what plants might successfully grow in Thomas Hogan Reserve, the soils and vegetation of other local parks in the eastern suburbs (see details including landform, geology, soil, soil surface cover, erosion control implemented and vegetation species recorded (details in Attachment A with photographs in Appendix 3b of Attachment A) were inspected and brief surveys, as well as Shelly Beach Reserve in Manly Local Government Area (see details in Attachment A with photographs in Appendix 3c of Attachment A).

The eastern suburbs parks inspected were the following:

Parks/reserve	**Located from Thomas Hogan Reserve**	**Managed for biodiversity**
Dickson Park	Approximately 80 m south-east	No apparent bush regeneration
Thornton Park	Approximately 1 km to north-west	No apparent bush regeneration. Erosion control measures implemented on slopes
Cooper Park	Approximately 1.2 km to the west	Long-term bush regeneration
Bird Sanctuary,	Approximately 2.8 km to the	Bush regeneration of the 0.9

Centennial Parklands	south-west	ha patch of known ESBS set aside for conservation in 1953
York Road (part of the Centennial Parklands)	Approximately 2 km to the south -west	Bush regeneration of the approximately 1 ha remnant patch of ESBS containing vegetation that has regrown after a clearing in the 1930s
Jennifer Street, Little Bay (part of Botany Bay National Park)	Approximately 15 km to the south	Bush regeneration of the known example of ESBS on sand deposits over-mantling sandstone.

Shelly Beach Reserve in Manly faces many of the problems associated with Thomas Hogan Reserve, including intensive use of lawn areas, salt spray and highly erodible soils. These problems have been creatively addressed (see photographs in Appendix 3c of Attachment A), with planting of *Ficinia nodosa* in protected garden beds in the flat central sandy area, *Livistona australis* on the lawn at the base of the slope, *Cissus antarctica* on the lower slopes, and *Imperata cylindrica* and *Lomandra longifolia* along heavily-used upper tracks as well as extensive enhancement of the *Banksia integrifolia* dominated community on the upper slopes, and *Ficus rubiginosa* on the lower slopes.

4.0 Threats to slope stability and establishing a diverse native vegetation

4.1 Existing threats

The primary threats include:
- abundance of weed trees, mainly *Cinnamomum camphora*;
- extent of bare soil on the slopes (low percent projected foliage cover of exotic and native groundcover species recorded (see Table A1);
- low occurrence of local native species. Local native species of sand systems tend to have related soil fungal hyphae which binds the sand grains, reduces erosion and are required for nutrient cycling;
- fragmentation of vegetation on the slope by a series of informal tracks; and
- stormwater management for upslope surrounding properties.

4.2 Managing potential threats

Threats to the vegetation will be managed by actions to maintain and improve existing vegetation by:
- controlling weeds, especially weed trees;
- re-establishment of local native understorey (shrubs and groundlayer);
- stormwater management;
- increasing awareness of the value of the vegetation;
- formalising access on the slopes; and
- improving habitat for the fauna species, especially birds and bats.

Ongoing monitoring will be required to assess progress of the rehabilitation and to ensure that corrective actions are undertaken promptly as required.

5.0 Vegetation Management Plan

5.1 Aims of the Vegetation Management Plan

The aims of the Vegetation Management Plan (VMP) of the approximately 1.3 ha Thomas Hogan Reserve are to:

- to assist in Council's long-term management in providing public recreational spaces to meet the expectation of the community;
- conserve, enhance and re-establish a diverse native vegetation structure in the park;
- conserve and enhance the plantings of likely heritage significance; and
- establish a long-term, ecologically diverse native viable ecosystems, especially on the highly-erodible slopes which:
  - *Contains and continually reduces weeds in the park*
  - *Maintains and enhances slope stability*
  - *Creates high quality habitat for a wide range of avian species.*

The long-term aims of re-establishment of ecologically diverse native viable ecosystems, especially on the highly erodible slopes, will be achieved by amelioration of potential threats and the implementation of management objectives with realistic targets.

The factors adversely affecting the Reserve will be progressively addressed. On-going maintenance weeding is expected to be required. Weeds may continue to germinate from the soil seed bank and/or from bird seed drop, but are unlikely to thrive once native vegetation is re-established with nutrient cycling factors addressed.

Without addressing the adverse factors such as weeds and the weed dominant nutrient cycling, the existing slope instability and weed dominance is expected to continue.

5.2 Areas to which the Vegetation Management Plan applies

The Vegetation Management Plan (VMP) applies to the entire Reserve.

5.3 Management Objectives

The following management objectives have been set:

1. Protection of the steep slopes

2. Increasing the recreational value of the central area

3. Weed control

4. Enhancing the area of heritage landscape significance

5. Re-establishing the local native vegetation

6. Increasing awareness of the conservation value of the vegetation

7. Monitoring and maintenance

The satisfaction of each management objective will be contingent on meeting specific targets. The specific targets, activities, time frame, and responsibility associated with the objectives are given in Targets and Actions Table 1.

5.3.1 Management Objective 1 – Protection of the steep slopes

Initial works
On the perimeters
Given that most of the boundaries on the steep slopes of Thomas Hogan Reserve adjoin residential properties, inspection with adjoining neighbours is required to discuss existing access to the Reserve (details in Attachment A), any dumpings, and stormwater drains. The stormwater outlets contribute to microclimate and should be considered in planning of the restoration works. Consultation and inspections with the adjoining residents identifies the existing issues as well as increases the appreciation of the Reserve by the adjoining residents.

On the perimeter an at least 1 to 2 m strip of dense perimeter native planting, following weed tree removal close to boundaries is used to clearly define the boundaries of the Reserve, provide a buffer from the adjoining land uses, as well as establish a readily available living seed bank for direct seeding.

Removal of SULE 4 trees and weed trees close at neighbouring properties is a high priority so that any issues can be further identified and the perimeter plantings on these upper slopes can proceed as soon as practicable.

The steep slopes support canopy vegetation of mainly weed trees. These slopes are currently prone to sand downwash in times of rain (observed following 62 mm of rain). The downwash is due to both direct runoff and likely concentrated stormwater from the upslope residential properties. Re-establishment of local native vegetation is required to increase the slope stability.

Formalising the track on slopes
The location of the formalised track on the slope should be discussed with local Police to ensure that it is designed for community safety.

Determining the location of the track on the slopes to be formalised is required as the risk of erosion from the existing series of informal tracks on these steep slopes is high. Formalising these ad hoc paths to a well-designed and located single path, not only reduces erosion risk, but also provides community recreational amenity and access for on-going maintenance. The location of the formalised track is to be marked onsite using timber stakes. This will assist in determining placement of cut tree trunks and branches.

The removal of the SULE 4 rated trees is of highest priority, especially if the trees are in areas used by the community. The areas close to the location of SULE 4 trees should be fenced off to reduce risk of injury to pedestrians.

Erosion controls related to removal of SULE 4 and weed trees
To reduce erosion risk on the steep slope, the cut weed tree trunks, including *Cinnamomum camphora*, are to be placed along the contour on the slope on weed controlled soils. *Cinnamomum camphora* is a soft wood timber and likely to rapidly breakdown, especially the SULE 3 and SULE 4 rated individuals. The placement of cut timber branches and trunks along the contour reduces the risk of slope collapse during the tree removal and the establishment phase of planted pioneer native species.

Use of machinery on the steep slopes is to be avoided, where practicable. All machinery and loading equipment entering the Reserve is to be cleaned prior to entry.

Prior to removal of SULE 4 and weed trees

- sufficient suitable tubestock of local provenance pioneer species especially are to be ordered from a specialist nursery such as the Randwick City Council Community Nursery (see local species from 2016 Nursery Stock List in Appendix 5). The tubestock is to be planted in a 2-3 m wide strip upslope of the placed tree trunks on the slope in weed controlled soil;
- all site workers are to be inducted and made fully aware of the erosion risk on the slope;
- the groundcover weeds in an approximately 5 m wide strip along the contour in the area of the proposed trunk placement are to be treated with herbicide at least 2 weeks prior to the tree removal;
- immediately prior to tree removals, any weed re-growth in the proposed area where the tree trunk/s are to be placed should be spot sprayed; and
- immediately prior to tree removals, trees to be removed are to be checked by a qualified fauna expert to ensure that no native fauna are harmed. If native fauna are encountered, these are to be managed as specified by the fauna expert.

Post removal of SULE 4 and weed trees

- Spot spray any groundcover weed regrowth prior to tree cutting;
- Place the cut tree trunk and branches along the slope contour in the herbicide controlled strip;
- Densely plant an at least 1-2 m wide strip upslope of the placed cut tree trunk and branches with local native provenance tubestock (at 0.25 m centres);
- 4-6 weeks post tubestock planting, careful spot spray any weed regrowth;
- repeat weed control in the strip; and
- prepare next area for tree removals.

The outcomes on the slopes are series of planned 5 m wide strip along the contours of reduced erosion risk (with removal of priority and weed trees, re-establish local native vegetation and weed control). This stabilisation work results in an area of approximately 100 m^2 (assuming tree height of 20 m) for each tree removed.

With planned, progressive removal of the priority and weed trees, the slopes are stabilised by re-establish a diverse native vegetation structure, contains and continually reduces weeds in the park, and creates high quality habitat for a wide range of avian species.

Prior to removal of remaining weed trees

After the removal of trees with SULE rating 4 on the steep slope, removal of the weed trees is to follow in stages as:

- the area with sandstone outcrops in the west of the Reserve. This area has a risk of boulder movement, and lower risk of sand erosion due to higher clay content;
- this area supports palms of likely heritage significance; and
- extreme care must be exercised to minimise damage to the palms on the slope in the west and the likely remnant *Eucalyptus botryoides*.

The removal of weed trees is further discussed in Objective 3: Weed control.

The species suitable for this area are discussed in Objective 5: Re-establishing local native vegetation.

5.3.2 Objective 2 - Increasing the recreational value of the central area

Turf grasses require sunlight to achieve good cover in areas with pedestrian traffic. The best way of maintaining turf with pedestrian traffic are formalised paths in areas of high pedestrian traffic use and increasing the sunlight that reaches the grass areas.

On the central flat area, there are 11 *Cinnamomum camphora* (Trees 160-170) of which one (Tree 168) has a SULE rating of 4. Removal of these trees will require the trunks to be removed from the Reserve, where practicable. *Cinnamomum camphora* is desirable timber for wood turners.

The removal of these trees, inclusive of the SULE 4 tree, will:

- decrease the risk of tree/branch collapse in proximity to the community hall;
- increase sunlight to the grass area east of the 11 trees being removed;
- increase visual access to *Ficus macrophylla* (Tree 182), a tree of conservational and likely heritage significance that is close to the community hall; and
- increase the visual access of conservational and likely heritage significant *Ficus macrophylla* (Tree 182) close to community hall and *Ficus rubiginosa* (Tree 201) on the slope to the south of the community hall.

Additional planting, paths, and barbeques in the central area should to be considered, see example at Shelly Beach (photographs in Appendix 3c). Additional palm planting, especially of the local native species *Livistona australis*, should be considered at the base of the slope where there are existing problems of soil slip.

Turf grass choices

Cyndon dactylon (Common Couch) can tolerate some shade with reduced pedestrian traffic and less frequent mowing. *Cyndon dactylon* is a cosmopolitan species and its invasion in garden beds is generally more acceptable than exotic grasses such as *Pennisetum clandestinum* (Kikuyu).

The most shade tolerant turf grass is *Stenotaprum secundatum* (Buffalo Grass) and can cope with 50% shade with high wear at normal mowing heights, 60% shade with moderate wear, and 70% shade with low wear if it is mown at a height of 60 mm or more. This is about 3 to 4 hours of direct sun per day, or dappled sunlight from trees for a good proportion of the day.

As well as the problems of shading and pedestrian use, the observed sand erosion from the steep slopes results in burial of the grass areas at the base of the slope by sand downwash. Erosion control measures on slopes are addressed under Objective 1- Protection of the steep slopes.

5.3.3 Management Objective 3 – Weed control

The initial weed control is associated with removal of SULE 4 trees, followed by progressive removal of weed trees on the steep slopes (see Objective 1).

Associated with the removal of weedy trees, the weeds are removed in strips along the contours. Noxious and environmental weeds are to be continually suppressed and destroyed.

Weed management usually occurs in three stages with the specific weeds to be removed and techniques used determined by the bush regenerator supervisor onsite.

1. Primary weed control, involving initial weed removal works and resulting in the removal of the bulk of weed infestations;

2. Secondary weed control, involving follow-up removal of weed regrowth; and
3. Tertiary (maintenance) weed control.

Primary control of woody weeds
Removal of the woody weeds will most likely involve the application of undiluted glyphosate herbicide, using drill-or frill-and-inject, cut-and-paint, or scrape-and-paint methods.

- **Frilling** involves cutting through the tree's bark with a hammer and chisel, and drilling involves drilling into larger trees at intervals around the trunk, followed promptly in both methods by injecting herbicide into the active transport layer. Trees are left standing to die *in-situ*;
- **Cut-and-paint** method involves cutting the weed plant down as close to ground level as possible, followed by the manual application of dyed herbicide to the sapwood of the stump; and
- **Scrape-and-paint**, applicable to smaller diameter stems, specifically those that re-shoot if cut and painted, involves scraping off a vertical strip of the bark with a sharp implement followed by the application of dyed, undiluted herbicide onto the exposed sapwood.

These methods reduce the likelihood of slope erosion, as well as the need for the physical removal of the larger weeds, which makes the work faster and less physically demanding. These methods, however, require regular follow-up work, as treated weeds can sucker or basally sprout. Any flowering, fruiting or seeding bodies should be removed from plants treated using these methods. The use of undiluted herbicide should be undertaken carefully and no more than absolutely necessary. It is essential to use a glyphosate formulation such as *Roundup Biactive*® when working in the vicinity of water, to reduce the impact on wildlife, especially frogs.

Faunal habitats such as dense Lantana stands are to be considered with staged removal.

Secondary and maintenance control of woody weeds
Following initial treatment of woody weeds, there will be regrowth from the soil weed seed bank and bird seed drop. Small seedlings are to be removed by hand, where appropriate, and saplings or suckering plants scraped and painted with undiluted glyphosate herbicide. These actions will require regular implementation to exhaust the weed seed bank and prevent any new seedlings maturing and seeding.

It is important, following secondary weeding, that any new weed infestation is readily addressed as part of the on-going management.

Primary control of groundlayer weeds
In the barer areas with little native component, careful application of herbicides to new growth following tree removal and/or slashing may be required. Spraying new growth reduces ongoing herbicide use and maximises the success of the herbicide use. When used:

- prior to tree removals, areas dominated by exotic species are to be carefully sprayed with herbicide in strips along the contour and repeated careful herbicide application may be required;
- post-tree removals, re-shooting exotic species from root fragments or from seed in the soil is to be carefully spot sprayed with herbicide; and
- weed species are to be treated with herbicide until the native vegetation establishes from the planted tubestock or regeneration from soil seed bank.

Any herbicide application following planting is to occur during windless periods (0-5 km/hr) such as early mornings, using a nozzle set to large droplets to minimise risk of spray drift.

Secondary and Tertiary maintenance control of groundlayer weeds
Qualified bush regenerators will need to regularly weed the progressively treated slopes. This will involve hand pulling of smaller weeds and ongoing removal of flowering heads of annual and perennial weeds. This process should continue until planted natives are tall enough to shade out the bulk of weed regrowth. Ongoing careful spot spraying may be required.

It is important that weeds on immediately adjoining residential areas and roadsides are controlled and dense perimeter plantings established to minimise weed inputs from adjoining land.

Specific weed control actions required
Weed control management actions will vary, with abundance and environmental requirement of the weed species. The weeds (not including weed trees) recorded during the 2015 survey included:

Scattered occurrences:

Species	Common name
Acetosa sagittata	Rambling Dock, Turkey Rhubarb
Ageratina riparia	Mistflower
Anredera cordifolia	Madeira Vine, Lamb's Tail
Asparagus aethiopicus	Asparagus Fern
Asparagus plumosus	Climbing Asparagus Fern
Aspidistra elatior	Cast-Iron Plant, Aspidistra
Bidens pilosa	Cobbler's Pegs
Canna indica	Indian Shot
Chlorophytum comosum	Spider Plant
Conyza sumatrensis	Tall Fleabane
Hedera helix	Ivy, English Ivy
Hypochaeris radicata	False Dandelion
Mirabilis sp.	Four o'clock
Nephrolepis cordifolia	Fishbone Fern
Nerium oleander	Oleander
Ochna serrulata	Mickey Mouse Plant
Oxalis corniculata	Yellow Wood-sorrel
Oxalis debilis	Pink Oxalis
Pennisetum clandestinum	Kikuyu Grass, Kikuyu
Polycarpon tetraphyllum	Four-leaf Allseed
Sida rhombifolia	Paddy's Lucerne
Stellaria media	Chickweed
Taraxacum officinale	Dandelion
Veronica persica	Creeping Speedwell

More widespread or dense clump occurrences

Species	Common name
Ehrharta erecta	Panic Veld-grass
Ipomoea indica	Blue Morning Glory
Lantana camara	Lantana
Parietaria judaica	Wall Pellitory, Kirribilli Curse, Stickyweed

The listed key threatening processes involving weeds recorded onsite (http://www.environment.nsw.gov.au, accessed 30 November 2015) are as follows:

Invasion and establishment of exotic vines and scramblers
Invasion, establishment and spread of *Lantana camara*
Invasion of native plant communities by exotic perennial grasses
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

Waverley Council Weed Management Policy includes compliance with the Noxious Weeds Act 1993 as well as identifying Urban Environmental and Environmental Weeds(http://www.waverley.nsw.gov.au/__data/assets/pdf_file/0010/75817/Weed_Management_Policy_2012.pdf accessed 7 September 2015).

Urban Environmental Weeds	*considered by Council to be pest species in public open space.*
Environmental Weeds	*plants considered to negatively impact natural systems such as remnant bushland areas within the Waverley LGA. It is a plant species identified by Council as constantly causing public and private nuisance. Many environmental weeds that impact upon the sustainability of natural ecosystems have potential to be declared noxious weeds.*

Of the 53 exotic species recorded in Thomas Hogan Reserve:

- six are listed as Noxious Weed for Waverley LGA in Control Class 4 under the Noxious Weeds Act 1993, namely *Asparagus aethiopicus*, *Asparagus plumosus, Celtis sinensis*, *Lantana camara*, *Ligustrum lucidum, Ligustrum sinense* (http://weeds.dpi.nsw.gov.au/WeedDeclarations/Results?RegionId=117accessed 7 September 2015);
- two as Urban Environmental Weeds under Council Weed Management Policy, namely *Celtis* (genus), *Phoenix canariensis*; and
- ten as Environmental Weeds under Council Weed Management Policy, namely *Acetosa sagittata, Anredera cordifolia, Bambusa balcoona, Cinnamomum camphora, Ehrharta erecta, Ipomoea indica, Nephrolepis cordifolia, Ochna serrulata, Senna pendula, Tradescantia fluminensis*.

A approach used successfully in two highly degraded sites, Dalrymple Hay Nature Reserve in St Ives (DECC 2008) and Sheldon Forest in Pymble (McDonald *et al.* 2002) in Ku-ring-gai Local Government Area, is control burns and ongoing bush regeneration. This method may not be appropriate due to proximity to surrounding apartments.

Fire results in chemical, physical and temperature changes in the soil (Buchanan 1989). Fire is a traditional Aboriginal tool for managing vegetation, which was applied in mining restoration in the 1980-1990s (Grant *et al.* 1997A, B, C, Grant and Loneragan 1999, 2001, Smith *et al.* 2000) and more recently to bush regeneration in urban areas (McDonald *et al*. 2002, DECC 2008). Application of “smoke water” is also a useful restoration technique with the exposure of seeds to aerosol smoke or crude smoke extract stimulating the germination of a number of fire-dependent and fire-independent plant species (Roche *et al.* 1997, Flemetti *et al.* 2004). “Smoke water” has been used since the 1990s and is available as a dry granulated smoke-infused product.

If pile burns are not possible due to the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2010* (NSW), then smoke water can be used as a chemical stimulant in conjunction with primary weed control and rafted weed piles. The scratching/raking of the exposed soil by a population of Brush Turkeys would further stimulate the soil seed bank.

5.3.4 Management Objective 4 – Enhancing the areas of heritage landscape significance

The occurrence of the palms and figs are shown on Figure 8b. Not all of the palms (especially not *Archontophoenix cunninghamiana, Phoenix canariensis, Syagrus romanzoffiana*) are of likely heritage significance. Most of the palms of likely heritage significance are associated with the sandstone outcrops in the west of the Reserve. These include *Butia capitata* and *Livistona* spp. *Livistona australis* is the only likely local native palm.

The removal of weedy trees, careful weeding close to the base of the palms as well as complementary planting are required.

5.3.5 Management Objective 5 – Re-establishing the local native vegetation

Assisted natural regeneration is the preferred means for restoring native ecosystems wherever possible, but supplementary plantings are likely to be necessary in this highly degraded site for effective re-establishment of slope stability.

Unlike the dominant weedy tree species *Cinnamomum camphora*, the local native species adapted for aeolian sand deposits have mechanism for sand binding, especially facilitating soil fungal associations. The plant-soil-fungal association reduces erosion risk on low nutrient sandy soil and is important in nutrient cycling.

Local provenance plants are required. Randwick Council Community Nursery is a ready source of local provenance plants. By re-establishing local native species in Thomas Hogan Reserve, the Reserve becomes a living seed bank for seed dispersal onsite and for use in other restoration projects nearby.

Reducing the weed seed bank prior to planting and seeding
Following vegetation responses from herbicide control, weed clearing, and, if possible control burns, bare areas are likely to require planting and seed dispersal. The timing of the seeding and planting will depend on the extent of weed regrowth and time of year.

If there is low rainfall following weed clearing, then the cleared areas may require watering to encourage growth from the weed soil seed bank, followed by careful herbicide control.

If there is dense weed growth persisting after 2 or 3 herbicide treatments of weed seedlings, with no native plant germination, then scalping the soil surface and gently raking may be required to reduce the soil weed seed bank. The scalped 1-2 cm of weedy soil seed bank is to be either carefully removed from Thomas Hogan Reserve or placed in a black plastic covered stockpile.

The areas with sufficient controlled weed growth are to be direct-seeded and/or tubestock planted with local native provenance plants, depending on the extent of natural regeneration.

During secondary works, any areas that do not appear to be regenerating may require some supplementary planting and direct seeding.

From the Sheldon Forest experience (McDonald *et al*. 2002), the manual removal and control pile burns stimulated native regeneration with germinations especially *Acacia* spp*., Gonocarpus* sp., *Hibbertia* sp., *Leucopogon juniperinus* and *Ozothamnus diosmifolius.* The most common groundcovers regenerating and subsequently spreading after treatments were *Pseuderanthemum variabile, Dichondra repens, Oxalis sp. (native), Pratia purpurascens, Geranium homeanum, Lomandra longifolia, L. filiformis* and *Dianella* sp., and native grasses *Microlaena stipoides, Entolasia* spp., *Oplismenus* spp., and *twiners Glycine* sp., *Desmodium* sp., *Eustrephus latifolius, Clematis glycinoides, Hardenbergia violacea, Kennedia rubicunda* and *Pandorea spp*. For Thomas Hogan Reserve, the extent of natural regeneration is expected to be low.

Similar findings of native germinations were recorded at York Road, following the collapse of dense *Leptospermum laevigatum* from wind storm.

To delineate the perimeter of the Reserve, an approximately 1-2 m wide strip is to be densely planted with local native provenance tubestock. The perimeter plantings are to be undertaken as early as practicable in the rehabilitation program so that the perimeter plantings are establishing as soon as practicable.

The dense plantings of local native provenance species on the perimeter also provides an onsite seed source for the progressive rehabilitation works in the steep slopes.

Recommended species for planting on the slopes
Inclusion of some of the species suggested assumes that original vegetation of parts of Thomas Hogan Reserve would have had a sclerophyllous shrub layer, especially on the upper slope in the north-west. Typical Eastern Suburbs Banksia Scrub (ESBS) is likely have been widespread along the Bondi Junction–Bellevue Hill ridge top. The more likely original vegetation on the loose sandy soils of the slopes in the Reserve was a taller forest dominated by Bangalay (*E. botryoides)* with possibly even Blackbutt (*E. pilularis)* on the foot slopes, and such a forest often has a diversity of sclerophyllous plants in its understorey.

A mesophyllous understorey of a moist, sheltered forest is likely to have existed in the deeper parts of the gully, especially on the steeper east-facing slope (slope in the west on sandstone-derived soil). The species listed for slopes with sandstone outcrops are also appropriate for drainage lines on the aeolian sand slopes.

Species	**Slopes with sandstone outcrops**	**Aeolian sand slopes**	**Comment**
Canopy trees			
Alphitonia excelsa	X	X	Height can equal that of canopy eucalypts; a rainforest pioneer tree
Angophora costata	X	X	Common in most forest types near lower harbour, except rainforest
Angophora floribunda	X		Found at bases of slopes, where soil cations have been concentrated
Eucalyptus botryoides	X	X	In east of Sydney region this mostly favours slopes facing towards ocean

Species	Slopes with sandstone outcrops	Aeolian sand slopes	Comment
Eucalyptus pilularis	X	X	
Ficus rubiginosa	X		Self-seeding though only on rock outcrops and in tree forks, palm crowns etc
Subcanopy trees and taller shrubs			
Allocasuarina littoralis	X		
Backhousia myrtifolia	X		
Banksia integrifolia		X	Characteristic species of aeolian sands, even in littoral rainforest
Ceratopetalum apetalum	X		Only if shaded sandstone with water seepage available
Ceratopetalum gummiferum	X	X	
Clerodendrum tomentosum	X	X	
Cupaniopsis anacardioides		X	
Elaeocarpus reticulatus	X	X	
Ficus coronata	X		Mesophyll element, in sheltered gullies
Glochidion ferdinandi	X	X	Mesophyll element but gets onto exposed old dunes and sandstone near sea
Livistona australis	X	X	Mesophyll element
Melaleuca styphelioides	X	X	On sand only in swales
Myoporum acuminatum	X		Usually in habitats with saltwater influence
Myrsine variabilis	X		Mesophyll element but often found on sandstone outcrops
Notelaea longifolia	X	X	Mesophyll element
Pittosporum revolutum	X	X	
Synoum glandulosum	X	X	Mesophyll element
Xylomelum pyriforme	X	X	Sclerophyll element – some old remnant specimens still survive on perched sands at Bronte and above Redleaf Pool
Shrubs			
Acacia linifolia	X		
Acacia longifolia	X	X	
Acacia myrtifolia	X	X	
Acacia suaveolens	X	X	
Acacia terminalis subsp. *terminalis*	X	X	This subspecies localised to sites close to the lower harbour
Acacia ulicifolia	X	X	
Aotus ericoides	X	X	
Banksia ericifolia	X	X	
Bossiaea heterophylla	X	X	
Breynia oblongifolia	X	X	
Dillwynia retorta	X	X	

Species	Slopes with sandstone outcrops	Aeolian sand slopes	Comment
Dodonaea triquetra	X	X	Fast growing pioneer shrub
Epacris longiflora	X	X	Tends to be difficult to propagate
Epacris pulchella	X	X	Tends to be difficult to propagate
Eriostemon australasius	X		
Gompholobium latifolium	X	X	
Goodenia ovata	X	X	
Grevillea parviflora	X		
Grevillea sericea	X	X	
Hakea sericea	X		
Kunzea ambigua	X	X	
Leptospermum trinervium	X	X	
Olearia tomentosa	X		
Ozothamnus diosmifolius	X		
Persoonia levis	X		
Phebalium dentatum	X		
Platylobium formosum	X	X	
Podocarpus spinulosus	X	X	
Polyscias sambucifolia	X		
Climbers			
Billardiera scandens	X	X	
Cayratia clematidea	X	X	
Cissus antarctica	X	X	Vigorous liana, can smother shrubs and young trees
Cissus hypoglauca	X	X	Vigorous liana, can smother shrubs and young trees
Clematis glycinoides	X		
Eustrephus latifolius	X		
Geotonoplesium cymosum	X		
Hardenbergia violacea	X	X	
Kennedia rubicunda	X	X	
Maclura cochinchinensis	X	X	
Morinda jasminoides	X		Found in moist soils, shady habitats
Pandorea pandorana	X	X	
Sarcopetalum harveyanum	X	X	
Smilax glyciphylla	X	X	
Stephania japonica	X	X	
Grasses/graminoids			
Aristida vagans	X	X	
Austrostipa pubescens	X	X	
Caesia parviflora	X		
Carex brunnea	X		Sedge of shaded mesophyllous vegetation
Carex longebrachiata	X		Sedge of moist soils
Cyperus imbecillis	X	X	

Species	Slopes with sandstone outcrops	Aeolian sand slopes	Comment
Cyperus mirus	X	X	Delicate small sedge, profusely re-seeding
Dianella caerulea	X	X	Local provenance important for this variable species
Dianella revoluta	X	X	Local provenance important for this variable species
Dichelachne crinita		X	Most appropriate for open areas
Dichelachne micrantha	X	X	
Echinopogon ovatus	X		
Entolasia marginata	X	X	Mostly in moist forest habitats
Eragrostis brownii	X	X	Profusely re-seeding grass on open sandy areas
Gahnia clarkei	X	X	Requires high soil moisture
Gahnia melanocarpa	X		
Imperata cylindrica	X	X	Rapid spreader by deep rhizomes, may choke out other groundlayer plants
Laxmannia gracilis	X	X	
Lepidosperma elatius	X	X	
Lomandra longifolia	X	X	Local provenance important for this variable species
Lomandra multiflora	X		
Lomandra obliqua	X		
Microlaena stipoides	X	X	Can be used in lawns
Oplismenus aemulus	X	X	
Oplismenus imbecillis	X	X	
Poa affinis	X		Sheltered forest habitats on slopes
Rytidosperma longifolium	X	X	
Rytidosperma tenuius	X	X	
Themeda triandra	X	X	Local provenance important for this variable species
Xanthorrhoea arborea	X		
Xanthorrhoea macronema	X		
Ferns			
Adiantum aethiopicum	X		
Adiantum hispidulum	X	X	
Asplenium australasicum	X		Needs quite strong shade
Blechnum cartilagineum	X		Confined to moist drainage lines on hill slopes
Calochlaena dubia	X		
Cyathea australis	X		
Cyclosorus dentatus	X		Sheltered wet areas, on margins of streams or trickles
Davallia solida var. pyxidata	X		Only on sandstone outcrops
Dennstaedtia davallioides	X		
Doodia aspera	X	X	

Species	Slopes with sandstone outcrops	Aeolian sand slopes	Comment
Gleichenia dicarpa	X		On damp sandstone faces, maybe difficult of cultivation
Histiopteris incisa	X		Occurs in high-nutrient seepage at base of rock faces
Hypolepis muelleri	X	X	
Pteridium esculentum	X	X	
Other groundlayer			
Actinotus helianthi	X	X	Not in heavily shaded areas
Dichondra repens	X		
Geranium homeanum	X		
Gonocarpus teucrioides	X	X	
Goodenia heterophylla	X		
Hibbertia dentata	X	X	
Hibbertia linearis	X	X	
Platysace lanceolata	X	X	
Plectranthus parviflorus	X	X	Freely re-seeding
Pratia purpurascens	X		
Pseuderanthemum variabile	X	X	Shaded areas beneath canopy
Schelhammera undulata	X		
Veronica plebeia	X		
Viola banksii	X		Sheltered habitats with moist soil
Xanthosia pilosa	X	X	

Planting densities
Canopy tree planting is to be limited to areas with existing low tree densities.

Mid-storey and Shrub plantings, direct seeding and/or natural regeneration in the prepared soil are to be undertaken under existing remnant trees at a density of 1 per 2 m^2 under existing canopy trees, and 1 per 1 m^2 without existing canopy trees. The mid-storey and shrub plantings are to be made in clumps with separation between clumps.

Groundcover plants are to be extensively planted, depending on any natural regeneration and responses to direct seeding.

Planting time, hardening off and watering
In common with nearly all parts of the Sydney region, the Reserve does not receive regular, reliable rainfall. Plantings should be undertaken following rain during late February to June and early spring, when temperatures are milder and transpiration rates are lower. Plants are to be hardened off in the nursery prior to delivery. Hardening off is essential for tubestock to cope with field conditions.

Plantings will require an initial thorough watering in. It is not recommended to water extensively after the initial stages of plant establishment as it discourages deep root growth. In times of low rainfall, water may be required. Excessive watering will render the plants reliant on a constant source of water, possibly resulting in plant death once the constant water source is inevitably removed at the end of the maintenance

period. Watering also encourages weed growth and increases weed competition with the germinating and establishing local native species.

Additional brush matting and seed dispersal
Some of the seed will be progressively available from the planted tubestock, which can be collected for propagation and direct seeding. The seed bearing branches are to be collected and dispersed on the steep slopes.

Brush matting with seed-bearing branches of local native species will assist regeneration and help to provide cover on bare surfaces. Seed-bearing branches are to be cut from local native species and laid in open areas between the plantings. Later, during secondary work, further brush matting should be applied to any areas that do not appear to be regenerating.

Collected local native seed of primary colonising native species may also be dispersed between plantings in the larger open areas. The use of cut seed-bearing branches or seed dispersal is dependent on the time of seeding of the various species and also on the availability of seed and/or plants and advisability of removal of the seed bearing branches.

5.3.6 Management Objective 6 – Increasing awareness of the conservation value of the vegetation

Thomas Hogan Reserve is surrounded by residential properties. The aim is to increase awareness by the people using the Reserve of the conservation and heritage of the vegetation as well as its associated fauna habitat values.

The most appropriate actions required for increasing awareness are:

During the staged tree removal
- a poster and/or signage are to be designed and displayed in the Reserve as well as distributed to nearby households. These materials can be utilised as part of site induction and weekly tool box talks;
- discussions with adjoining residents to ensure that the perimeter planting meets their expectation;
- fencing off areas being used by the community close to identified SULE 4 trees may be required with additional signage explaining the safety risk;
- all site workers are to be inducted and made fully aware of the erosion risk on the steep slopes, including during toolbox talks;
- the trees to be removed are to be clearly identified and their removal supervised by a fauna consultant and council;
- all machinery is to be cleaned prior to entry to the Reserve. The machinery and loading equipment are to be inspected and photographed as required;
- sediment fencing is to be erected as required; and
- copies of the VMP are to be kept readily available and accessible. A copy lodged with Waverley Library is also recommended.

During staged phase(s)
- the conservation significance of the local flora and fauna are to be described on signs located along the formalised path and in the community hall;
- access on the slopes is to be restricted to a formalised path to minimise risk of weed and pathogen introductions;
- utilise paths in the central area to reduce pedestrian impacts on the turf;
- seating in the Reserve is to be located adjoining the formalised paths; and

- environmental Awareness Kits are to be provided to adjoining residents.

5.3.7 Management Objective 7 – Monitoring and maintenance

The aims of the Vegetation Management Plan (VMP) are to:
- conserve, enhance and re-establish the local native vegetation;
- conserve and enhance the likely heritage significant plantings;
- establish a long-term, ecologically viable ecosystems and native fauna habitats, especially on the highly-erodible slopes; and
- provide public access recreational spaces to meet the expectation of the community.

These aims are to be achieved by implementation of the actions contained under the objectives.

Specific targets for measuring how well the aims are being achieved throughout the monitoring period, and for determining when or if further actions are required, and timeframes for carrying out the tasks to be completed is required to be developed.

Specific short-term targets include:
- establish an at least 1 to 2 m wide perimeter planting adjoining the steep slopes;
- removal of all identified SULE 4 trees;
- reduce the erosion risk in the area of the removed SULE 4 trees; and
- reduce risk of tree collapse in the Reserve.

Progressive targets include:
- establish 1 to 2 m wide perimeter planting adjoining the less steep slopes;
- removal of the weedy trees;
- reduce the erosion risk by progressive re-establishment of the local native species which are adapted to low nutrient sandy soils;
- conservation and enhancement on the likely heritage plantings;
- increased sunlight in the central cleared area and improved grasses area.

The long-term targets include weed control, native plant species diversity, providing fauna habitat, slope stability, and well-designed and used community recreation space.

Scheduling - Monitoring, maintenance and reporting relate to the time periods of Months 6, 12, then yearly. Monitoring is to commence with the removal of SULE 4 trees. For each of the monitoring periods, the specific performance targets are related to the successes in previous monitoring periods. The targets are set to guide site management for the next monitoring period(s).

Monitoring Reports are to include:
- rainfall recorded at the nearest meteorological station;
- maps showing areas and time of weed removal and of planting and any direct seeding;
- Changes in the extent of weed versus native cover and diversity;
- details of works undertaken;
- photographs from a series of established fixed monitoring points (see Figure 9 and baseline photographs from Monitoring Point 1 in Appendix 6);

- Vegetation structure, species composition and percent projected foliage cover recorded in the fixed monitoring transects (Transect 1, 2, 3, baseline data in Tables A1, A2) as required;
- Any native fauna observed, including photographs if possible;
- Any issues that arise through the monitoring process are to be addressed and corrective actions implemented, and outcomes of implementation documented in the next monitoring report; and
- findings at each monitoring period are to discussed with the local community; and
- Monitoring report publicly available.

These reports are to be used to evaluate the success of the project over each monitoring period and to assess the long-term potential resilience of the ecosystems.

Research - The implementation of the VMP provides an opportunity for rigorous statistical testing of the differences in rates of establishment of native species (percent projected foliage cover), soil nutrient changes (pH, nitrogen and phosphorus), and species diversity for both the establishment period and during long-term monitoring, due to treatments such as:

- manual rafting weeds;
- manual weed rafting with control burns;
- clearing followed by addition of smoke water / other chemicals; and
- clearing followed by no addition of smoke water / other chemicals.

Discussions with the experienced Council's bushland team may assist in guiding the treatments to be statistically tested. The results should be provided to the Council bushland team and may be published in a peer-reviewed journal.

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Attachment A: Environmental assessment of Thomas Hogan Reserve and nearby reserves to identify vegetation constraints and opportunities

A1.0 Introduction

This report assesses the vegetation and soils of Thomas Hogan Reserve and nearby reserves. Thomas Hogan Reserve (Figures 1a, 1b-1, 1b-2, 1c) consists of:

Street Address	Lot and Deposited Plan	Approximate area (ha)
134-140 Francis Street, Bondi Beach	Lots 11, 12, 13 DP 14694 in the north	0.146 ha
	Lot 1 in the north-west and Lot 2 DP 119342 in the centre	0.872 ha
	Lot 8 (the stairway access) and Lot 10 DP 306797 in south	0.278 ha
	Total	**1.296 ha**

A2.0 Environmental Setting

Thomas Hogan Reserve is a public reserve located in a gully, and overlooked by the surrounding residential buildings, mainly apartment blocks.

It is described on Council website (http://www.waverley.nsw.gov.au/recreation/parks/parks_in_waverley/thomas_hogan_reserve, accessed September 2015) as

> *"A pleasant grassed area among residences, set in a gully, with shade trees and a small hireable hall.*

Facilities			
Main use	*Informal Recreation*	***Shade Trees***	*Yes*
Barbecues	*No*	***Shelter***	*Yes*
Play equipment	*Yes*	***Beach***	*No*
Public Toilets	*No*	***Pool***	*No*
Sport Lights	*No*	***Parking***	*Limited*
Goalposts	*No*	***Kiosk***	*No*
Views	*No*	***Maximum Party Size***	*100*

Prohibitions: alcohol, ball games, bicycles, skateboards, portable BBQs.

Thomas Hogan Reserve is bounded to the:

- north by Francis Street and further to the north by residential properties fronting Francis Street and Old South Head Road;
- south by Martins Avenue at the top of the stairway and by rear boundaries of residential buildings fronting Martins Avenue;
- west by rear boundaries of residential properties fronting Penkivil Street; and in

- east by rear boundaries of residential properties fronting Simpson Street.

The approximately 100 m wide (east to west) flat area of the park has an elevation of:
- 40 m AHD at the base of the slope in the north and west and in the center; and
- 39 m AHD adjoining the community hall in the east.

The elevation of the boundaries of Thomas Hogan Reserve (Location A to L, Figures 1c-1 to 1c-4) varies from 39 m AHD in the east to 60 m AHD in the southwest:
- along the northern boundary – 46 m AHD in the north-west (Location A) to 41 m AHD in the north-east (Location B);
- along the eastern boundary – 41 m AHD in the north-east (Location B) to 40 m AHD in the center (Location C), to 40 m AHD (behind the community hall, Location D), to 52 m AHD in the south-east (Location E);
- along the southern boundary – 60 m AHD in the south-west (Location F) to 52 m in the south-east (Location E);
- along the western boundary – 60 m AHD in the south-west (Location F) to 57 m AHD in the center (Location G), and 50 m AHD east of 57 m AHD in the centre (Location H) to 50 m AHD to the north-west (Location I), 50 m AHD to the west of Location I (Location J), 56 m AHD to the north of Location J (Location K), 51 m AHD to the south-east of Location K (Location L), and 46 m AHD in the north-west (Location A).

There are no mapped creeks on or near the Reserve. In the 19th Century, there may possibly have been a small natural waterfall in the drainage line flowing down from Penkivil Street (from the 1876 document held in Waverley Council Library).

A2.1 Climate

Climate affects the survival of vegetation. Times of heavy rainfall are likely to be times of increased potential erosion risk.

The nearest meteorological station with long-term rainfall records is Randwick (Randwick St) (Station Number 66052, open since 1917), located approximately 3 km to the south-west of Thomas Hogan Reserve.

From rainfall records (www.bom.gov.au, accessed 1 September 2015):
- Annual - mean is 1201 mm, annual records varying from 646.7 mm (1968) to 3145.9 mm (1975);
- Monthly - highest mean monthly is 135 mm (June) and lowest 66 mm (September) with highest monthly record being 265 mm and lowest monthly being 0 mm.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	100	112	131	119	119	135	96	88	66	76	83	76	1201
Lowest	4	3	6	2	5	1	1	0	1	5	3	3	34
Median	79	83	106	87	91	109	72	61	52	55	74	62	931
Highest	178	225	243	177	155	104	161	297	88	265	164	143	2200

Prior to the current survey on 26 August 2015, there was 75 mm recorded between 23 and 26 August 2015, with 62 mm recorded on 24 August 2015. The rainfall recorded in August 2015 (78 mm) was close to the monthly mean of 88 mm.

At time of survey, there was white sand erosion down the sandy slopes, especially in the north-west and south, indicating that a rainfall event of 62 mm was sufficient to trigger erosion on these slopes.

Hence, rainfall events are known to resultant in erosion, especially on the sandy slopes.

A2.2 Geology and Soil Landscape

The geology and soil landscape mappings indicate that some of Thomas Hogan Reserve may be on an aeolian sand deposit overlying Hawkesbury Sandstone.

The geology of the Reserve is mapped at 1:100 000 scale by Herbert and West (1983) as Hawkesbury Sandstone (map unit Rh) and on the boundary of Quaternary deposits (map unit Qhd), with Volcanic breccia (map unit Jv) occurring approximately 100 m to the east (Figure 3a).

The Soil Landscapes of the Reserve are mapped at a 1:100 000 scale by Chapman *et al.* (1989) as Hornsby (map unit ho) surrounded by Newport (map unit np) (Figure 3b). The Newport Soil Landscape is associated with Quaternary (Holocene age) sand deposits.

These two soil landscape map units are described by Chapman *et al.* (1989) as follows:

> **Hornsby**
> *Landscape – undulating to rolling low hills on Wianamatta Group shales. Local relief 50-80m, slopes 5-20%. Narrow ridges hillcrests and valleys. Extensively cleared tall open-forest (wet sclerophyll forests).*
> *Soils – shallow to moderately deep (<100cm) Red Podsolic soils…on crests. Moderately deep (70- 150cm) Red and Brown Podzolic soils… on upper slopes, deep (>200cm) 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.*
>
> **Newport**
> *Landscape - gently undulating plains rolling rises of Holocene sands mantling other soil materials or bedrock. Local relief <10m, slopes <10% on lower slopes and plateaux surface and up to 35% against obstacles, facing prevailing winds. Extensively cleared low, eucalypt open-woodland, scrub and open heathland.*
> *Soils - shallow (<50cm), well sorted Siliceous sands ... overlying moderately deep (<150cm) buried oils including Yellow Podzolic soils ... with sandy topsoil crests and gentle slopes; deep (>200cm) Podzols ... on steep slopes, lower slopes and in depressions.*
> *Limitations - very high soil erosion hazard, localised steep slopes, very low fertility, non-cohesive topsoils.*

A2.2.1 Site specific soil survey

At the time of the flora survey on 26 August 2015, soils were sampled at 10 m intervals along three 40 m long flora transects (soil sites 1 to 4, 6 to 9, 10 to 13), with soil site 5 on the flat (Figure 3c).

Soils were photographed (Appendix 2) and sampled from the profile to a depth of 30-40 cms, using either a 3 cm diameter stainless steel auger or a shovel. The sampled soils were assessed and soil properties described by Dr Pamela Hazelton (Appendix 2). It was found that:

Transect 1 (soil sites 1 to 4 at 10, 20, 30 and 40 m on the tape) was located along a moderately steep slope in the north. The texture of the topsoil and subsoil material was loose fine-grained sand. The topsoil colour is black from organic staining similar to Newport np *1* (aeolian material). The subsoil colour varies from brownish grey to yellowish brown similar to Newport np *2* (Chapman and Murphy 1989).

Transect 2 (soil sites 6 to 9 at 10, 20, 30 and 40 m on the tape) was dominated by a cliff line of sandstone with large sandstone "floaters" which have moved downslope. Site 5 at the base of the slope near Transect 2 and site 7 have a clayey sand topsoil overlying a fine to coarse sand subsoil. Sandy loam is the texture of both the topsoil and subsoil of site 6 (similar to the soil material of Lambert la 4) described in Lambert Soil Landscape with sandstone pieces at a depth >25 cm. Site 8 and site 9 have been disturbed. Lambert la *4* is described as blackish-brown loose sandy loam with sandstone and charcoal fragments (Chapman and Murphy 1989).

Transect 3 (soil sites 10 to 13 at 10, 20, 30, 40 m on the tape) was located along a moderately steep slope in the south. The soil texture of the topsoil and subsoil of sites 10,11 12 and 13 is sand similar to the soil material description of Newport np *1* (Chapman and Murphy 1989).

The soil sites 5, 8, 9, 12, 13 sampled were located on the flat area, with soil of site 5 being clayey sand derived from sandstone, soils of site 8, 9 being disturbed, and soil of sites 12, 13 being sand.

Dr Hazelton concluded that (Appendix 2):

> *The soil in Transects 1 and 3 was formed from wind-blown aeolian sands as described in Newport Soil Landscape (Chapman and Murphy 1989). Hawkesbury sandstone outcrops as a cliff-line at the western end of Thomas Hogan Reserve, with cascading rock ledges down the steeper area of the gully wall. The topsoil and subsoil in Transect 2 has a higher percentage of clay (sandy loam) compared with Transect 1 and 3 in which the topsoil and subsoil texture was predominately sand. The soil in Transect 2 has been weathered in-situ from the Hawkesbury sandstone.*

The soil in Transects 1 and 3 is consistent with that characteristic of the endangered ecological community *Eastern Suburbs Banksia Scrub* as described in the Final Determination, namely:

> *2. The Eastern Suburbs Banksia Scrub is the accepted name for the ecological community occurring on nutrient poor sand deposits in the Sydney Basin Bioregion.*
>
> *7. The Community has been reported from areas of sand deposits in the local government areas of Botany, Manly, Randwick, Waverley and Woollahra which are all within the Sydney Basin Bioregion. On North Head, within Manly local government area the ecological community occurs on a sand sheet of similar age and composition to that on which the ecological community occurs further south.*

Fungal hyphae were observed in the soils in soil samples 3, 10, 11, and 12 (vegetation sampling Transect 1 subquadrat 3, Transect 3 subquadrats 1, 2, 3).

A2.3 Historic land use

Comparing the current and the 1943 historic aerial photographs (Figures 1b-2, 1d), it was observed that:

- the surrounding road network and residential buildings had been constructed prior to 1943; and
- many of the older houses have been replaced by high-rise apartment blocks; and
- the canopy vegetation was less dense in the east and canopy vegetation was absent in the location of the current stairway access to Martins Avenue in 1943.

It was observed in the 2015 flora survey that the more recent development adjoining the steep slopes have generally included the construction of high retaining walls on the reserve boundary, often with loose rubble slopes.

From the historic records held at the Waverley Library, Thomas Hogan Reserve was part of a larger landholding with records dating back to 1839, with the first mention of a garden being that of the landscape gardener Adolph Schneider. The 19th century records include:

Year	Land use	Notes
1839	Land purchased by T. & M. Woolley Ironmongers.	
1876	4 ha of the land were sold to the renowned landscape gardener Adolph Schneider by the Dickson family.	The area became known as 'Schneider's garden'. Filled with exotic plants. Free flowing waterfall from Penkivil St, known to occasionally flood. (This water source may be the drainage easement on 15 Penkivil Street, Bondi).
1879-1880	Park was fenced.	No longer remains.
1882	Large parcel of the land around the reserve was subdivided and sold off.	Properties were built, fences installed, trees planted along back fences.
1883	*Ficus* planted by Schneider.	Includes the *Ficus* noted in Spot B, close the community hall.
1886	Alfred Lee and his wife Minnie bought the property then known as 'Glen Roona'.	Thomas Hogan Reserve once formed part of the lands associated with the property 'Glen Roona', the homestead of which was located on Francis Street.

In the 20th Century, up to 1935, Thomas Hogan Reserve remained part of a larger land holding, with:

Year	Land use	Notes
1915	'Schneider's Garden' formally made a park.	Bird sanctuary brought migratory birds. Mature trees.
1920s	Glen-Roona Tennis Courts active onsite.	Estimated to have been built in the early 1920's. Green grass courts lined by a grove of palms and sweet pea plants.
1935	Charles Baker buys property for redevelopment.	

With the construction of the surrounding Art Deco apartments in 1938, an open space in the gully was created, with:

Year	Land use	Notes
1938	Possible time frame for removal of tennis courts.	Tennis courts and cottage garden estimated to have been demolished.
1958	Glen-Roona Reserve formally renamed Thomas Hogan Park.	Thomas Hogan had been a Mayor for Waverley council as well as long serving councillor, and had lived close to the reserve.
1959	Waverly Council management.	Scout hall and seating provided.
1983	Stairway built on the southern slope adjoining Martins Avenue.	Tubestock were planted along either side of the new stairway; species list provided.
Undated 1998?	Plan of Management.	Repair of retaining wall, upkeep of stone steps. Plan for park maintenance including weeding and waste disposal.

A3.0 Vegetation

A3.1 Previous vegetation studies

Benson and Howell (1990) described landforms and original vegetation of Waverley LGA:

> *…mainly a Hawkesbury Sandstone plateau cut in two by the low lying sand-filled valley between Bondi Beach and Rose Bay.*
>
> *Behind the major beaches, particularly Bondi, were extensive deposits on unstable sand. Before the car parks and high rise, there would have been low dunes with sand colonizer species,* Spinifex hirsutus *and* Festuca littoralis *near the ocean, and the typical coastal sand dune zonations through* Hibbertia scandens *and* Correa alba *to* Leptospermum laevigatum *and* Banksia integrifolia*. There is no record of any hind-dunes rainforest associated with these beaches.*
>
> *The sands between Bondi and Rose Bay appear to have been naturally unstable, and conspicuous to ships at sea.*

The location of Thomas Hogan Reserve was mapped as being on the boundary of "Eastern Suburbs Banksia Scrub" and "Sandstone Heath, Woodlands and Forest", from among the vegetation types presumed to have existed in Waverley in 1788 and at time of first European settlement in the area (Figures 4a, 4b).

Department of Environment and Conservation (DEC 2004) mapped the current distribution of Eastern Suburbs Banksia Scrub. Thomas Hogan Reserve was not mapped as currently supporting Eastern Suburbs Banksia Scrub (Figure 4c).

NSW Office of Environment and Heritage (2013) is the Version 2 digital map of the Native Vegetation of the Sydney Metropolitan Area. Thomas Hogan Reserve is mapped at a scale of 1:5,000 (Figure 4d-1, 4d-2), as:

Vegetation map unit	Onsite
Plantation (native/exotic)	Majority of the Reserve, except the north-west
Coastal Sandstone Foreshore Forest	In north-west of the Reserve.

A3.2 Previous assessments

Waverley Council project for stairway to Thomas Hogan Reserve, off Martins Avenue, Bondi completion date May 1983 (available on Council website, accessed September 2015). It is stated that the stairway was constructed of:

> *sandstone and CCA treated Radiata Pine for retaining walls, treated pine and some hardwood for stairs and concrete paving stones for landings*.
>
> *The surrounding slopes were cleared of all weed material and unwanted vegetation, rubble etc., and minor regarding took place. The following plant species were selected for mass planting on the slopes, for stabilisation, for individual attractiveness, for variety and for bird attraction*, [namely]:

Species	Comments
Tree	
Acacia elata	Native in Sydney (but rare close to the coast) - Unlikely to naturally occur onsite
Eucalyptus botryoides	Native in Sydney
Eucalyptus nicholii	Native to the NSW Northern Tablelands; Vulnerable
Casuarina glauca	Native in Sydney - Unlikely to naturally occur on slopes
Melaleuca quinquenervia	Native in Sydney - Unlikely to naturally occur on slopes
Shrubs	
Acacia longifolia	Native in Sydney
Acacia floribunda	Native in Sydney
Albizia lophantha (now *Paraserianthes lophantha*)	Endemic to WA: widely naturalised but not common; chiefly on the coast south from Newcastle, also in some inland districts
Callistemon viminalis	Native from Moree to Grafton
Dodonaea viscosa	Native in Sydney - Unlikely to naturally occur in the Reserve
Grevillea 'Robyn Gordon'	Cultivar
Grevillea banksii	Native to QLD
Leptospermum laevigatum	Native in Sydney
Leptospermum petersonii	Native in QLD and NSW north from Port Macquarie
Melaleuca incana	Native to south-west WA
Russelia juncea (now *Russelia equisetiformis*)	Native to Mexico and Guatemala
Westringia fruticosa	Native in Sydney
Ground cover	
Cissus antarctica	Native in Sydney
*Grevillea '*Royal Mantle'	Cultivar
Hardenbergia violacea	Native in Sydney
Myoporum parvifolium	Native to far south-west of NSW, Vic and SA
Juniperus conferta	Native to Japan

Waverley Council (not dated, probably 1998) is the undated Thomas Hogan Reserve Draft Plan of Management (available on Council website, accessed September 2015). The Management Plan relates to the activities of Waverley Council from 1995 to 1998, and their plans for Thomas Hogan Reserve (Figure 5a).

The *Local Government Act 1993* requires the classification and management of public land. The local history of the park, detailed works done, and declared intentions for the use and maintenance of the park are presented. The Reserve was identified as being of local significance. The first documented proof of purchase is listed as being in 1839 by Mr. Michael Woolley.

The Council document covered policy, planning, implementation and performance, and supporting material. The implementation and performance program was designed to be updated annually.

Sections 3 and 4 listed the key characteristics of Thomas Hogan Reserve including topography, flora, zoning, adjoining landholders, and the built features along with problems with the Reserve to be addressed (e.g. bins and waste). Specific details of the flora were not provided.

Waverley Council (2011) in the Plan of Management for Thomas Hogan Reserve (available on Council website, accessed September 2015) identified three landscape sections (Figure 5b-1), namely:

1) *the central grass clearing, playground and community building*
2) *the access stairway down from Martins Ave and*
3) *the steep vegetated slopes.*

The planned improvements are shown on Figure 5b-2. The issues, opportunities and key objectives are summarised as follows:

Issues	Opportunities for improvement	Key objectives
Ecology		
▪ Lack of remnant vegetation ▪ Dense tree canopy ▪ Weed control ▪ Eroding slopes ▪ Drainage ▪ Exotic trees - Privet - Camphor laurels - Corals - Date palms ▪ Many trees are over-mature or in decline	▪ Need to develop the existing rainforest, as there is no remnant vegetation: - Rainforest planting plan - Weed management strategy; and - Community tree adoption scheme	"To maintain and improve the land, vegetation and habitat resources in such a way as to promote and facilitate its use to achieve the other core objectives."
Habitat		
▪ Lack of food for indigenous birds; i.e. shrubs ▪ Patrons feeding birds ▪ Feral cats	▪ Bird sanctuary - Planting plan - Pest management strategy - Connection to broader biodiversity corridor network ▪ Bird watching experience - Lookouts, bird bath, info panels	
▪ *Heritage*		
▪ Lack of heritage interpretation through signage or design elements	▪ Site furniture, materials, interactive displays and signage ▪ Could become part of broader Waverley heritage trail	"To celebrate the rich and diverse heritage of Thomas Hogan Reserve."
▪ *Cultural*		
▪ Community involvement	▪ Bushcare group, a Pocket Park scheme, or adoption by a school or business	"To encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities."
Recreation		

Issues	Opportunities for improvement	Key objectives
▪ No equal access from Martins Avenue ▪ Informal tracks along the steep slopes have lead to increasing erosion ▪ Lack of pedestrian lighting also limits safe night use of the reserve ▪ Dogs are not currently permitted in the reserve	▪ Investigation of paths across the slopes ▪ Green links signage at the reserve entrances ▪ Dogs on-leash and rubbish facilities provided ▪ Green gym: warm-up, gardening, cool-down	"To provide for passive recreational activities or pastimes and for the casual playing of games."
Amenity		
▪ Structural assessment: need to repair and replace some of the retaining walls in the reserve ▪ Garden beds require regular maintenance ▪ Garden bed edging needs replacing with a consistent material	*None listed*	"To provide quality facilities that meet needs of the community."

The proposed actions associated with the environment include the following:

	Action	Monitoring and reporting
Environmental		
E2	Identify trees that are in decline or damaged, assess for safety and plan for replacement	Yearly
E3	Develop a planting plan to increase the feeding habitat of birds	Yearly
E5	Develop a vision for a Bird Sanctuary	5 years
E6	Develop a long term rainforest planting plan	5 years
E7	Investigate developing a long term weed management programme	Yearly
E8	Investigate slope stabilisation through weed removal and replanting	5 years
E9	Maintain tree canopy to allow solar access to grass clearing and new plantings	Yearly
E12	Investigate the establishment of a Biodiversity Corridor	5 years
Heritage		
H2	Investigate the development of a pathway to the stone stair remnant	Yearly
Recreational		
R4	Investigate developing accessible paths across slopes	Yearly
Amenity		
A3	Develop an outcomes based maintenance schedule to maintain and assess the infrastructure and landscaping of the Reserve	Yearly

Australian Museum Business Services (2011) in the Biodiversity Study for the Waverley LGA (available on Council website, accessed September 2015) assessed the vegetation of Thomas Hogan Reserve in terms of fauna habitat. The vegetation was described as exotic dominated.

Thomas Hogan Reserve was identified as part of a biodiversity corridor connecting to the larger green spaces of Bellevue Hill and Cooper Park. It was also identified as avifauna habitat and part of a broader migratory bird path.

A3.2.2 Onsite flora survey

A total of 80 species (14 native, 13 non-local native, and 53 exotic) were recorded in three 40 m long and 10 m wide transects, and the three Spot locations A to C by Dr AnneMarie Clements, Tony Rodd and Jessica Gardner on 26 August 2015 (Figure 6, Table A1), with:

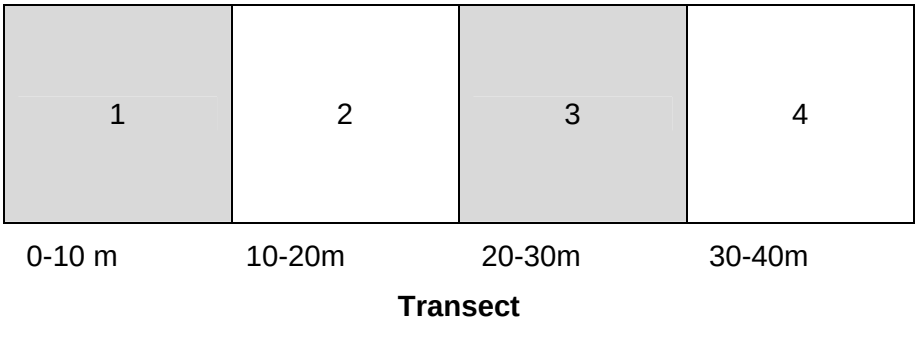
Sampling location	Total number of species recorded	Number of local native species recorded	Number of exotic species recorded	Number of non-local native species recorded	Percent native to total recorded
Transects					
1.	29	7	15	7	24%
2.	32	5	24	3	16%
3.	33	3	26	3	9%
Spot locations					
A.	23	4	16	3	17%
B.	9	1	7	1	11%
C.	17	3	8	6	18%

A3.2.2.1 Methods

Three 40 m long transects were located at right angles to the slope contours. The transects consisted of four contiguous 10 m x 10 m subquadrats, with:

- Transect 1, running north to south, with subquadrat 1 (0 m on the tape) at the top of the slope, starting from the south-east corner adjoining 142 Francis Street, and subquadrat 4 (40 m on the tape) near the base of the slope;
- Transect 2, running west to east, with subquadrat 1 (0 m on the tape) starting at the base of the sandstone outcrop below rear boundary of 6-8 Penkivil Street, and subquadrat 4 (40m) ending on the flat area in the centre of the reserve; and
- Transect 3, running south-east to north-west, with subquadrat 1 (0 m on the tape) starting at the north-east corner of 9 Martins Avenue; and subquadrat 4 (40 m on the tape) ending well into the central flat area.

The layout of the subquadrats was as follows:



The percent projected foliage cover was estimated in each of the 10 m x 10 m subquadrats (Table A1). The numbers and maximum heights of all species at least 2 m tall were recorded in each of the 10 m x 10 m subquadrats (Table A2).

Supplementary data from the three Spot locations A to C consisted of species recorded in an approximately 10 m radius (Table A1), as well as heights and numbers of species at least 2 m tall (Table A2).

The sampling locations were photographed at the time of survey, together with additional photographs of the Reserve (Appendix 3a). GPS coordinates of each sampling location were recorded using a hand-held Garmin *GPSmap 60CSx* at the time of survey. The GPS coordinates in conjunction with ground features were used to plot the sampling locations (Figure 6).

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 (www.plantnet.rbgsyd.nsw.gov.au) incorporating Flora Online is the major source for updated taxonomy.

A3.2.2.2 Findings

The 14 local native species (18% of the 80 species recorded) generally had sparse cover. There were three possible remnant trees of *Eucalyptus botryoides* recorded on the slopes with two individuals in the north (Spot location C, Figure 6) and one individual in the east (Spot location A, Figure 6).

The following table lists the local native species recorded together with their percent projected foliage covers in the three transects and presence only in the three spot locations.

		Transect			Spot location		
Species	**Common name**	**1**	**2**	**3**	**A**	**B**	**C**
Trees							
Eucalyptus botryoides	Bangalay				X		X
Ficus rubiginosa	Port Jackson Fig	<1					
Subcanopy trees							
Cupaniopsis anacardioides	Tuckeroo	<1					
Glochidion ferdinandi	Cheese Tree	<1					X
Homalanthus populifolius	Bleeding heart	<1					
Pittosporum undulatum	Pittosporum	<1	3	3			X
Shrubs							
Breynia oblongifolia	Coffee Bush				X		
Ferns							
Adiantum aethiopicum	Common Maidenhair Fern		<1				
Asplenium australasicum	Birds-nest Fern	<1	<1				
Pteris tremula	Tender Brake	<1					
Monocot herbs							
Cyperus mirus			<1				
Microlaena stipoides	Weeping Grass			10	X	X	
Oplismenus aemulus	Australian Basket Grass	<1	1		X		
Dicot herbs							
Oxalis exilis	Creeping Oxalis			<1			

Transect 1 was on erodible aeolian deposited sand. Very little local native component was recorded, with projected foliage cover of <1% or 1% recorded in the subquadrats:
Native canopy trees: *Ficus rubiginosa* 1% cover in subquadrat 1.
Native subcanopy trees: *Cupaniopsis anacardioides, Glochidion ferdinandi, Homalanthus populifolius*.
Native shrubs: none.
Native groundlayer: *Asplenium australasicum, Oplismenus aemulus, Pteris tremula*.

Of the non-local native species recorded:
Canopy tree species: *Lophostemon confertus* (50% cover).
Subcanopy tree: *Brachychiton acerifolius* (1%, 3% cover), and *Syzygium oleosum* (10% cover).
Shrub: none.
Groundlayer: the fern *Nephrolepis cordifolia* (3, 1, 3% cover).

Of the exotic species recorded:
Canopy tree: *Cinnamomum camphora* (20–40% cover) up to 20 m in height.
Subcanopy: *Phoenix reclinata* (3%, 5% cover).
Of the other exotic species with more than 5% projected foliage cover, all were in the groundlayer, *Tradescantia fluminensis* (15–90% cover), *Ehrharta erecta* (2–0% cover).

In terms of palms (family Arecaceae), four were recorded with projected foliage covers of <1– to 5% in the subquadrats, namely:

		Subquadrat			
Species	**Common name**	**1**	**2**	**3**	**4**
# *Archontophoenix cunninghamiana*	Bangalow Palm	<1	2	1	5
* *Phoenix canariensis*	Canary Island Date	1			
* *Phoenix reclinata*	African Wild Date		5	3	
* *Syagrus romanzoffiana*	Cocos Palm		3		

Note: # = non-local native, * = exotic

Transect 2 on steep sandstone-derived soils and sandstone cliff outcrop, there was a persistence of palms, with four species recorded with relatively high projected foliage cover (up to 50% cover in one subquadrat), namely:

		Subquadrat			
Species	**Common name**	**1**	**2**	**3**	**4**
# *Archontophoenix cunninghamiana*	Bangalow Palm		50	40	
* *Butia capitata*	Butia Palm, Jelly				5
* *Phoenix canariensis*	Canary Island Date	20			
* *Syagrus romanzoffiana*	Cocos Palm, Queen				5

Note: # = non-local native, * = exotic

Of the native species recorded:
Native canopy trees: none.
Native subcanopy trees: *Pittosporum undulatum* (3% cover in subquadrat)
Native shrub: none.
Native groundlayer: *Adiantum aethiopicum* (<1% cover), *Asplenium australasicum* (<1% cover), *Cyperus mirus* (<1% cover), *Oplismenus aemulus* (1, 3% cover).

Of the non-local native species recorded:
Canopy trees: none.
Subcanopy trees: *Archontophoenix cunninghamiana* (40, 50% cover), *Brachychiton acerifolius* (<1% cover).
Shrubs: none.
Groundlayer: *Lomandra longifolia* (<1% cover).

Of the exotic species recorded with >5% projected foliage cover in at least one subquadrat:
Canopy trees: *Cinnamomum camphora* (5, 30% cover).
Subcanopy trees: *Butia capitata* (5% cover), *Brachychiton acerifolius* (<1% cover) *Ligustrum lucidum* (3, 15% cover), *Phoenix canariensis* (20% cover), *Syagrus romanzoffiana* (5% cover).
Shrub: *Lantana camara* (80% cover).
Groundlayer: *Ehrharta erecta* (1, 5, 2% cover), *Lolium perenne* (80% cover in the lawn on the flat), *Setaria palmifolia* (2–15% cover), *Tradescantia fluminensis* (3–20% cover).

Transect 3 on an erodible aeolian deposited sand slope, the native species recorded:
Native canopy trees: none.
Native subcanopy trees: *Glochidion ferdinandi* (1% cover in subquadrat), *Pittosporum undulatum* (10% cover).
Native shrub: none.
Native groundlayer: *Microlaena stipoides* (10% cover on the flat), *Oxalis exilis* (<1% cover on the flat).

Of non-local native species recorded:
Canopy trees: *Lophostemon confertus* (50% cover in subquadrat).
Subcanopy trees: *Brachychiton acerifolius* (1% cover), *Callistemon salignus* (3% cover).
Shrub: none.
Groundlayer: none.

Of the exotic species recorded with >5% projected foliage cover in at least one subquadrat:
Canopy trees: *Celtis sinensis* (1, 5, 1% cover in the subquadrats), *Cinnamomum camphora* (10, 25, 20% cover).
Subcanopy trees: *Bambusa balcooa* (5, 40% cover), *Phoenix canariensis* (1 to 15% cover).
Groundlayer: *Clivia miniata* (20, 2, 5% cover), *Tradescantia fluminensis* (2–70% cover).

In terms of palms (family Arecaceae), two species were recorded with projected foliage covers of 1 to 15% in the subquadrats, namely:

		Subquadrat			
Species	**Common name**	**1**	**2**	**3**	**4**
* *Phoenix canariensis*	Canary Island Date	10	15	1	3
* *Phoenix reclinata*	African Wild Date	2			1

Note: * = exotic

Fungal hyphae were observed in the soils in soil samples 3, 10, 11, and 12 (vegetation sampling Transect 1 subquadrat 3, Transect 3 subquadrats 1, 2, 3). The

only species common to all of these locations was the exotic species *Tradescantia fluminensis*.

A3.2.3 Recording of landscape species planted at time of the stairway works

Of landscape species plantings in 1983, the only species recorded in current 2015 survey was *Eucalyptus botryoides* at Spot locations A, C. From the locations of *Eucalyptus botryoides*, these trees are more likely remnant trees than derived from the 1983 plantings.

A3.2.4 Existing lawn in the central area

The central lawn was on sandy soil and overshadow by the canopy trees, mainly *Cinnamomum camphora* up to 20 m in height.

In the lawn there were bare sandy patches. It appeared to have been recently sown with *Lolium perenne* (Perennial Rye Grass). There were scattered patches of the exotic grass *Ehrharta erecta* and of the native grass *Microlaena stipoides* (Weeping Grass).

A3.2.5 Access to the Reserve from surrounding residential blocks

Some of the residential properties abutting the Reserve have gated access to the Reserve. Some of the properties appear to have informal access to the Reserve.

Residential properties adjoining the south-east boundary have unfenced rear access to the slope in the south-east of the Reserve. Residents of 9 Martins Avenue access the Reserve directly through a platform adjoining the eastern side of the staircase from Martins Avenue. There are also gates built into the eastern boundary fence of the Reserve close to the community hall.

Throughout the Reserve, there are a series of informal walking tracks on the slopes. Large sandstone blocks present on both the north-western slope (see Appendix 3a, photograph of Transect 1, subquadrat 3) and the western slope appear to be evidence of previous more formal pathways. These pathways have not been maintained over time.

A4.0 Conservation Significance

Originally, parts of the area of aeolian sands in Thomas Hogan Reserve are likely to have supported the now listed endangered ecological community, *Eastern Suburbs Banksia Scrub* (ESBS). None of the 14 native species recorded in the 2015 survey are characteristic of this community. *Eucalyptus botryoides* is not a listed ESBS species, but does occur naturally on coastal sands. Currently the conservation significance of the vegetation of the Reserve is low.

A5.0 Heritage significance

There is a variety of planted and naturalised palms including 60 individuals of *Archontophoenix cunninghamiana* (Bangalow Palm) recorded by the arborist*, 9 Livistona chinensis,* 9 *Phoenix canariensis as well as Arenga engleri, Butia capitata, Phoenix reclinata, Sabal* sp., *Syagrus romanzoffiana* and *Washingtonia robusta*.

The most common of the palms recorded in the Reserve, *Archontophoenix cunninghamiana,* occurs naturally in the broader Sydney region, but there is a major

gap in its natural distribution between Gosford to the north of Sydney and Otford to the south. However, it has been popular for a long time as a cultivated palm and reseeds itself freely with subsequent colonisation of sheltered suburban habitats, particular where soils are moist and with elevated nutrient levels from urban runoff. This appears to have been the case on the steep western and south-western slopes of Thomas Hogan Reserve, where Bangalows are very abundant. But this palm is not to be regarded as a local native. Bangalows are not likely to be of heritage significance as part of the 19th landscaping or the 1930s plantings associated with the Art Deco buildings.

The only palm likely to have been part of the Reserve's original vegetation is the *Livistona australis* (Cabbage Tree Palm). The presence of *Livistona australis* would be of conservation significance.

The less abundant palm species have been planted and persist on the sandstone slope in the west and on the sandstone downwash of the central lawn area, but not as common on the aeolian sand slopes. These palms are likely to be of heritage significance.

The *Ficus macrophylla* (Morton Bay Fig) near the community hall may be part of the original Schneider landscaping.

A6.0 Noxious Weeds Act 1993 and Council Weed Management Policy

Waverley Council Weed Management Policy includes compliance with the Noxious Weeds Act 1993 as well as identifying Urban Environmental and Environmental Weeds (http://www.waverley.nsw.gov.au/__data/assets/pdf_file/0010/75817/Weed_Management_Policy_2012.pdf accessed 7 September 2015).

Urban Environmental Weeds	*considered by Council to be pest species in public open space.*
Environmental Weeds	*plants considered to negatively impact natural systems such as remnant bushland areas within the Waverley LGA. It is a plant species identified by Council as constantly causing public and private nuisance. Many environmental weeds that impact upon the sustainability of natural ecosystems have potential to be declared noxious weeds.*

Of the 53 exotic species recorded in Thomas Hogan Reserve:

- six are listed as Noxious Weed for Waverley LGA in Control Class 4 under the Noxious Weeds Act 1993, namely *Asparagus aethiopicus*, *Asparagus plumosus, Celtis sinensis*, *Lantana camara*, *Ligustrum lucidum, Ligustrum sinense* (http://weeds.dpi.nsw.gov.au/WeedDeclarations/Results?RegionId=117accessed 7 September 2015);
- two as Urban Environmental Weeds under Council Weed Management Policy, namely *Celtis* (genus), *Phoenix canariensis*; and
- ten as Environmental Weeds under Council Weed Management Policy, namely *Acetosa sagittata, Anredera cordifolia, Bambusa balcoona, Cinnamomum camphora, Ehrharta erecta, Ipomoea indica, Nephrolepis cordifolia, Ochna serrulata, Senna pendula, Tradescantia fluminensis*.

A7.0 Vegetation in other parks

A7.1 Local parks in the eastern suburbs

In order to understand what plants might successfully grow in Thomas Hogan Reserve, the soils and vegetation of other local parks were inspected on 24 September 2015 by Dr Pamela Hazelton (soil scientist), Dr AnneMarie Clements, Tony Rodd and Jessica Gardner (see photographs in Appendix 3b).

The soil of *Eastern Suburbs Banksia Scrub* is described in the NSW Scientific Committee's final determination as "sand deposits". Aeolian sand deposits are mapped and recorded on part of Thomas Hogan Reserve. Aeolian sand deposits also occur nearby including in local parks.

Dickson Park is located 80 m south-east of Thomas Hogan Reserve, geology mapped on Hawkesbury Sandstone (Herbert and West 1983) and with a mapped patch of Coastal Headland Banksia Heath (OEH 2013).

It was observed that:
Landform: north facing slope.
Geology: sandstone based on sandstone outcropping in the park and from a building excavation of the adjoining land south of the park.
Soil: From examining the soils, there were sandstone fragments in the soil profile.
Soil surface: litter cover and scattered clumps of the exotic grass *Ehrharta erecta* without moss occurrence, and minor occurrence of the native grass *Microlaena stipoides* and the exotic herb *Sida rhombifolia*.
Vegetation: planted *Ficus microcarpa*, *Eucalyptus microcorys*, and less frequent planting of *Angophora costata*, *Callistemon salignus*, *Eucalyptus robusta*, *Hakea salicifolia* as well as self-seeded *Phoenix canariensis*.

There was no area of Coastal Headland Banksia Heath observed onsite. The park appears to have no remnant native vegetation.

Thornton Park is located approximately 1 km to north-west of the Thomas Hogan Reserve, geology mapped as Quaternary Holocene sand deposits (Herbert and West 1983) and vegetation mapped as 'Urban Exotic/Native' (OEH 2013).

It was observed that:
Landform: steep north-facing sandy slope.
Soils: loose aeolian sand.
Soil surface: erosion control matted prior to planting. There was no obvious ongoing erosion issues, despite the sandy soil and steep slope.
Vegetation: successfully planted with *Lomandra longifolia* and *Doryanthes excelsa*, as well as the rainforest trees *Harpullia pendula* (Tulipwood) and *Podocarpus elatus* (Plum Pine) with *Hibbertia scandens* ground cover. *Syzygium luehmannii* was planted at the top of the slope as a hedge plant adjoining the houses.

There was an open sunny lawn on the central flat area of the park. The park appears to have no remnant native vegetation.

Cooper Park is located approximately 1.2 km to the west of Thomas Hogan Reserve, geology mapped as Quaternary Holocene sand deposits (Herbert and West 1983) and vegetation of the area observed mapped as Coastal Sandstone Foreshores Forest (OEH 2013).

It was observed that:
Landform – sandstone gully with some remnant vegetation (remnant vegetation in Cooper Park is difficult to identify due to extensive native species planting in the 1930s and 1970s (from Woollahra Council website, http://www.woollahra.nsw.gov.au/environment/biodiversity_flora_and_fauna/vegetation, accessed 10 September 2015).
Soils – sandstone derived.
Vegetation
On the south-facing slope north of the tennis courts, local native species included *Acmena smithii, Angophora costata, Callicoma serratifolia, Calochlaena dubia, Eucalyptus pilularis*, *Eucalyptus resinifera, Eupomatia laurina, Glochidion ferdinandi, Histiopteris incisa, Hypolepis muelleri, Pittosporum undulatum* and *Pyrrosia* rupestris.

On the north-facing slope, south of the tennis courts, noted to be warmer and drier than the south-facing slope, the native species observed included *Acacia floribunda, Acacia longifolia, Adiantum aethiopicum, Angophora costata, Calochlaena dubia, Cupaniopsis anacardioides*, *Dianella caerulea, Dodonaea triquetra. , Eucalyptus botryoides, Eucalyptus piperita, Eucalyptus punctata, Eucalyptus tereticornis, Ficus rubiginosa, Kunzea ambigua, Lomandra longifolia, Macrozamia communis, Themeda triandra, Tristaniopsis laurina* and *Zieria smithii.*

Bird Sanctuary, Centennial Parklands is a 0.9 ha patch of known ESBS set aside for conservation in 1953 (DECC 2009). It is located 2.8 km to the south-west of the Thomas Hogan Reserve, geology mapped as Quaternary Holocene sand deposits (Herbert and West 1983) and vegetation mapped as Eastern Suburbs Banksia Scrub (OEH 2013).

It was observed that:
Soil: mainly aeolian sands with exposed bare light-grey loose speckled sand surface.
Soil surface: scattered litter cover and clumps of moss growth.
Vegetation: included planted large non-local native *Eucalyptus microcorys* as well as characteristic species of ESBS including *Banksia aemula, Monotoca elliptica, Kunzea ambigua, Dianella revoluta, Banksia serrata,* and *Acacia longifolia*. Other species observed include *Omalanthus populifolius, Dianella longifolia, Microlaena stipoides, Acacia sophorae, Lachnagrostis filiformis, Cotula australis, Leptospermum juniperinum, Muellerina celastroides, Eucalyptus paniculata,* and *Angophora costata.* On the outer edges of the patch, there were occurrences of scattered clumps of the exotic grass *Ehrharta erecta* which appeared to being removed and replaced by *Dianella* spp.

York Road (part of the Centennial Parklands) is an approximately 1 ha remnant patch of ESBS containing vegetation that has regrown after a clearing in the 1930s (DECC 2009). It is located approximately 2 km to the south-west of the Thomas Hogan Reserve, geology mapped as Quaternary Holocene sand deposits (Herbert and West 1983) and vegetation mapped as Eastern Suburbs Banksia Scrub (OEH 2013).

It was observed that:
Soil: mainly aeolian sands with exposed bare light-grey loose speckled sand surface.
Soil surface: scattered litter cover and clumps of moss growth.
Vegetation - characteristic species of ESBS, with species recorded including *Acacia sophorae, Acacia ulicifolia, Dianella caerulea, Monotoca elliptic, Monotoca scoparia*, *Microlaena stipoides, Leptospermum laevigatum* and *Micrantheum ericoides.*

Jennifer Street, Little Bay is part of Botany Bay National Park.
Soil: mainly aeolian sands with exposed bare light-grey loose speckled sand surface.
Soil surface: scattered litter cover and clumps of moss growth.
Vegetation: characteristic of ESBS in the Final Determination.

A7.2 Park on low nutrient sand with intensive use

Shelly Beach Reserve in Manly Local Government Area faces many of the problems associated with Thomas Hogan Reserve, including intensive use of lawn areas, salt spray and highly erodible soils. These problems have been creatively addressed (see photographs in Appendix 3c), with planting of *Ficinia nodosa* in protected garden beds in the flat central sandy area, *Livistona australis* on the lawn at the base of the slope, *Cissus antarctica* on the lower slopes, and *Imperata cylindrica* and *Lomandra longifolia* along heavily-used upper tracks as well as extensive enhancement of the *Banksia integrifolia* dominated community on the upper slopes, and *Ficus rubiginosa* on the lower slopes.

A8.0 Conclusions

It was found that despite a history of landscape gardens, long periods of little maintenance and widespread invasion by the exotic canopy tree *Cinnamonum camphora*:

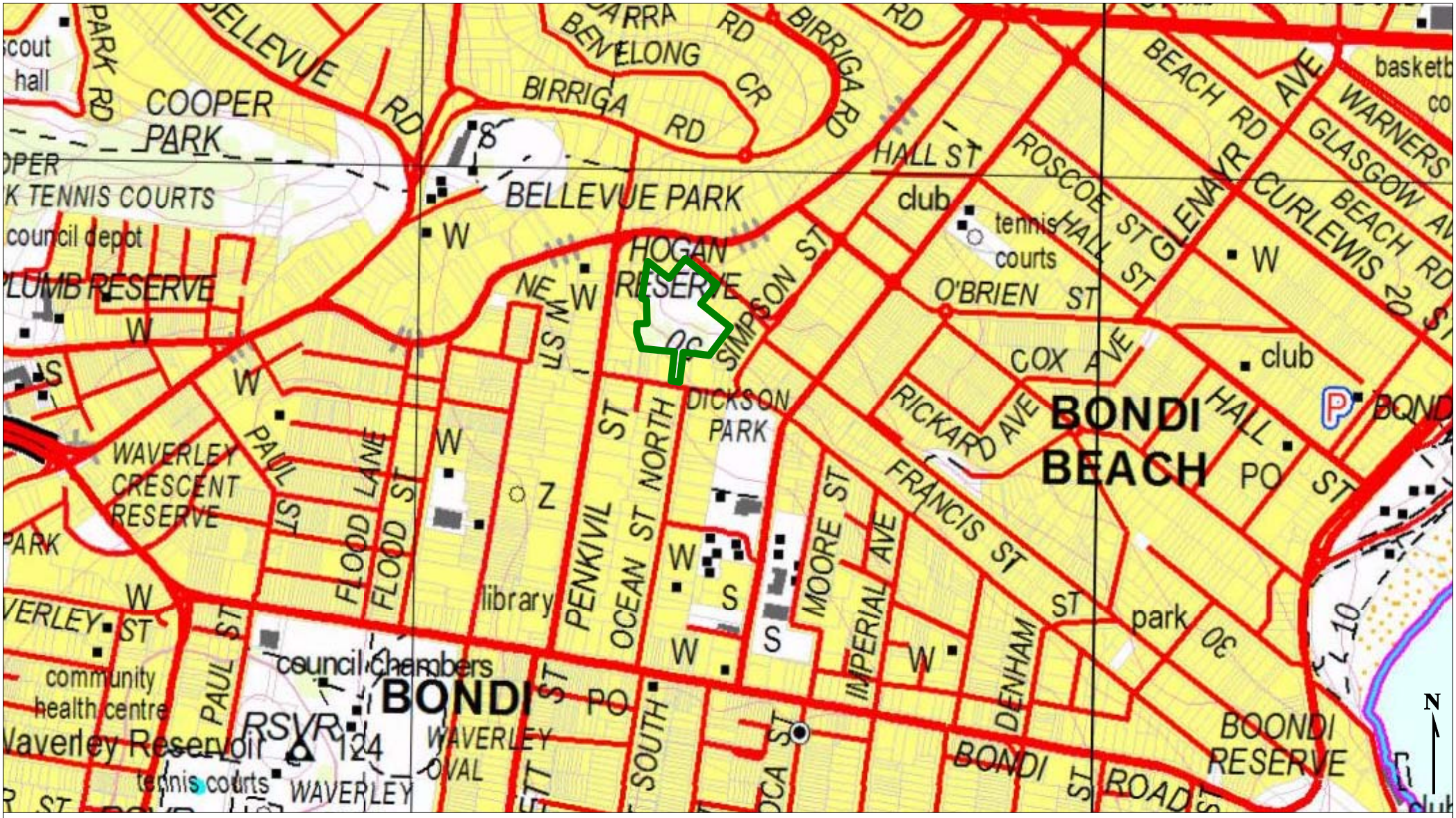
- The less abundant palm species have been planted and persist on the sandstone slope in the west and on the sandstone downwash of the central lawn area. The palm species were abundant on the sandstone derived soils in the west of the reserve (sampled in Transect 2), but sparser on the aeolian deposited sands (sampled in Transects 1, 3);
- 14 local native species had persisted on the aeolian deposited sands; despite being recorded as scattered individuals with low percent projected foliage cover.

The aeolian deposited sands in the north and east of Thomas Hogan Reserve are prone to erosion in times of high rainfall events. There appears to be little soil root holding capacity of exotic species on the slopes. Low occurrence of fungal hyphae was recorded in the soil samples (Soil fungal hyphae are known to be associated with the native species of sand ecosystems).

The central lawn in the gully had bare sandy patches and was overshadowed by the canopy trees, mainly *Cinnamomum camphora* up to 20 m in height. The recently sown *Lolium perenne* (Perennial Rye Grass) and scattered patches of the exotic grass *Ehrharta erecta* and of the native grass *Microlaena stipoides* (Weeping Grass) do not provide sufficient cover for the existing pedestrian usage.

The sunny playground near Francis Street has had a more successful lawn establishment but lacking sufficient cover for the intensity of use.

Figures



Site boundary

Figure 1a.
Site boundary overlaid on the 1:25 000 topographic map

Figure 1b-1.
Site boundary overlaid on the Nearmap aerial photograph
(dated August 11 2015)

Figure 1b-2.
Site boundary overlaid on the
Nearmap aerial photograph (dated August 11 2015)

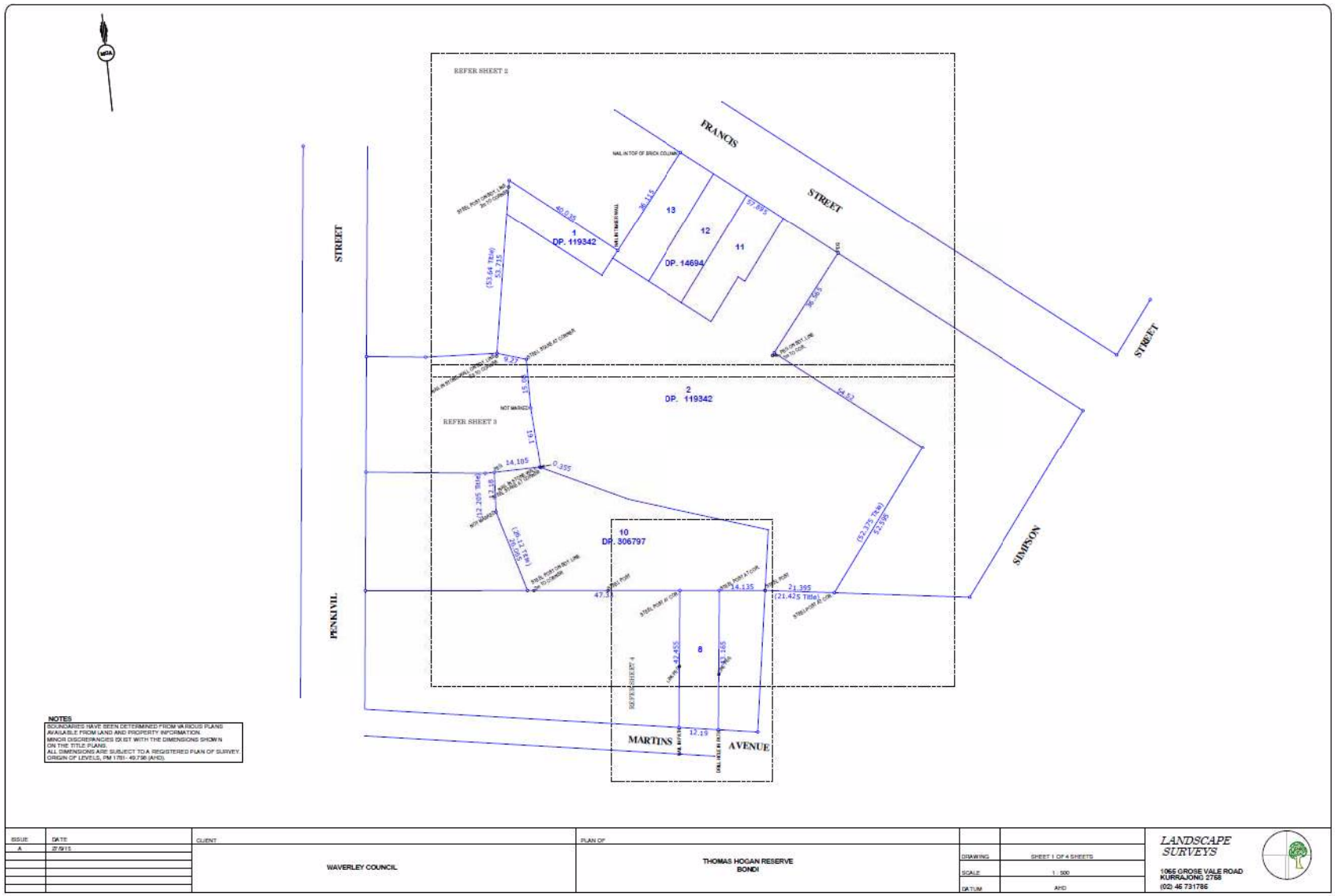


Figure 1c-1.
Survey Plan (Sheet 1 of 4)
(Landscape Surveys 2015)

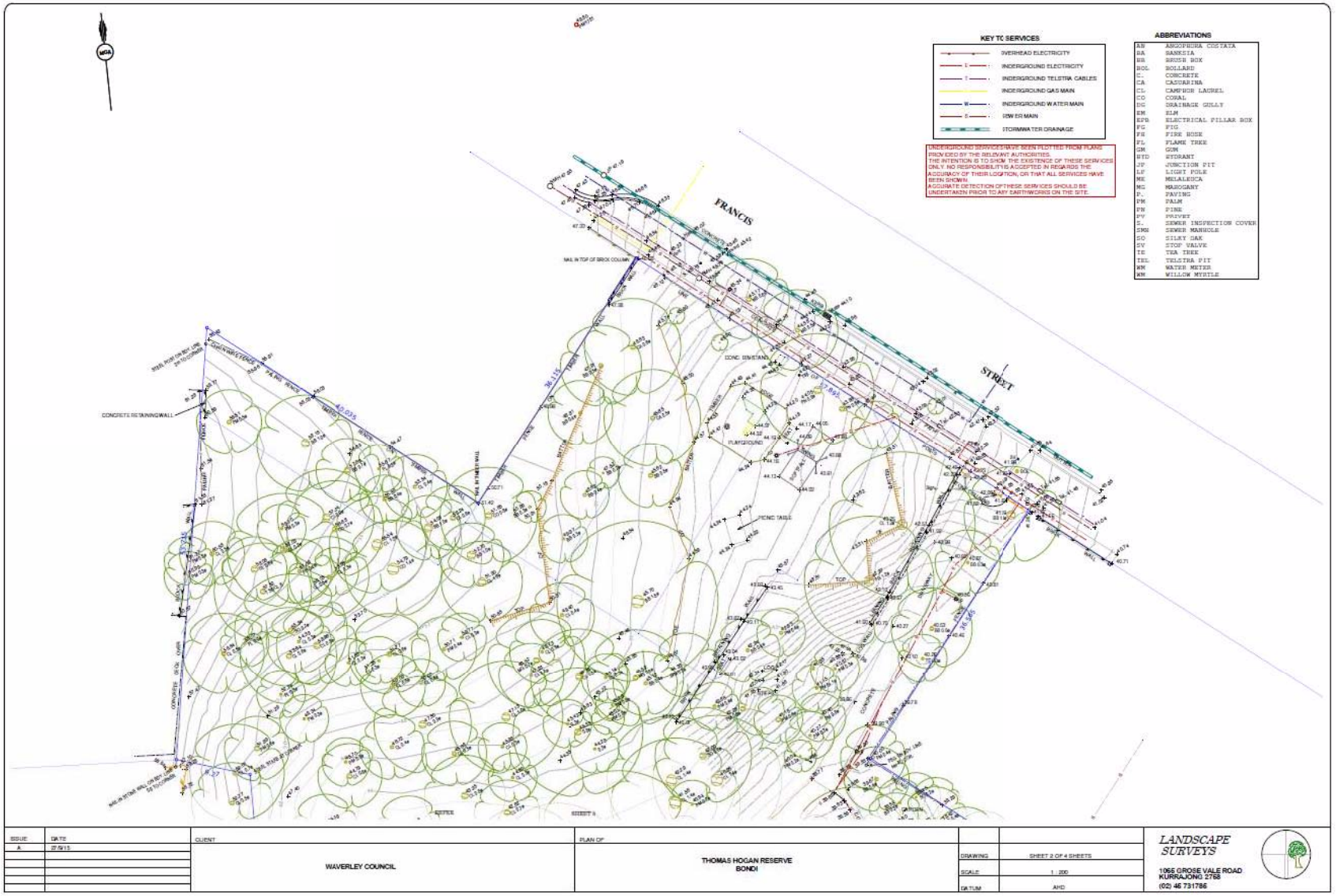


Figure 1c-2.
Survey Plan (Sheet 2 of 4)
(Landscape Surveys 2015)

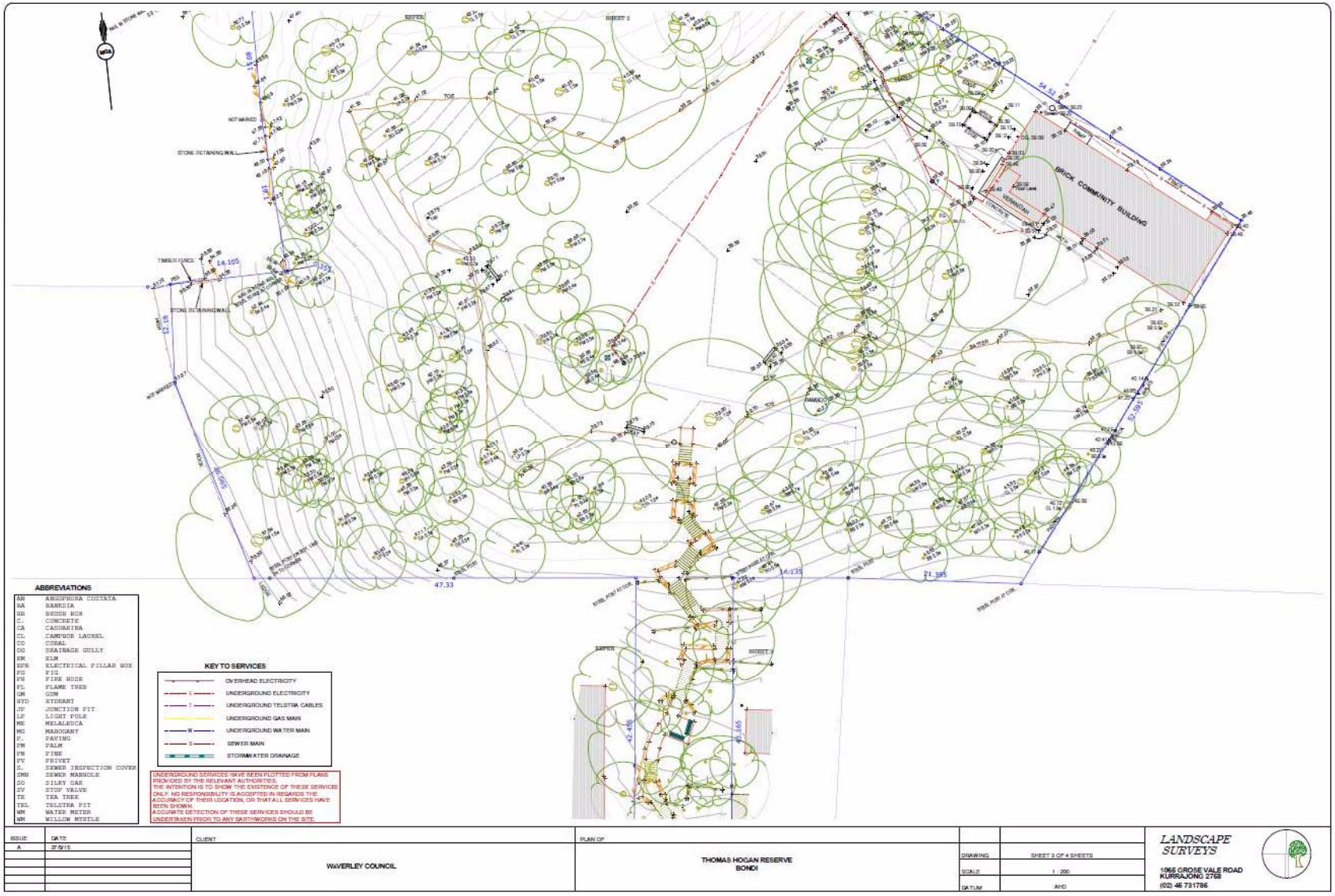


Figure 1c-3.
Survey Plan (Sheet 3 of 4)
(Landscape Surveys 2015)

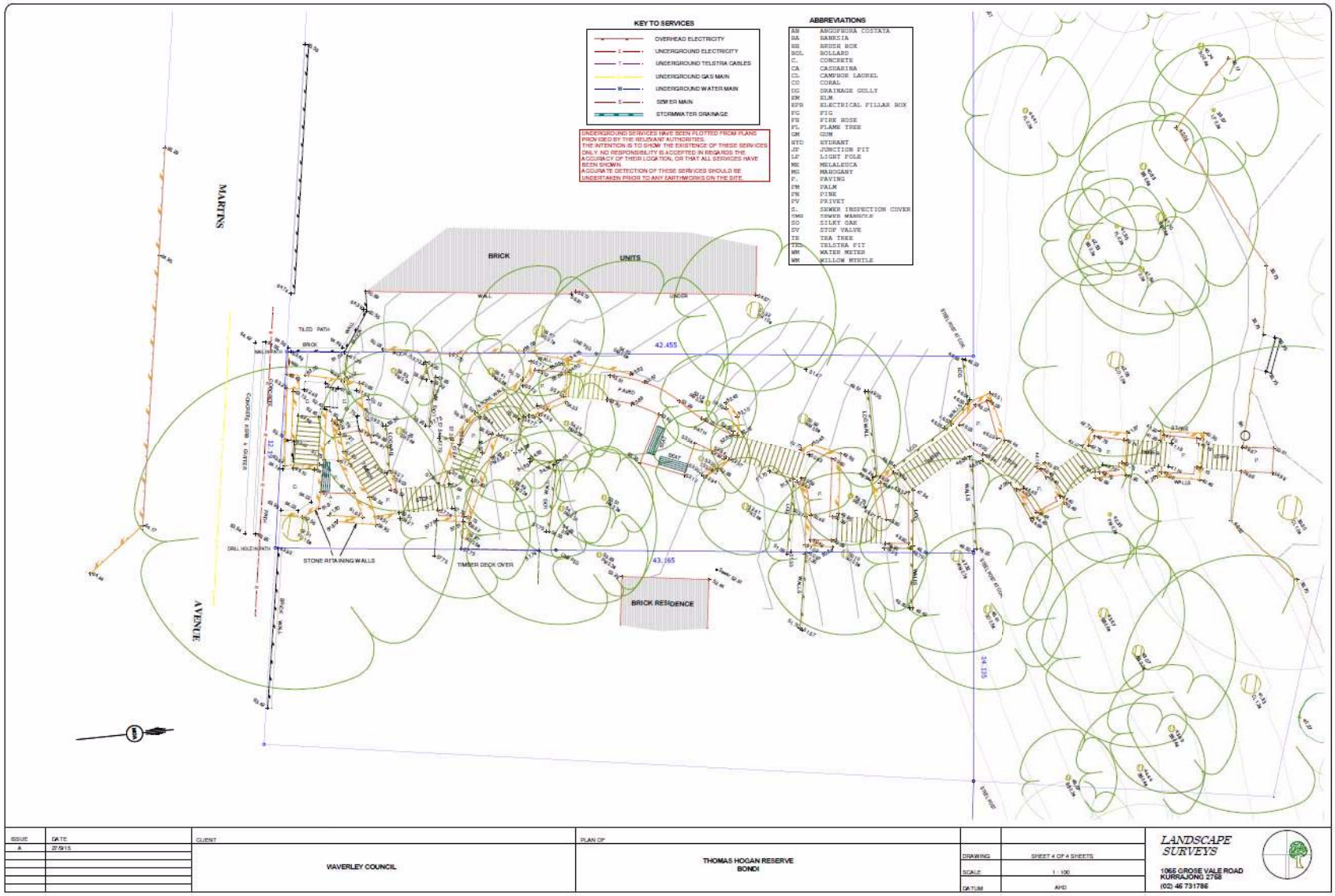


Figure 1c-4.
Survey Plan (Sheet 4 of 4)
(Landscape Surveys 2015)

Figure 1d.
Site boundary overlaid on to the
SIXmaps 1943 aerial photograph

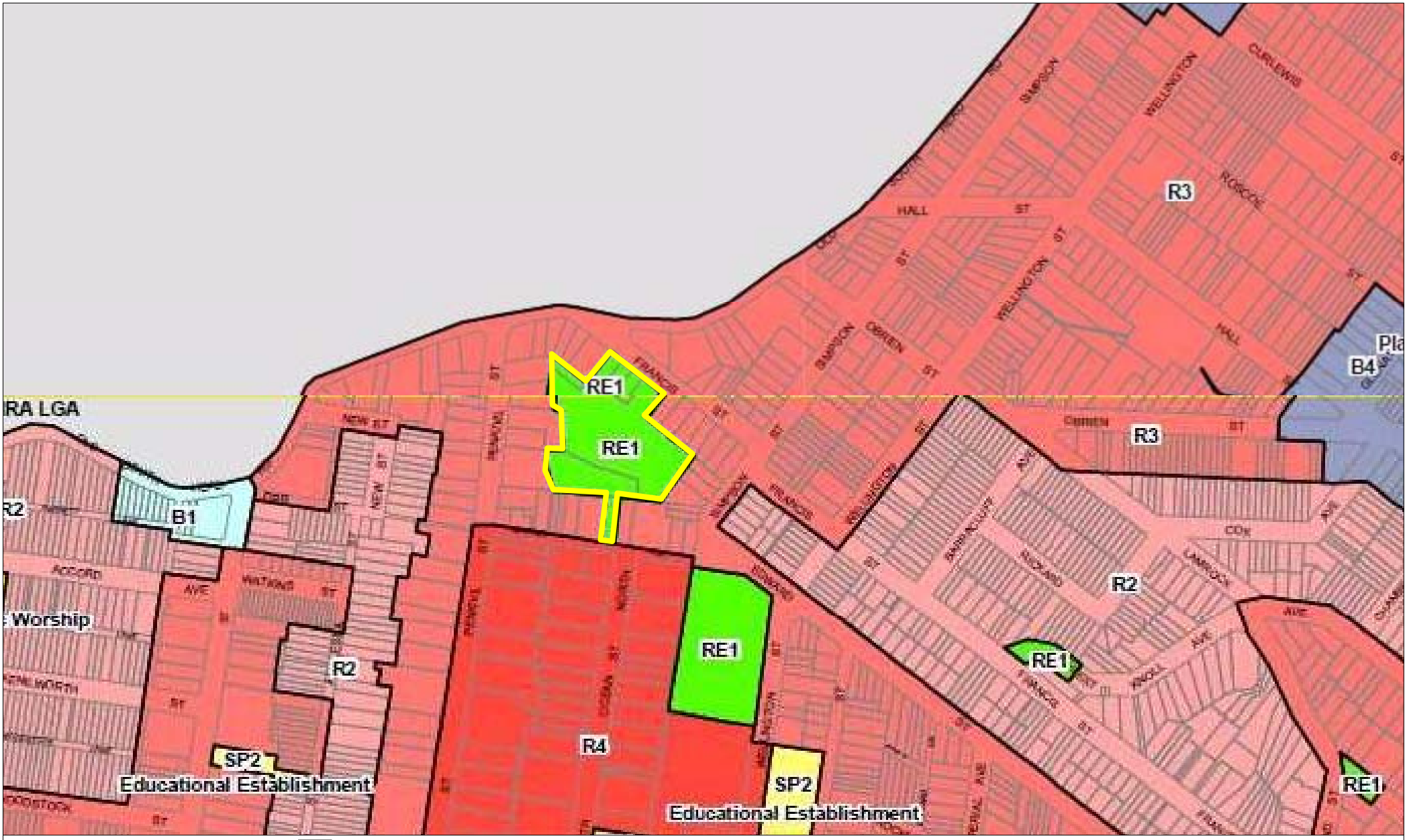


Figure 2a.
Site boundary overlaid on Land Zoning Map LZM_04 (Waverley LEP 2012)

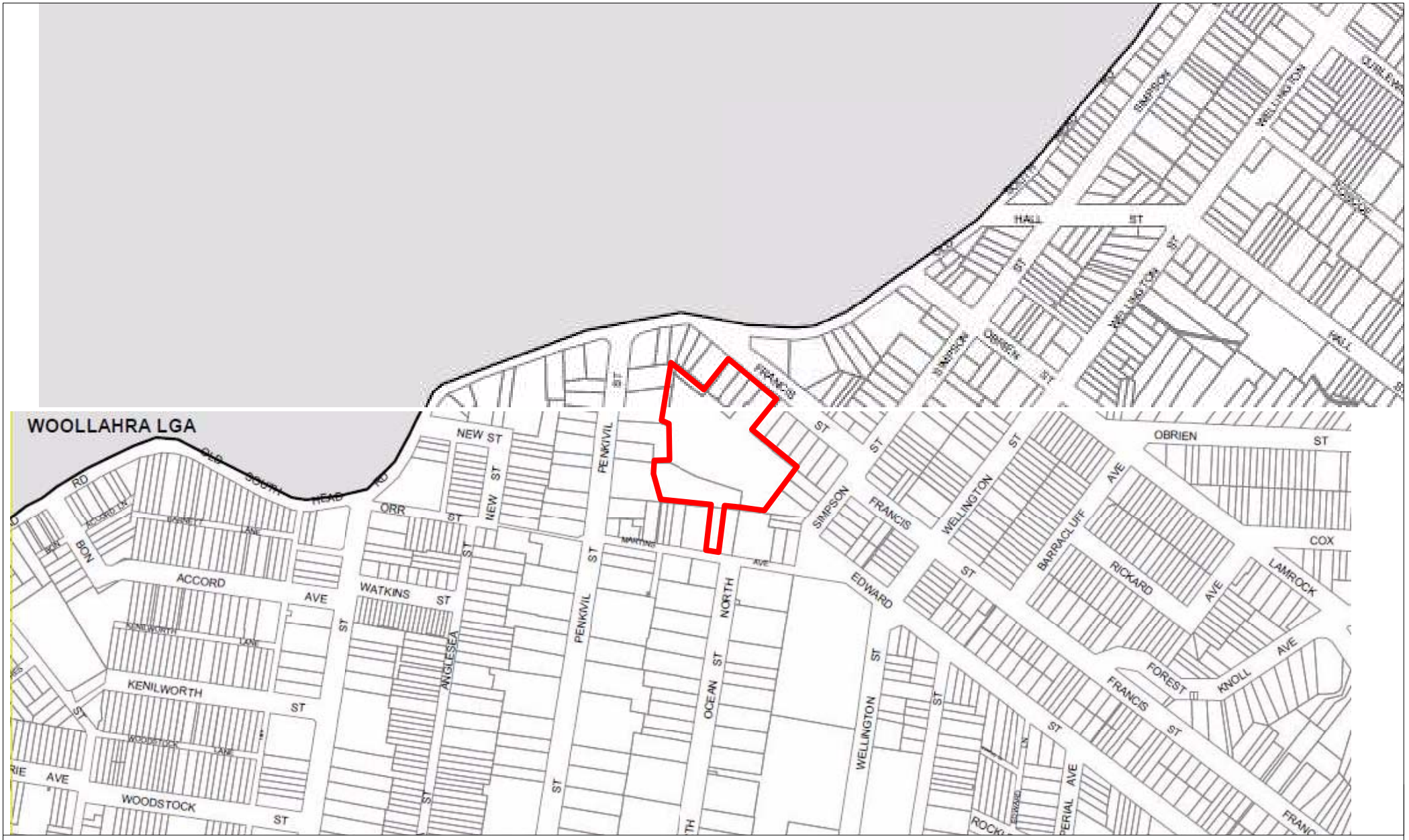


Figure 2b.
Site boundary overlaid on Biodiversity Maps BIO_004 (Waverley LEP 2012)

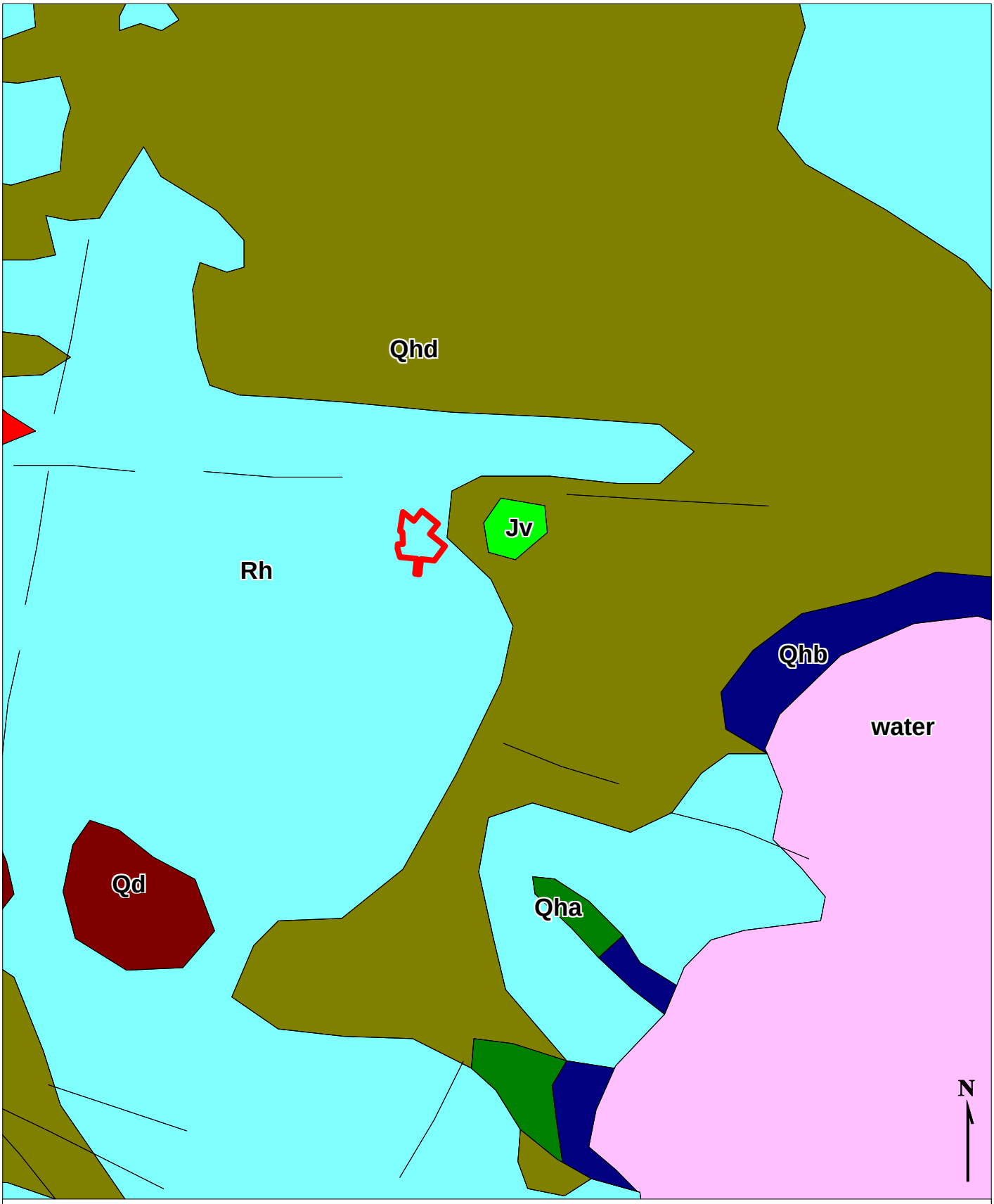


Figure 3a.
Site boundary overlaid on the Sydney 1:100,000 Geology map (Herbert and West, 1983)

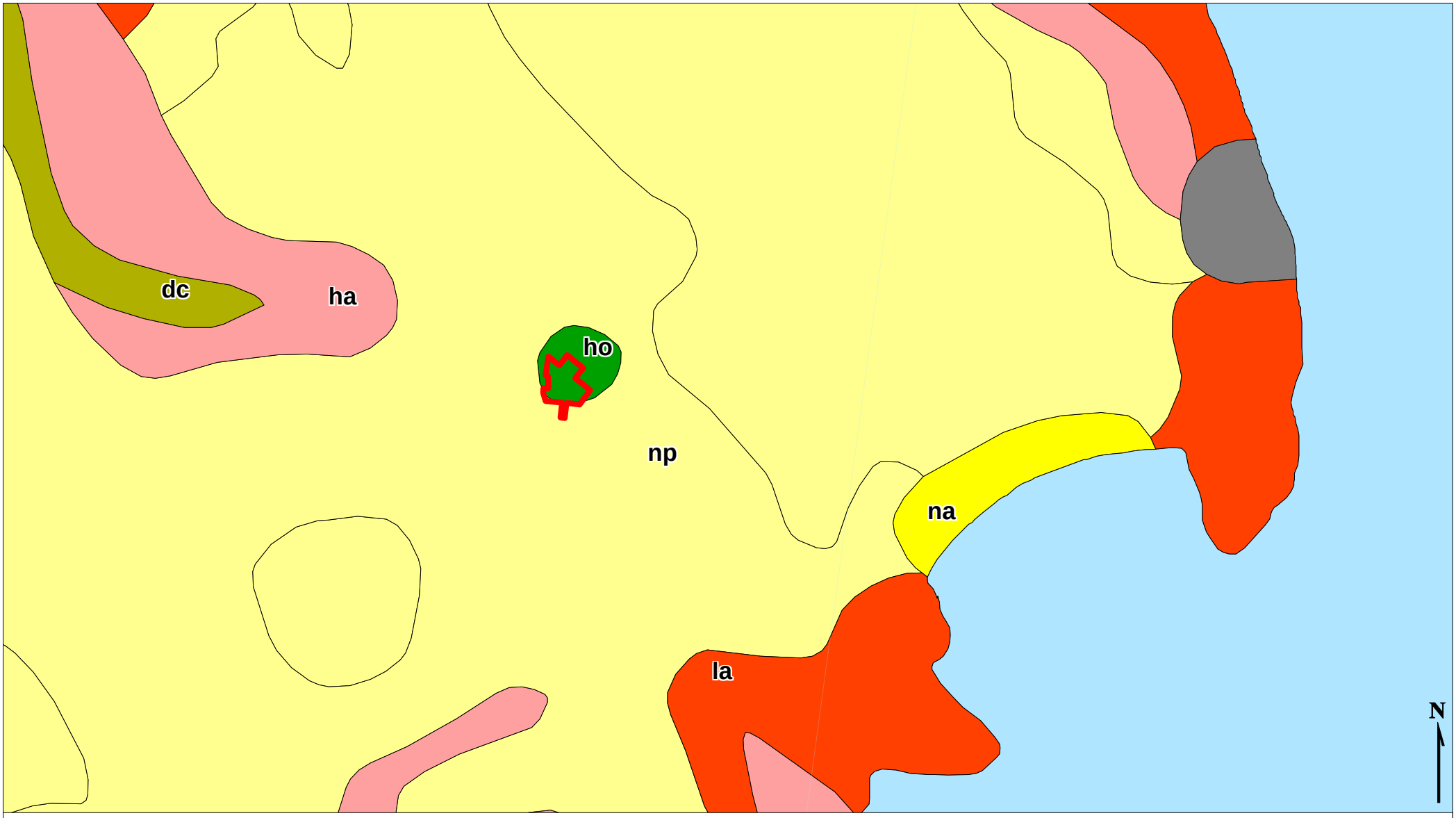
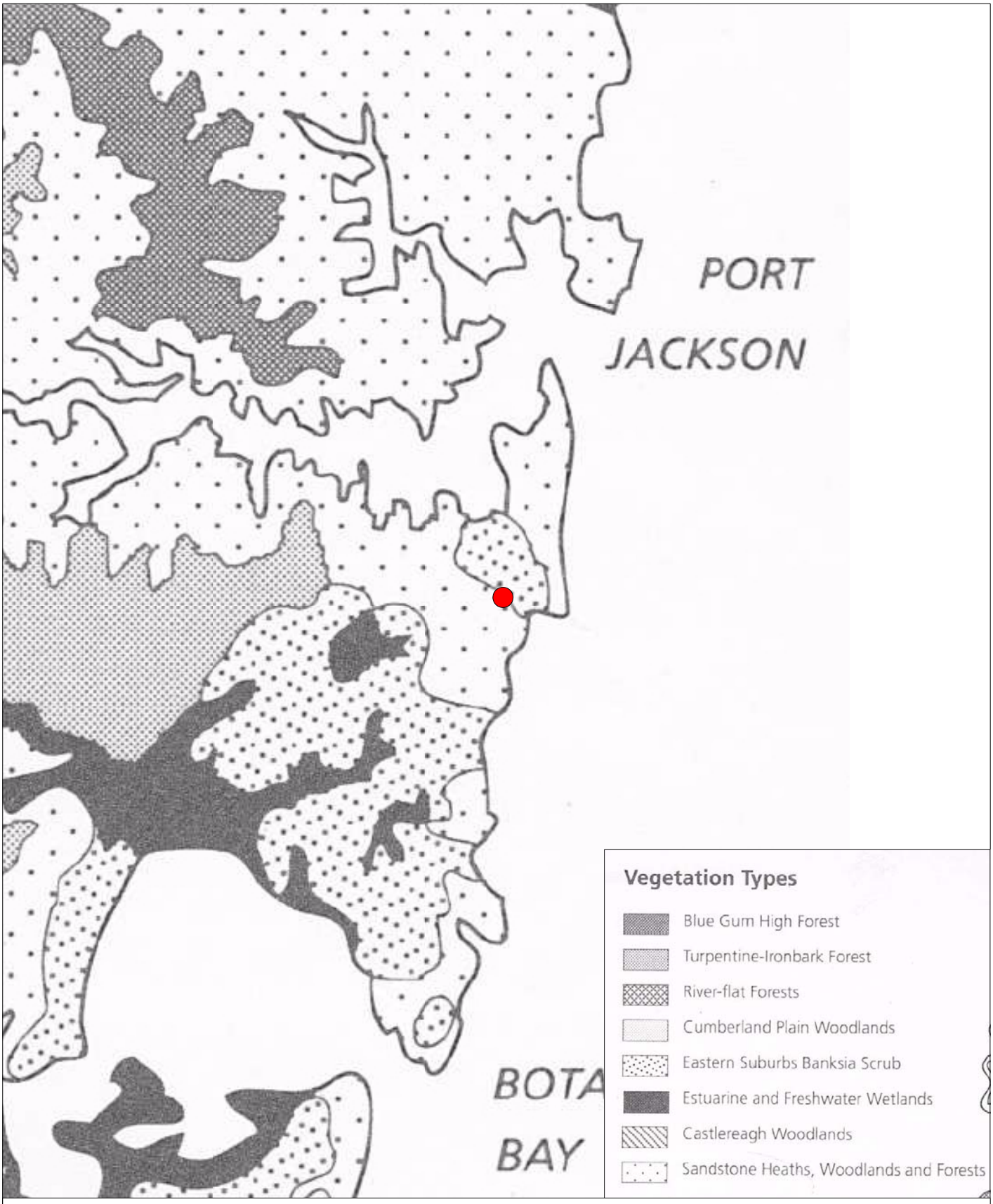


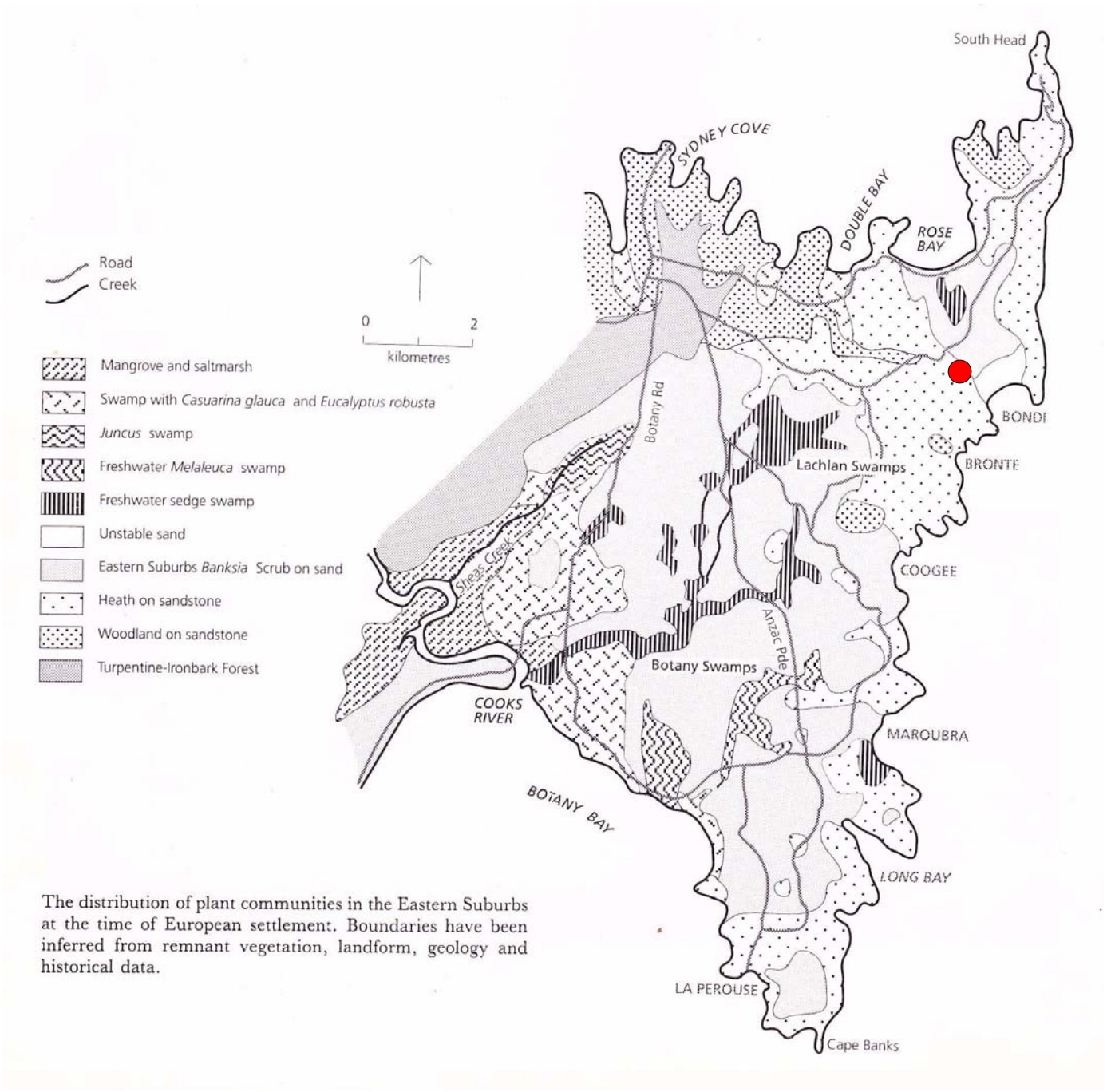
Figure 3b.
Site boundary overlaid on the Sydney 1:100,000 Soil Landscape Map (Chapman et al. 1989)

Figure 3c.
Soil sample sites and Transect locations overlaid on the Nearmap aerial photograph (dated 11 August 2015)



Approximate location of the Study Area

Figure 4a.
Vegetation Types present in the Sydney district east of the Nepean-Hawkesbury River in 1788 (Benson and Howell, 1990)

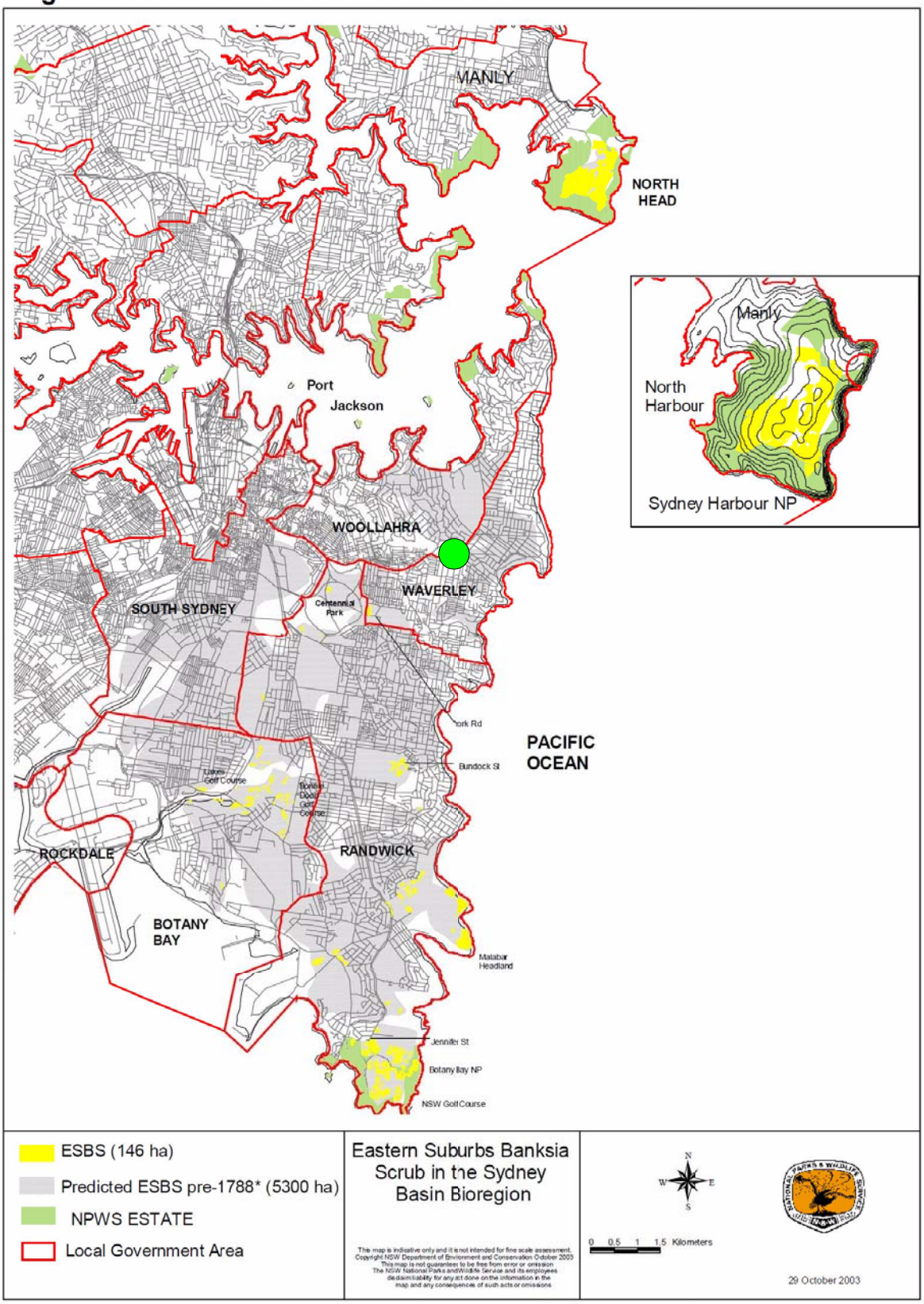


The distribution of plant communities in the Eastern Suburbs at the time of European settlement. Boundaries have been inferred from remnant vegetation, landform, geology and historical data.

● Approximate location of the study area

Figure 4b.
Plant communities in the Eastern Suburbs at the time of European settlement (Benson and Howell 1990b)

Figure 1. Eastern Suburbs Banksia Scrub



Approximate location of the study area

Figure 4c.
Current and predicted area of Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion (DEC 2004)

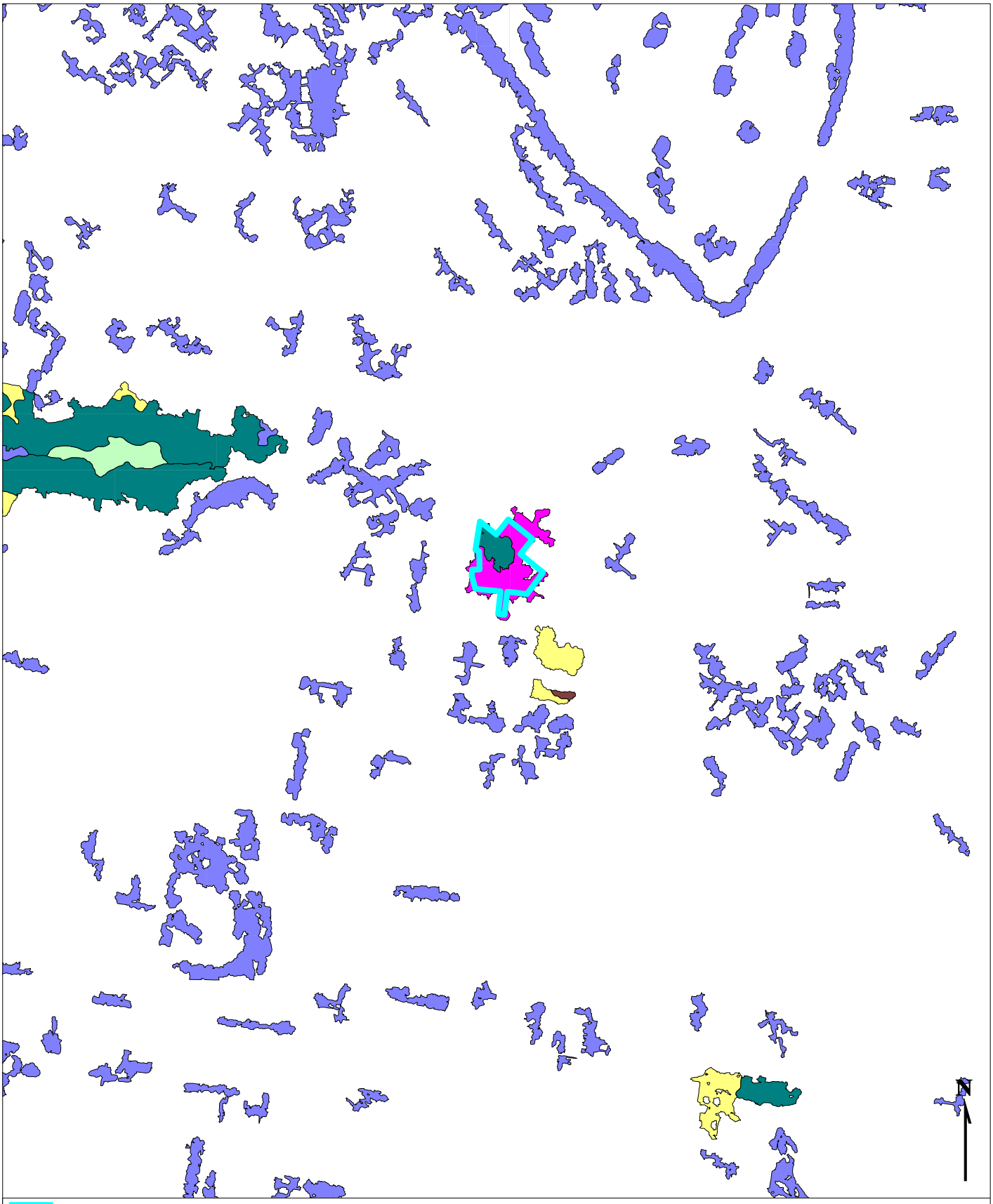


Figure 4d-1.
Site boundary overlaid on the Native Vegetation of the Sydney Metropolitan Area (OEH 2013, VIS_ID 3817)

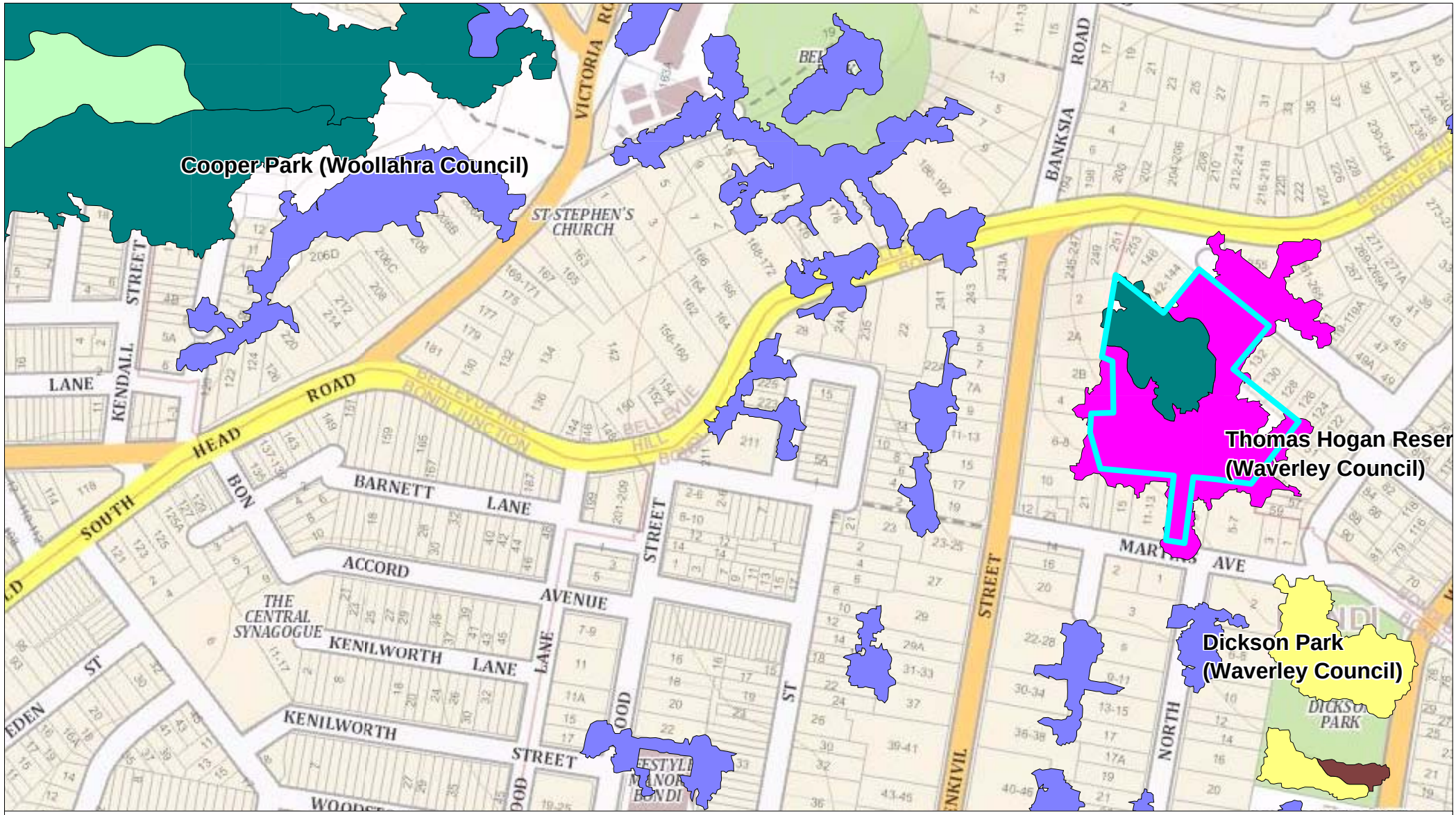


Figure 4d-2.
Site boundary overlaid on the Native Vegetation of the Sydney Metropolitan Area (OEH 2013, VIS_ID 3817), overlaid on the SIXMaps NSW Map

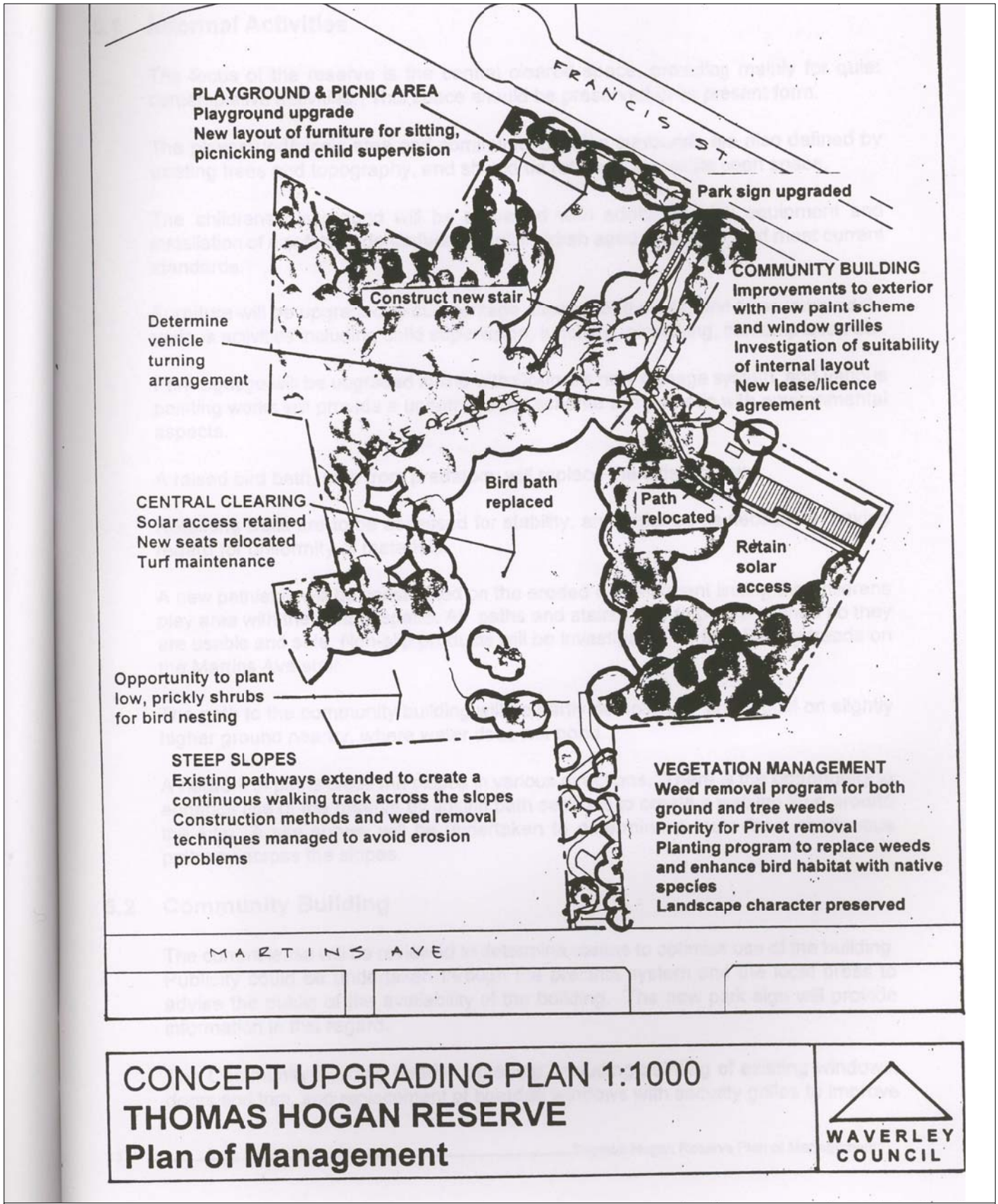
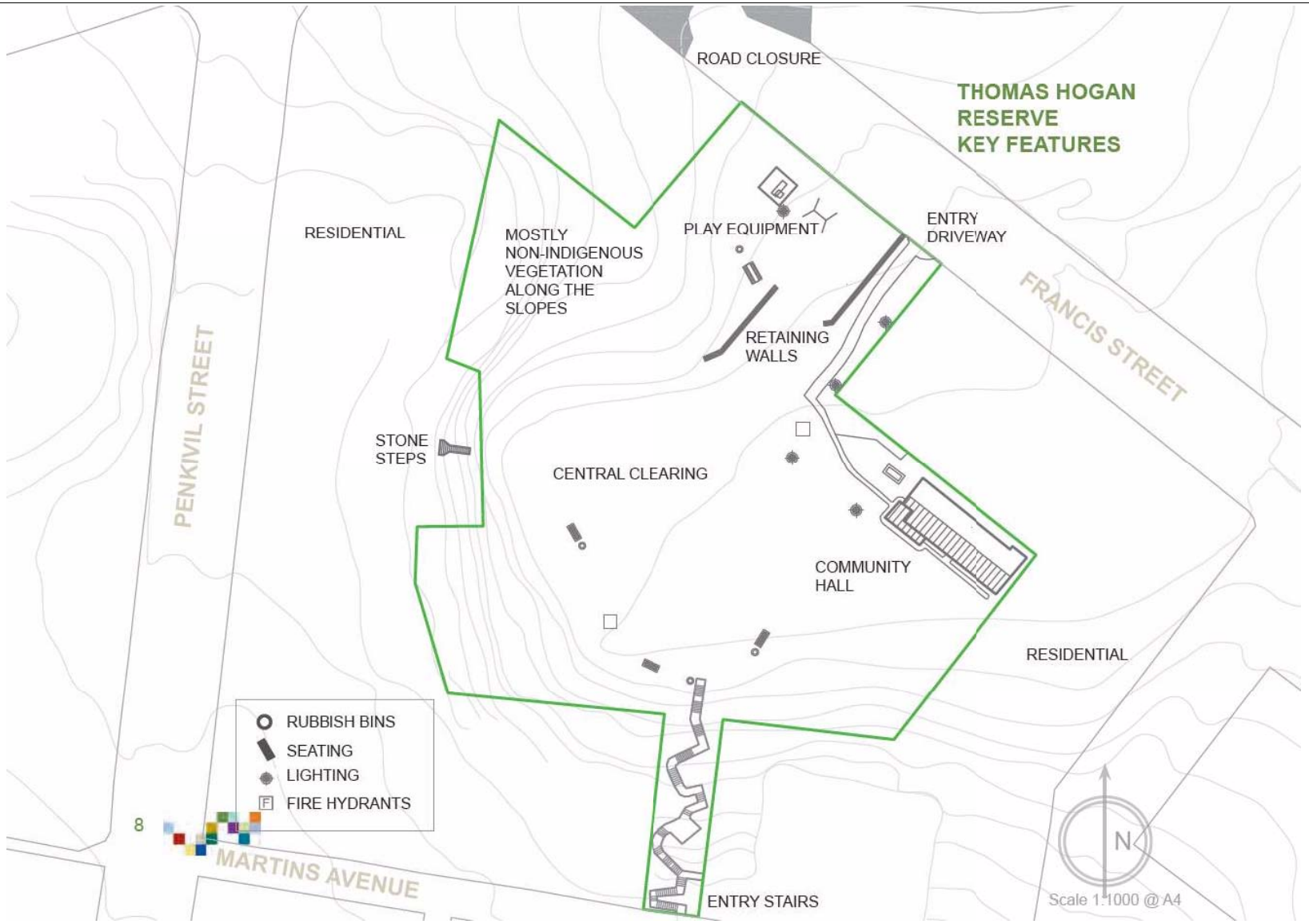
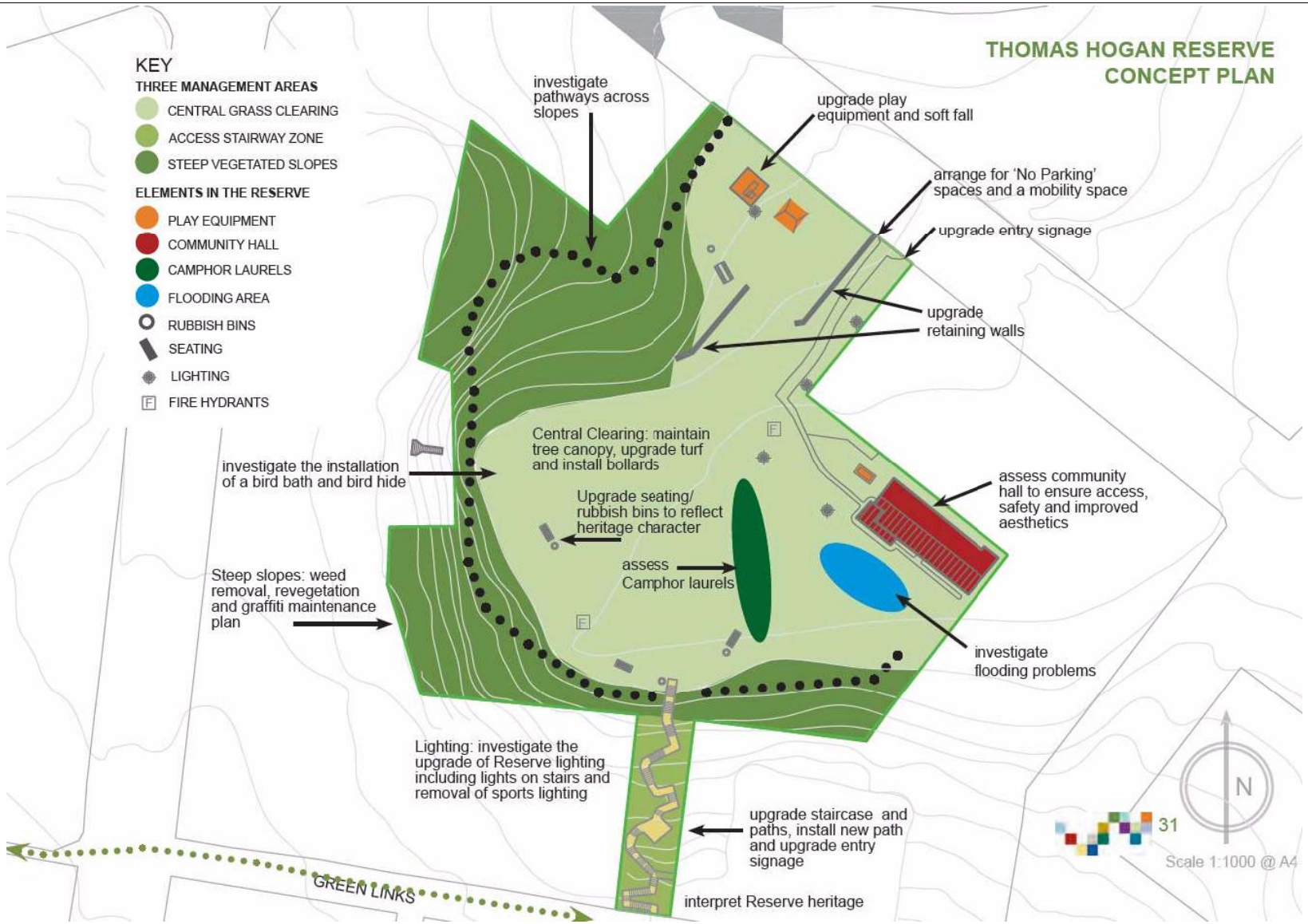


Figure 5a.
Concept upgrading plan 1:1000 from the Thomas Hogan Reserve Plan of Management (Waverley Council 1998?)



Site boundary

Figure 5b-1.
Thomas Hogan Reserve Key features (pg 8 of Thomas Hogan Reserve Plan of Management 2011-2021 prepared by Waverley Council, Recreation & Community Planning & Partnerships Division 2011)



Site boundary

Figure 5b-2.
Thomas Hogan Reserve Concept Plan (pg 31 of Thomas Hogan Reserve Plan of Management 2011-2021 prepared by Waverley Council, Recreation & Community Planning & Partnerships Division 2011)

Figure 6.
Sampling locations overlaid on the Nearmap aerial photograph (dated 11 August 2015)

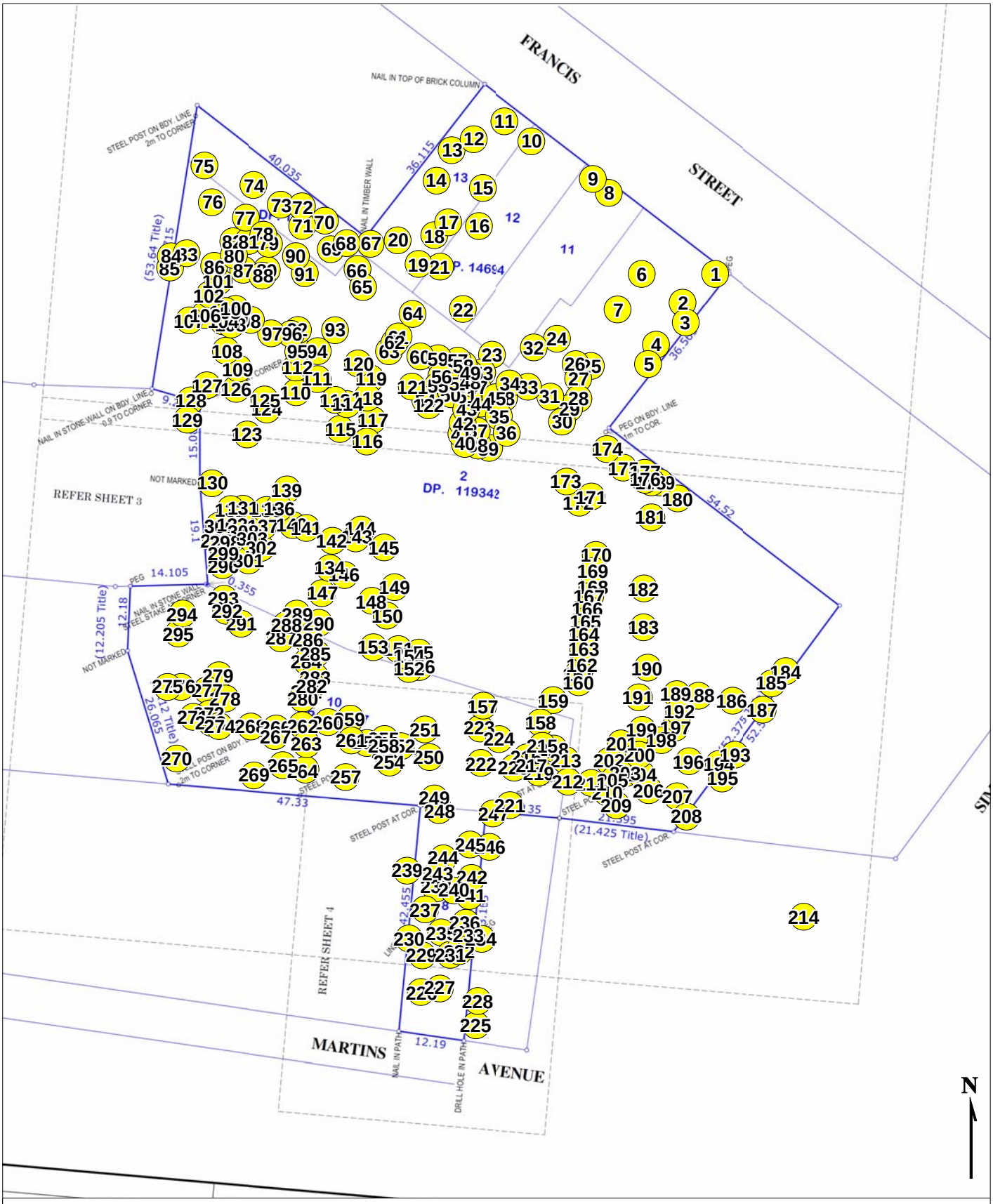


Figure 7a.
Location of trees overlaid on the Survey Plan Sheet 1 (Landscape Surveys 2015)

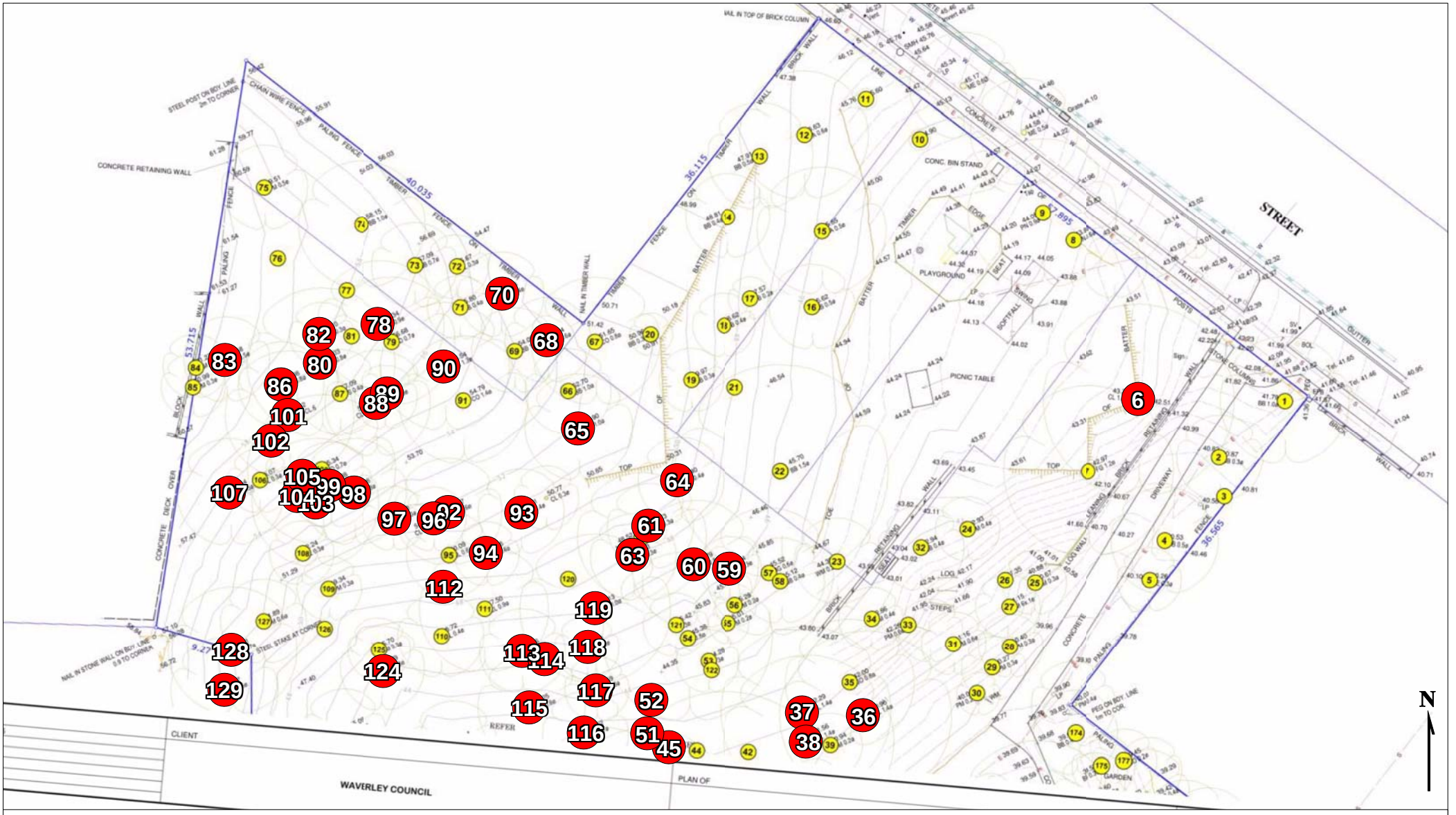


Figure 7b-N.
Location of Cinnamomum camphora overlaid on Site Plan with Trees
(Appendix 1a in Advanced Treescape Consulting 2016)

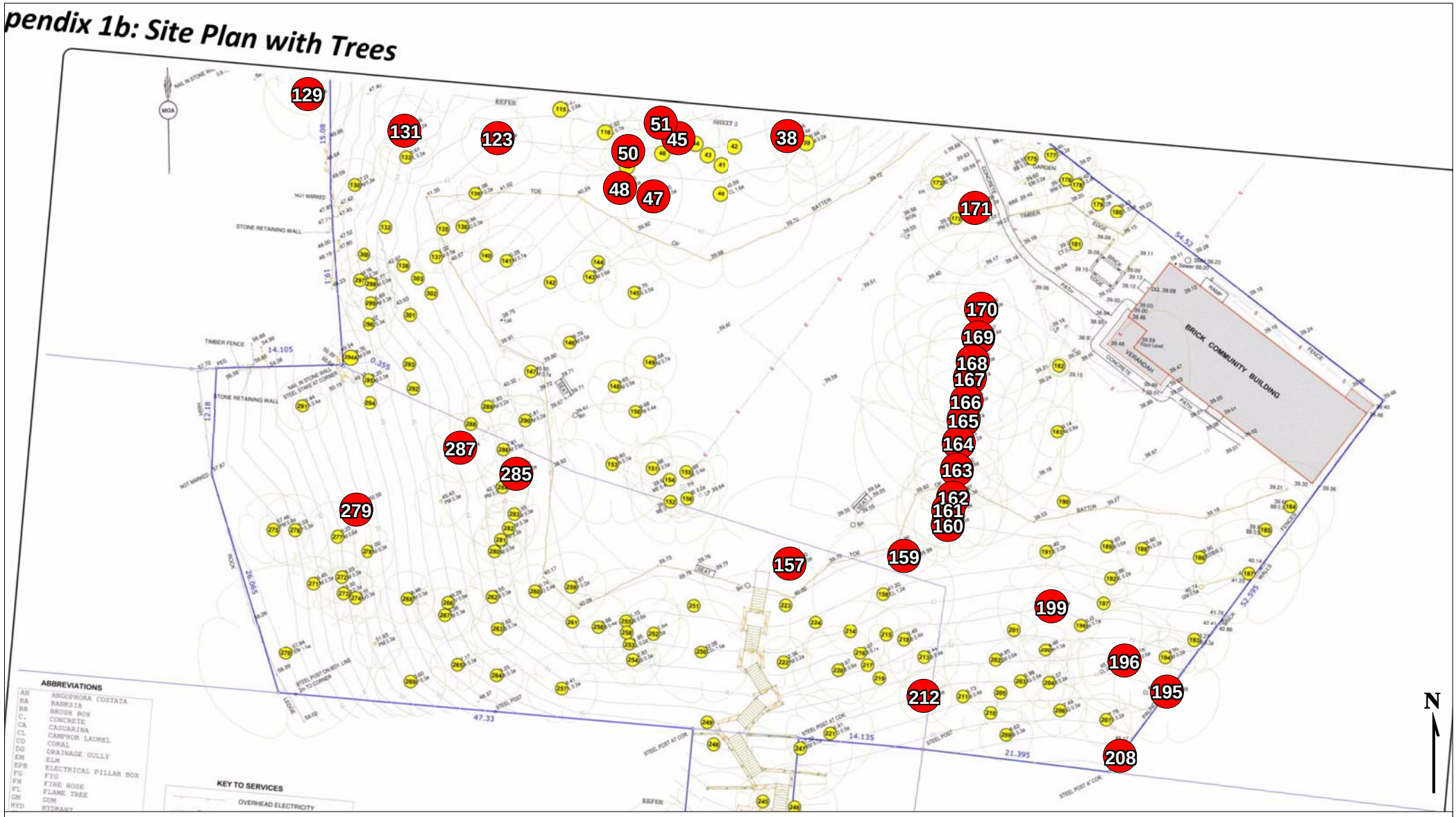


Figure 7b-S.
Location of Cinnamomum camphora overlaid on Site Plan with Trees
(Appendix 1b in Advanced Treescape Consulting 2016)

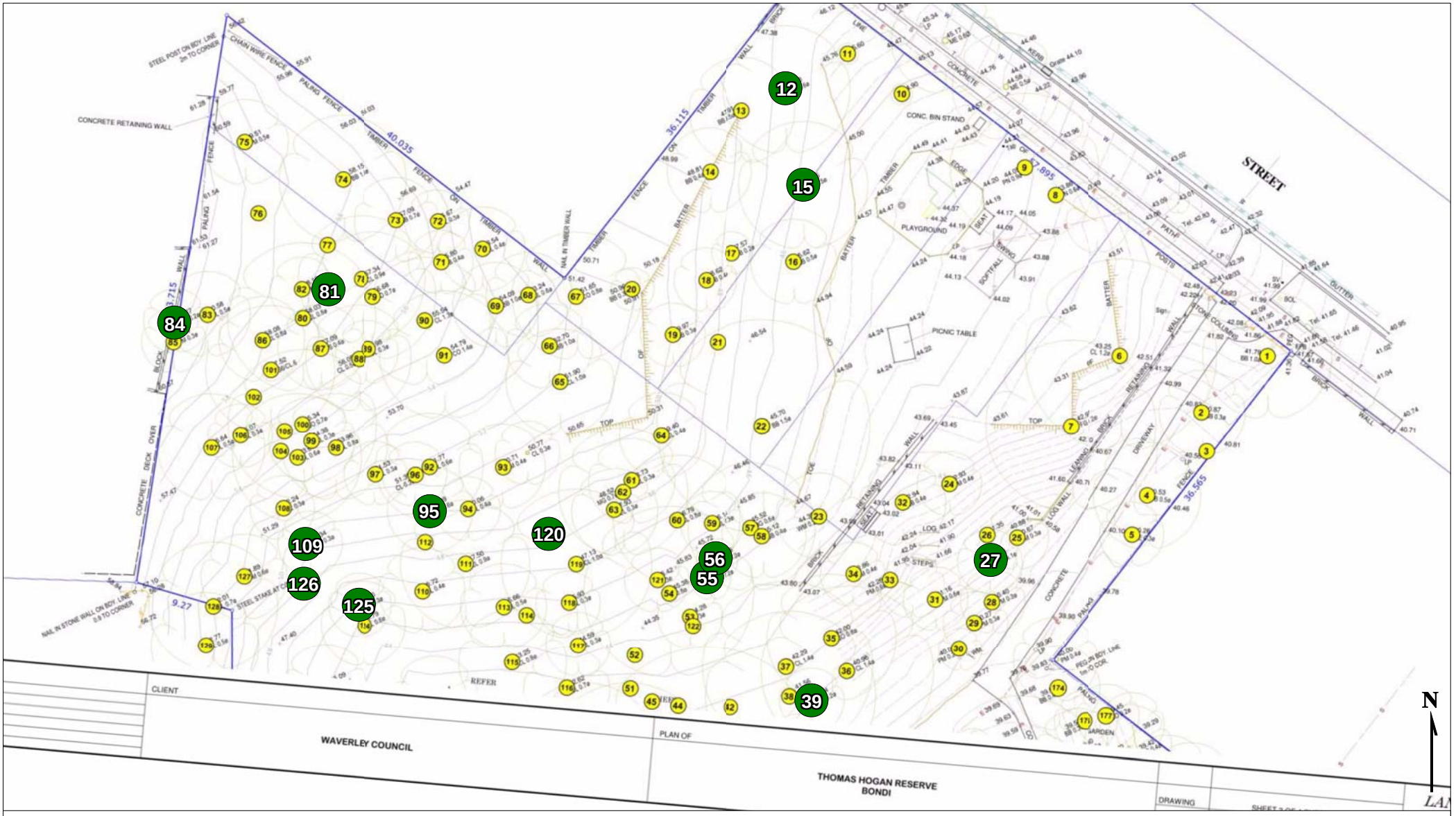
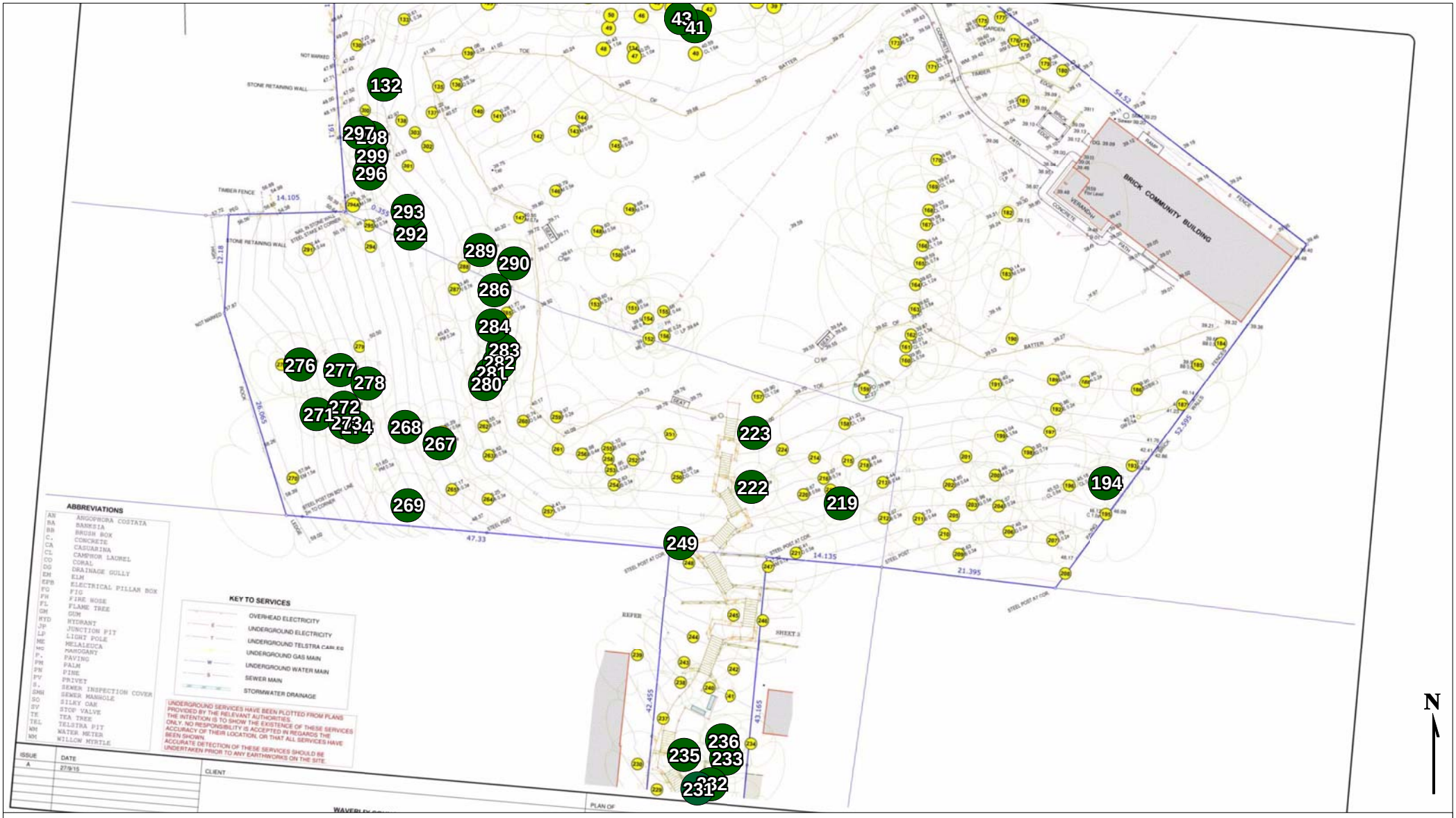


Figure 7c-N.
Location of Archontophoenix cunninghamiana overlaid on Site Plan with Trees
(Appendix 1a in Advanced Treescape Consulting 2016)



Archontophoenix cunninghamiana (Bangalow Palm)

0 14 28
metres

Figure 7c-S.
Location of Archontophoenix cunninghamiana overlaid on Site Plan with Trees
(Appendix 1b on Advanced Treescape Consulting 2016)

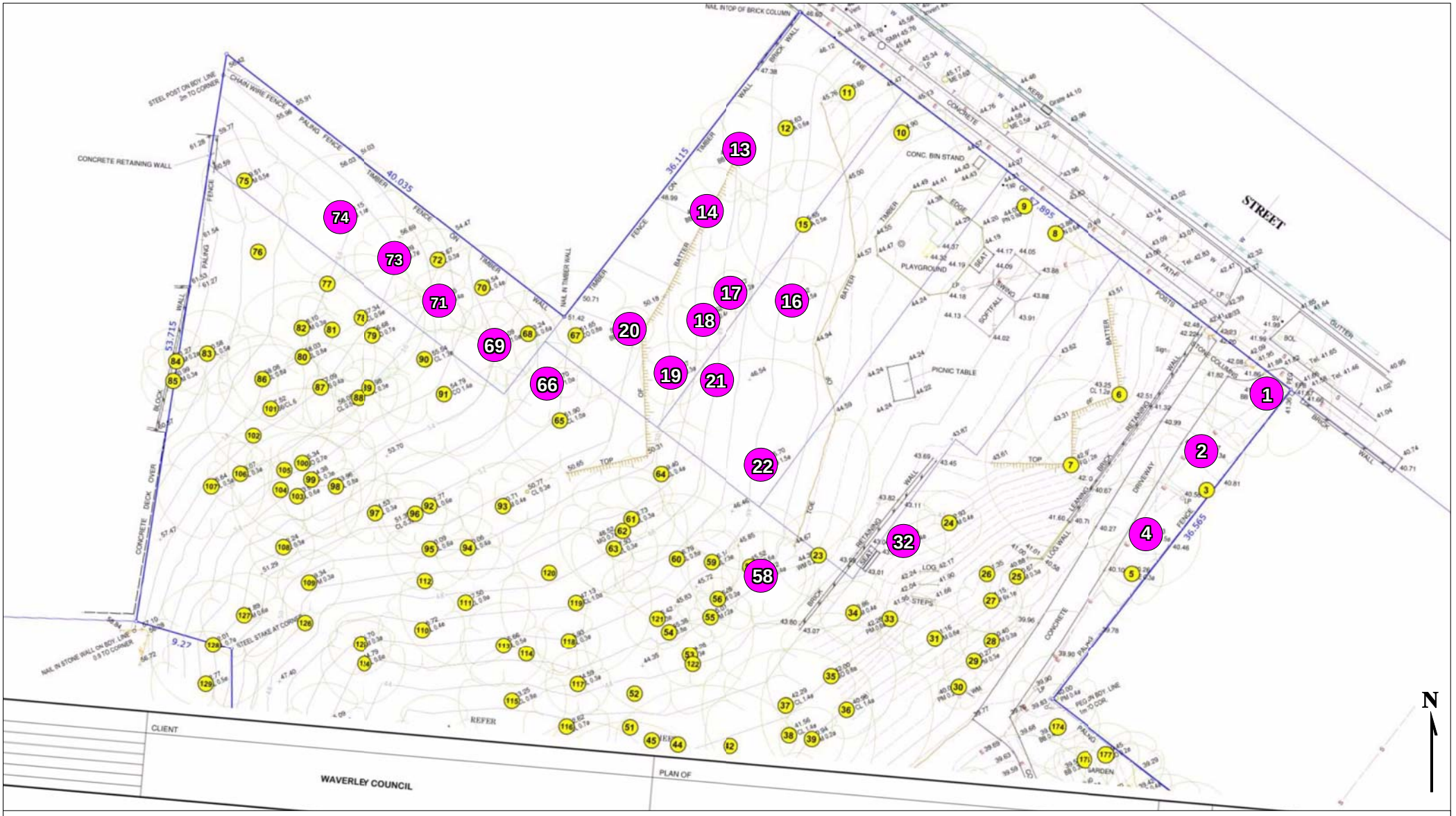
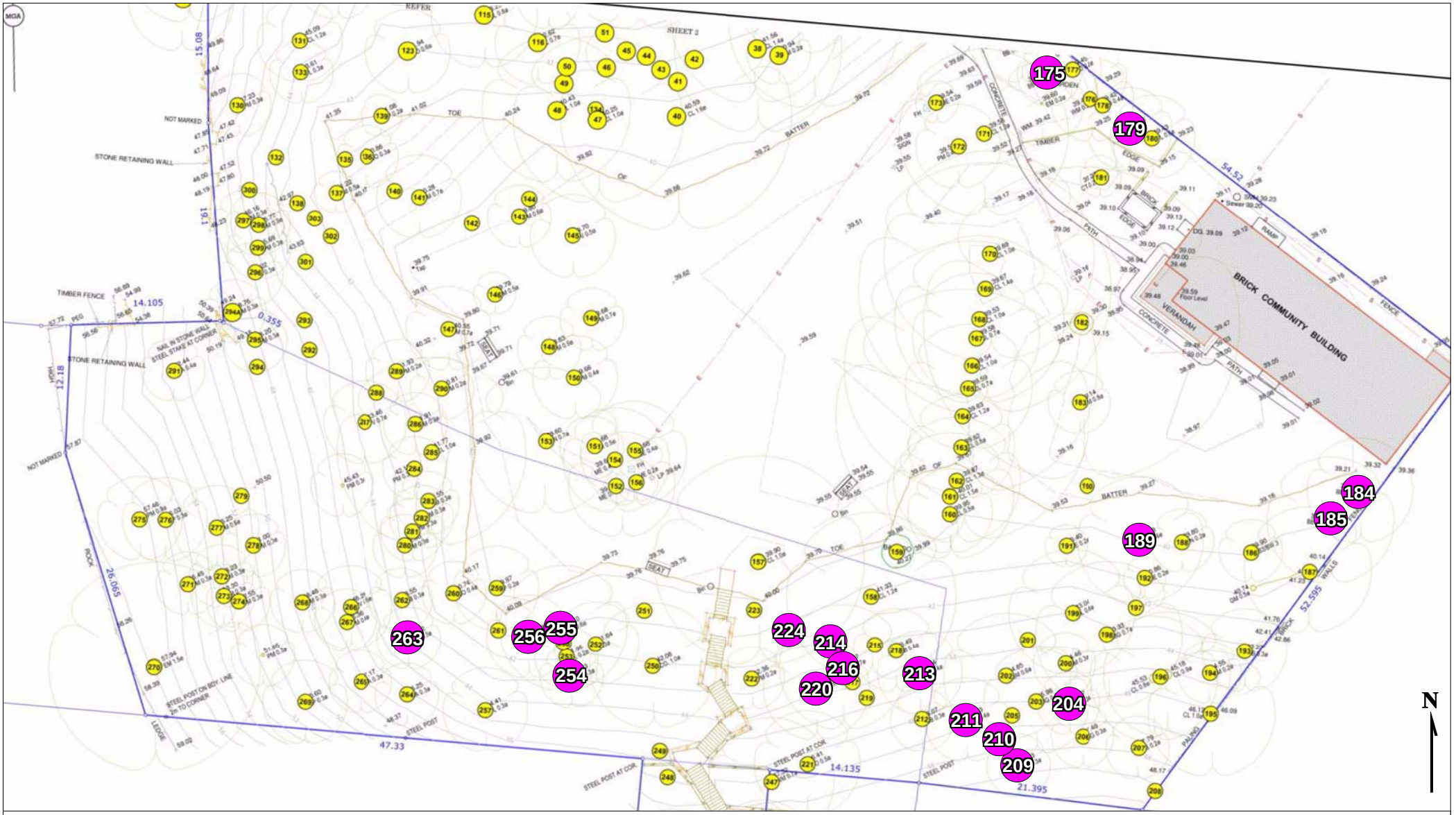


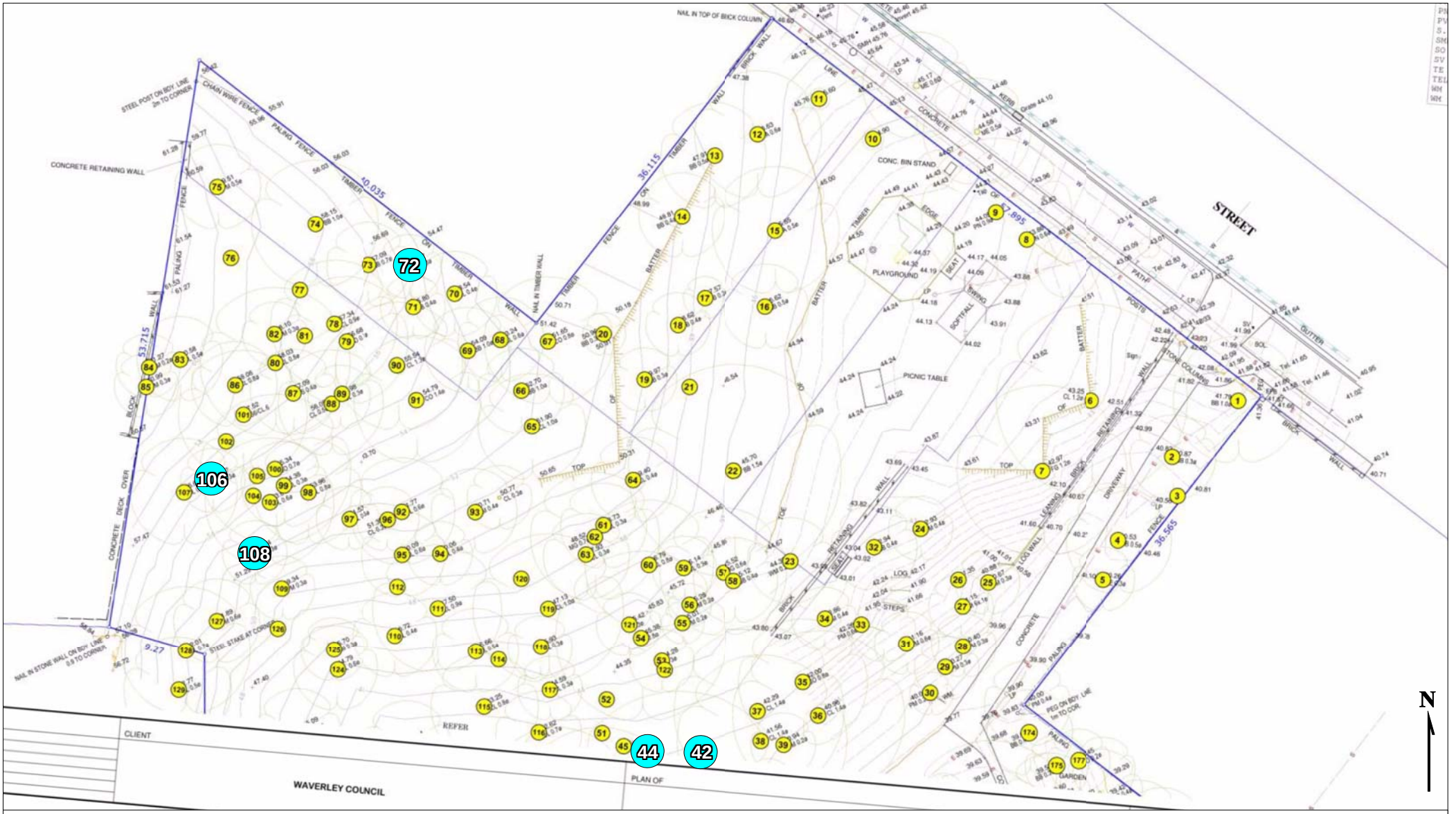
Figure 7d-N.
Location of Lophostemon confertus overlaid on Site Plan with Trees
(Appendix 1a on Advanced Treescape Consulting 2016)



Lophostemon confertus (Brushbox)

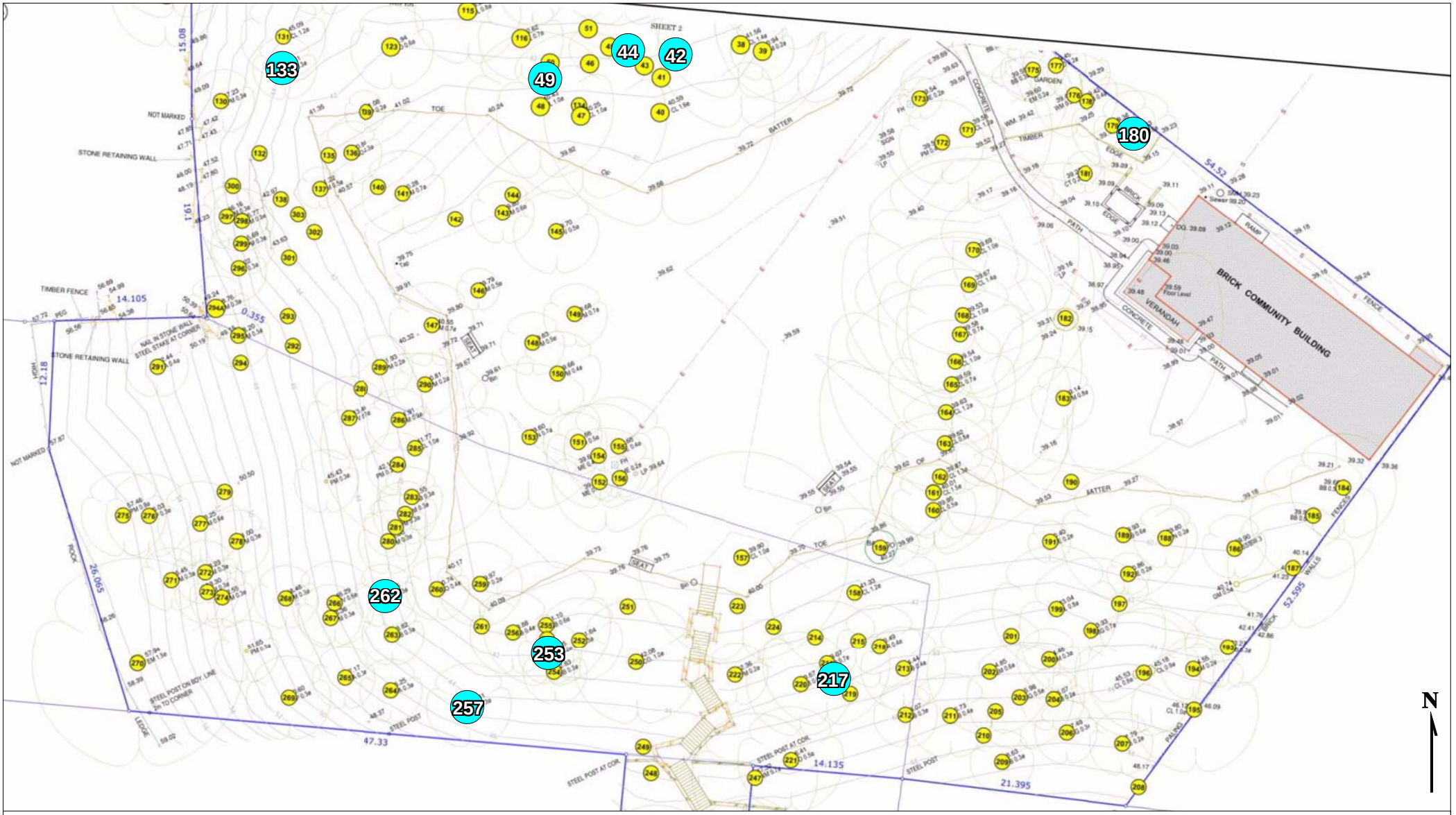
0 10 20
metres

Figure 7d-S.
Location of Lophostemon confertus overlaid on Site Plan with Trees
(Appendix 1b on Advanced Treescape Consulting 2016)



Brachychiton acerifolius (Illawarra Flame Tree)

Figure 7e-N.
Location of Brachychiton acerifolius overlaid on Site Plan with Trees
(Appendix 1a on Advanced Treescape Consulting 2016)



Brachychiton acerifolius (Illawarra Flame Tree)

0 10 20
metres

Figure 7e-S.
Location of Brachychiton acerifolius overlaid on Site Plan with Trees
(Appendix 1b on Advanced Treescape Consulting 2016)

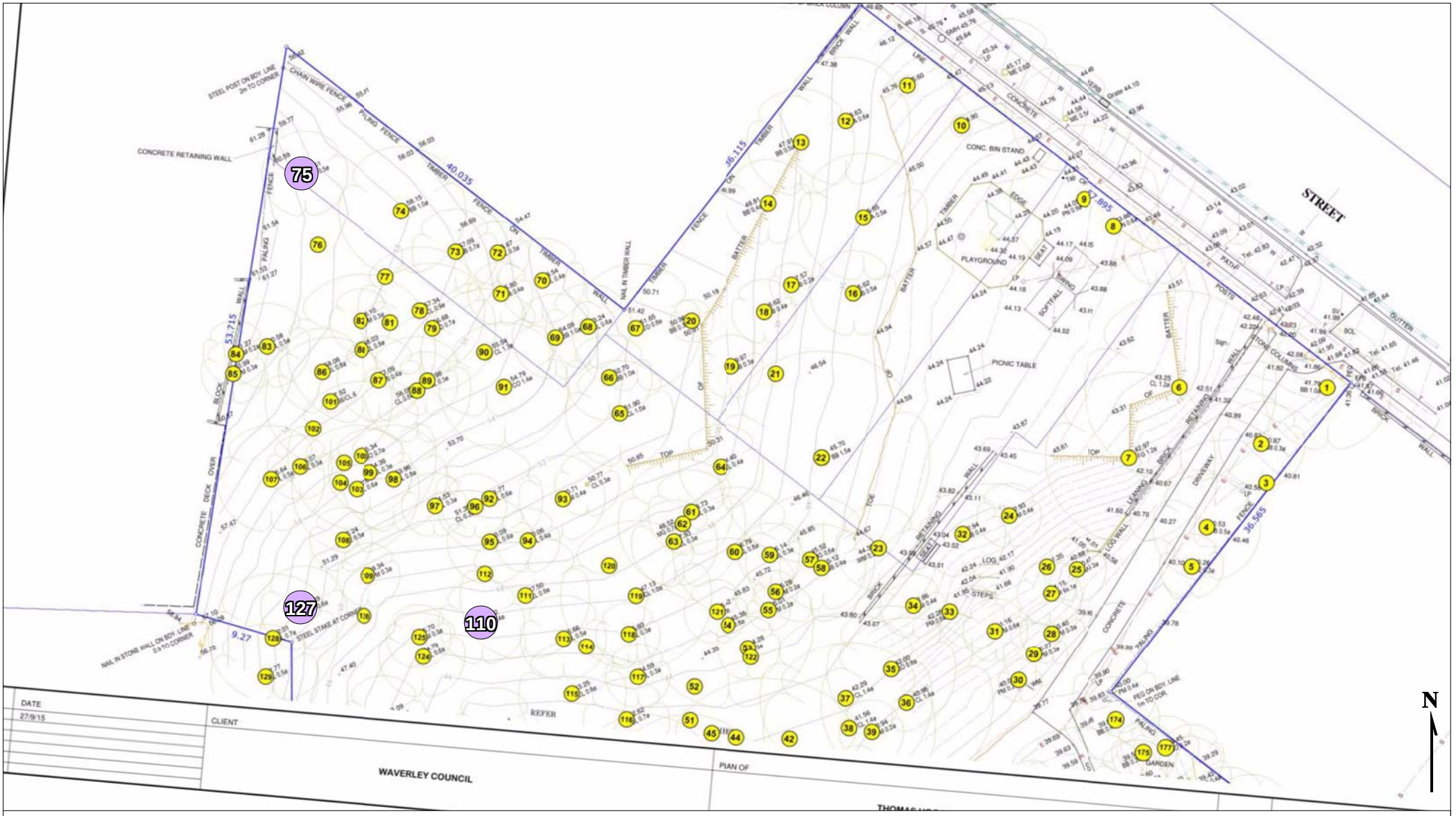


Figure 7f-N.
Location of Phoenix canariensis overlaid on Site Plan with Trees
(Appendix 1a in Advanced Treescape Consulting 2016)

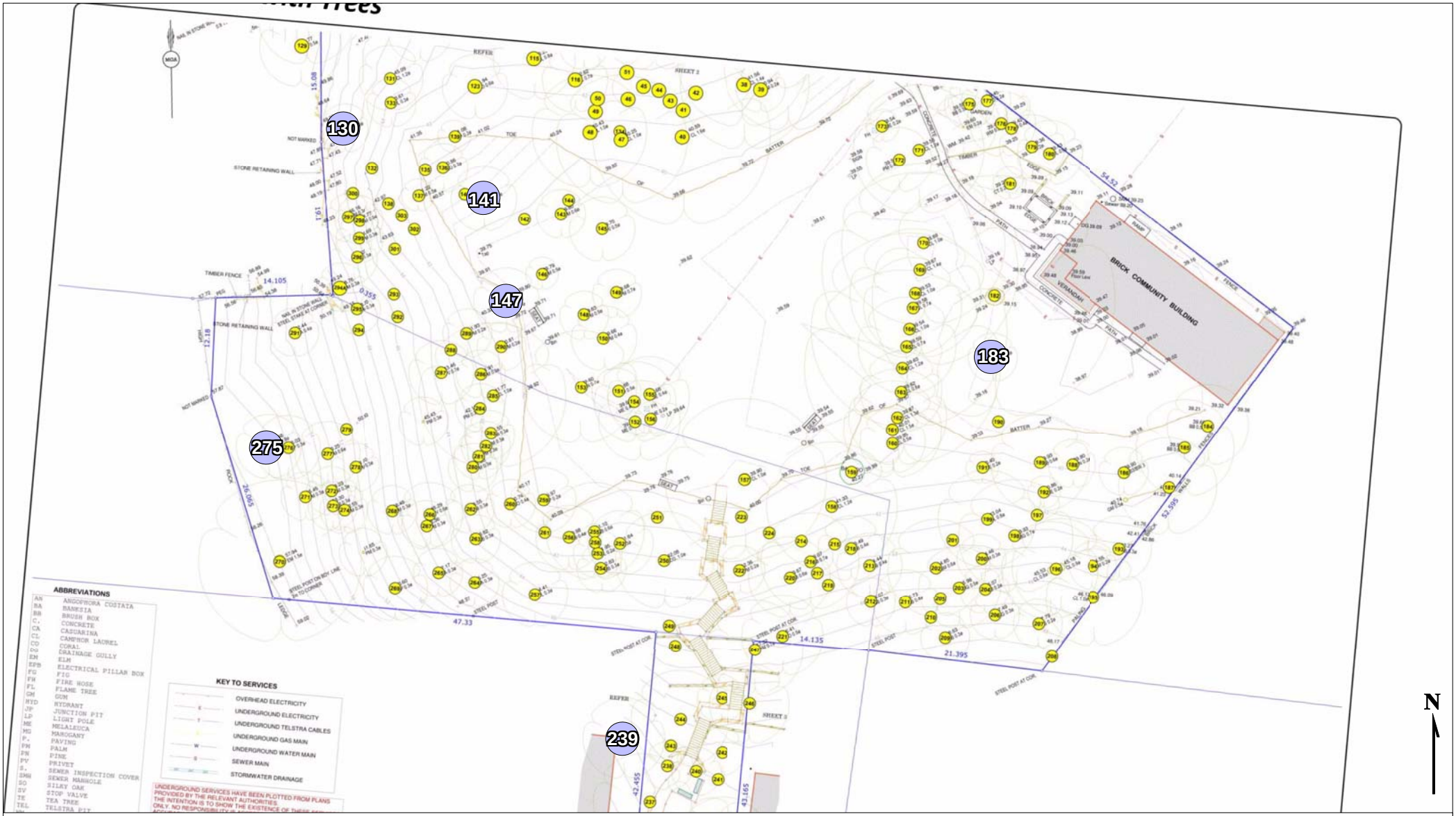


Figure 7f-S.
Location of Phoenix canariensis overlaid on Site Plan with Trees
(Appendix 1b on Advanced Treescape Consulting 2016)

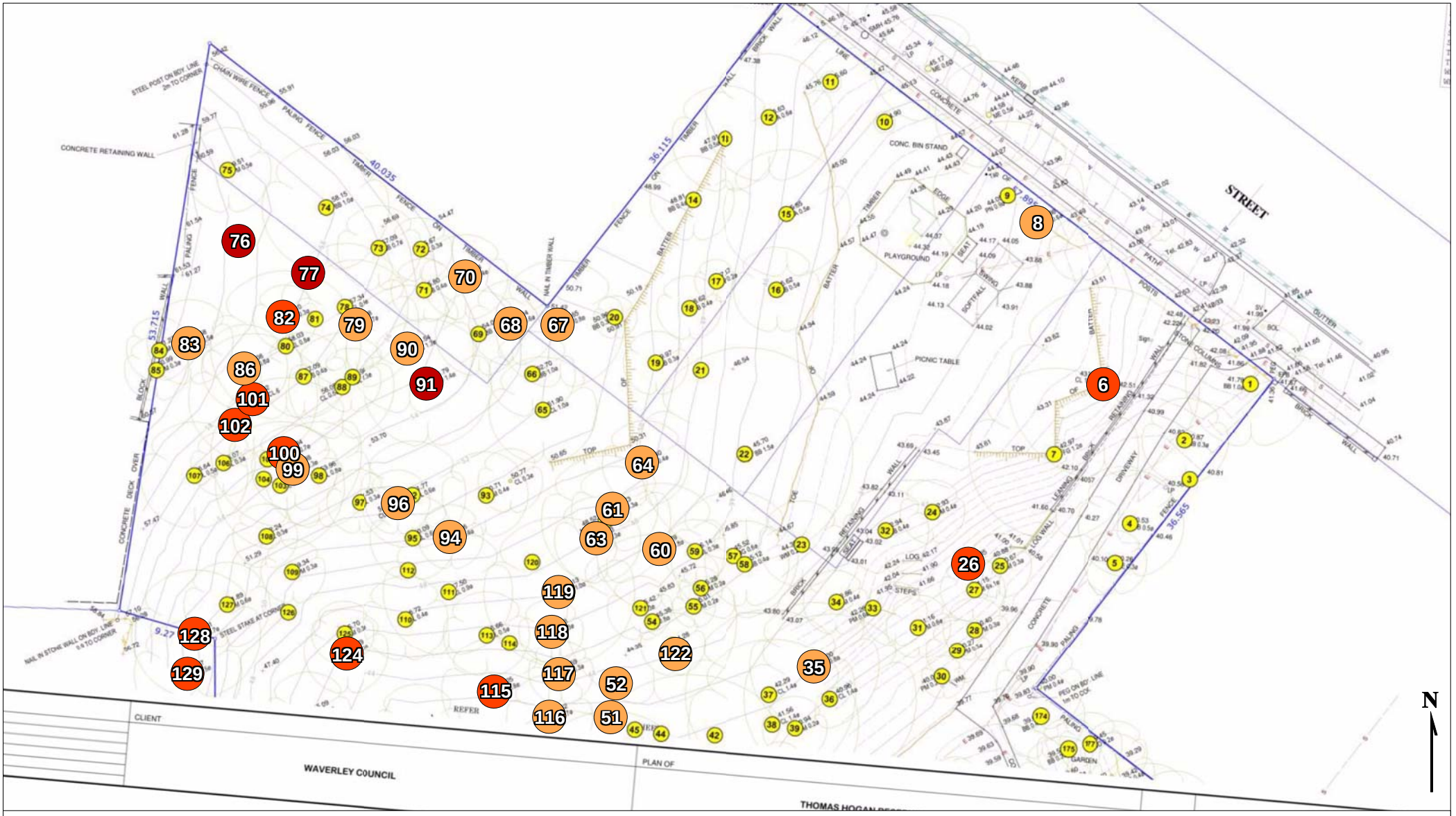


Figure 8a-N.
Trees recommended for removal with priority levels of 1, 2 and 3, overlaid on Site Plan with Trees (Appendix 1a on Advanced Treescape Consulting 2016)

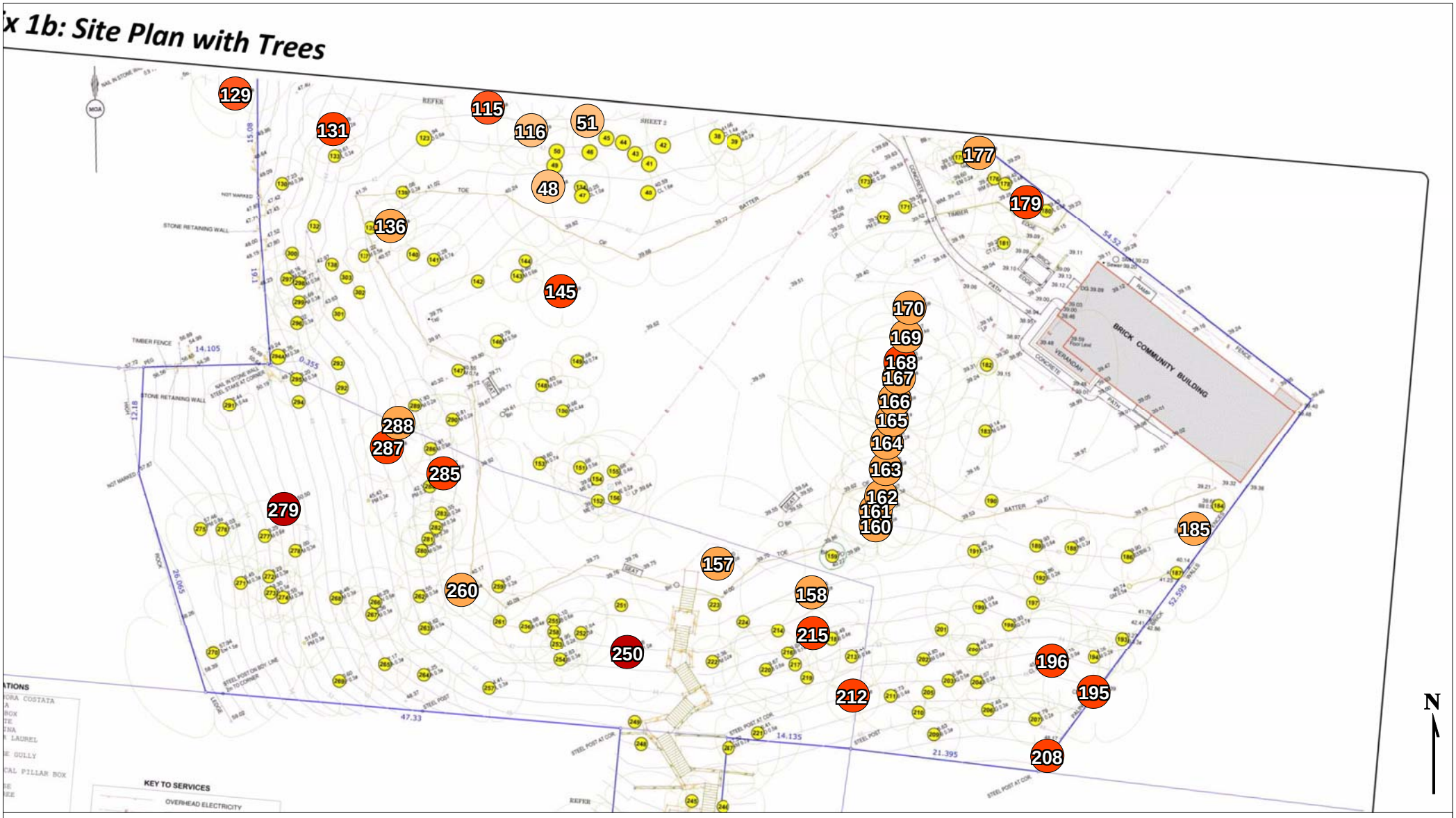


Figure 8a-S.
Trees recommended for removal with priority levels of 1, 2 and 3, overlaid on Site Plan with Trees (Appendix 1b on Advanced Treescape Consulting 2016)

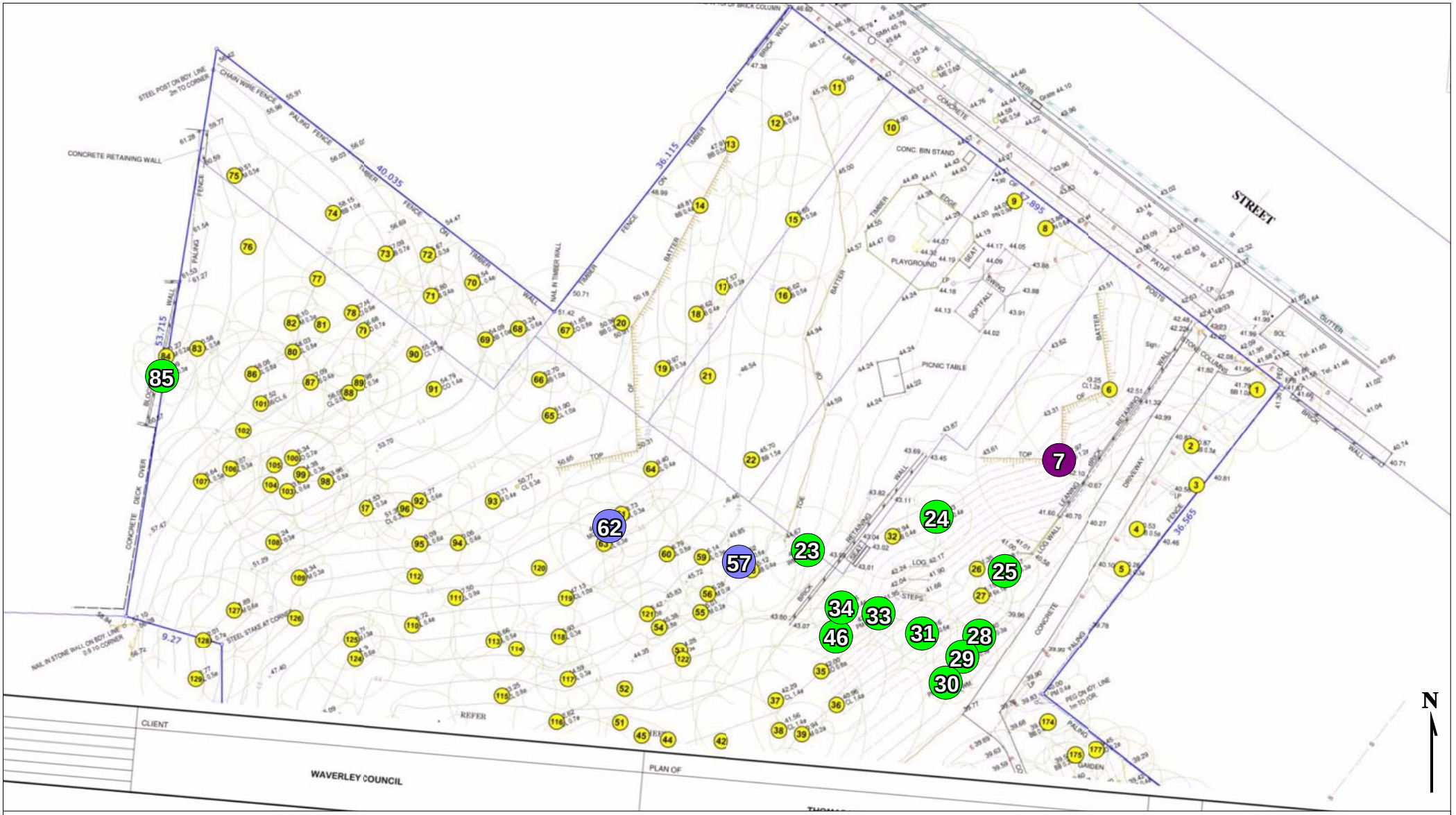
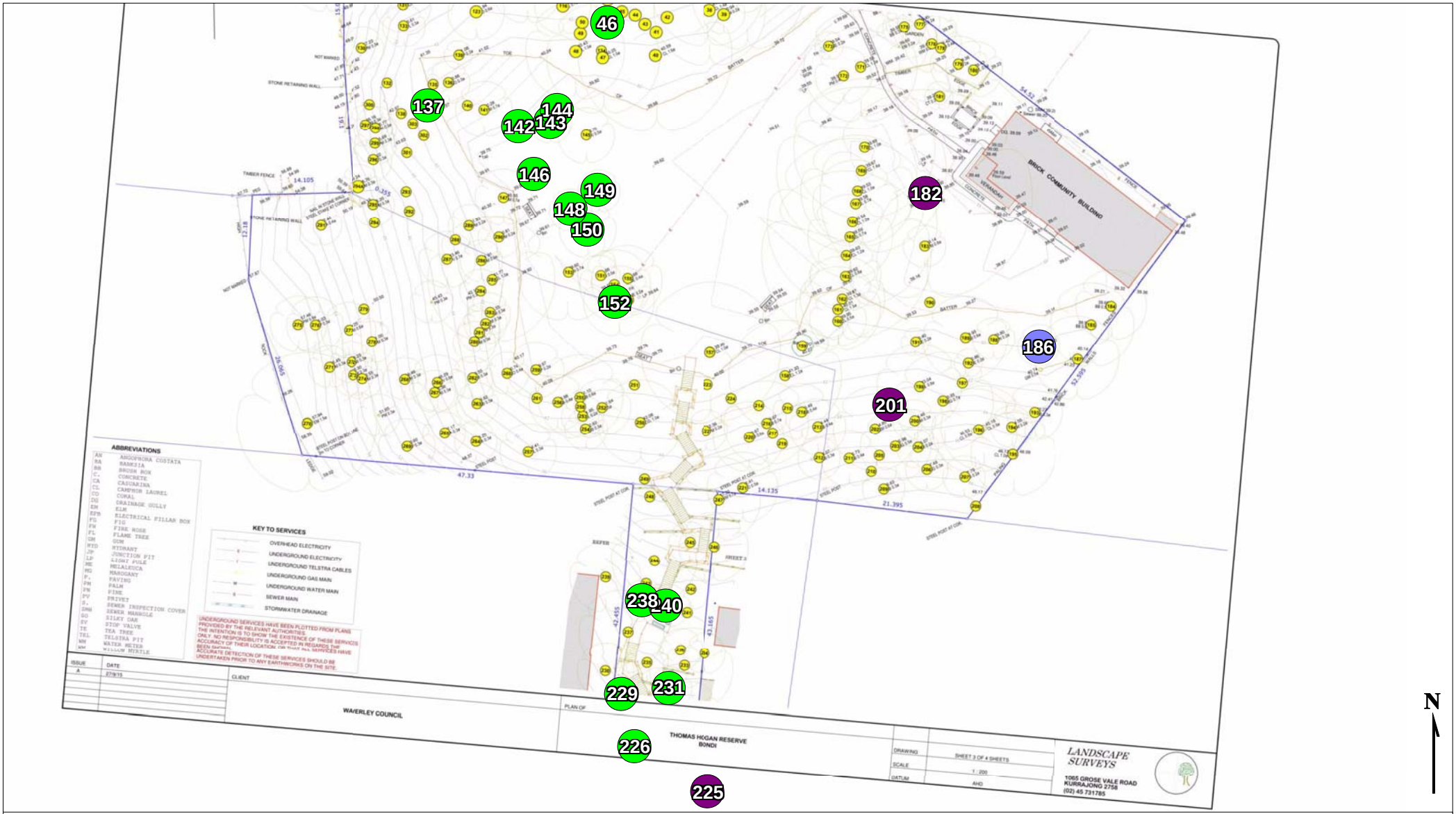


Figure 8b-N.
Location of palms (not including Archontophoenix cunninghamiana and Phoenix canariensis), figs and Eucalyptus botryoides overlaid on Site Plan with Trees (Appendix 1a on Advanced Treescape Consulting 2016)



Ficus (fig) spp.

Palm species

Eucalyptus botryoides

Figure 8b-S.
Location of palms (not including Archontophoenix cunninghamiana and Phoenix canariensis), figs and Eucalyptus botryoides overlaid on Site Plan with Trees (Appendix 1b on Advanced Treescape Consulting 2016)

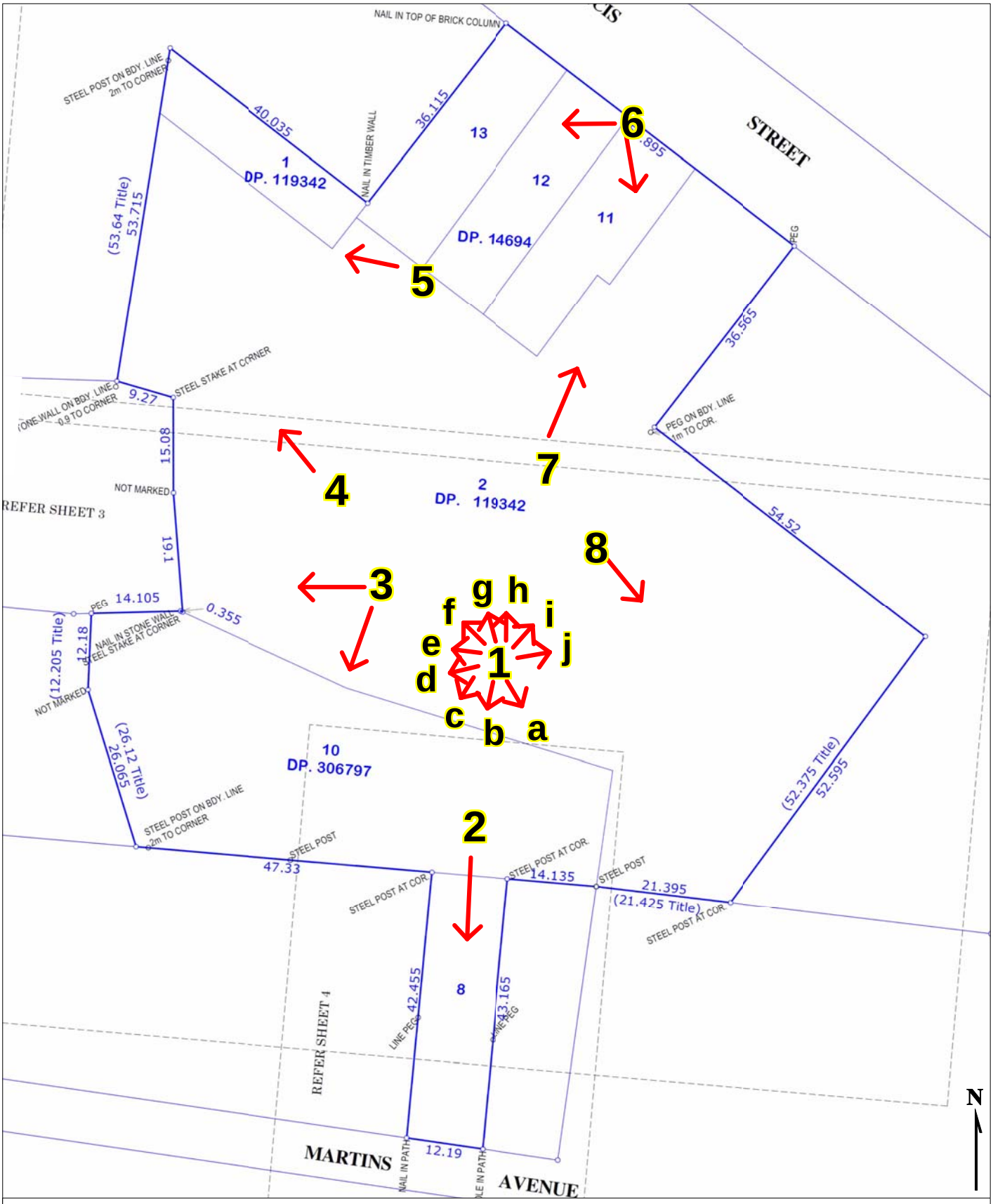


Figure 9.
Suggested monitoring photograph points overlaid on Survey Plan, Sheet 1 (Landscape Surveys 2015)

Tables

Table 1

Targets and Actions Table

Targets and Actions Table required for the implementation of the Vegetation Management Plan

The following management objectives have been set:

1. Protection of the steep slopes
2. Increasing the recreational value of the central area
3. Weed control
4. Enhancing the area of heritage landscape significance
5. Re-establishing the local native vegetation
6. Increasing awareness of the conservation value of the vegetation
7. Monitoring and maintenance

Management Objectives or	Targets	Actions	Time frame	Responsibility
1 to 7	**Appoint Environmental Manager** to implement the VMP.	Appoint an Environmental Manager with experience restoring degraded sites. The Environmental Manager is to be a responsible person with at least 5 years experience of supervising the restoration of degraded native ecosystems and with at least a university degree in natural sciences to supervise, co-ordinate and document works.	Prior to commencement of works.	The Council
1 to 7	**Appoint required personnel.**	Specialist nursery, broad-scale weed controllers (qualified and experienced and hold appropriate licenses), as well as professional planting teams, as required.	As soon as possible.	The Council and the Environment Manager.
1, 6, 7	**Environmental**	Prepare and install signage about the planned	Prior to commencement	The Council and the

Management Objectives or	Targets	Actions	Time frame	Responsibility
	Awareness of park user and residents	works. Copies of the VMP should be made readily available and accessible to all personnel involved with the project. It is also recommended that a copy of the VMP is available on Council's website and lodged with the Waverley Council Library	of phases in the staged works in the Reserve.	Environment Manager.
1, 5, 6	**Environmental Awareness of personnel involved in onsite works.**	Prepared induction document to be signed by all persons working in the Reserve. All persons working in the Reserve are to be fully aware of the erosion risk on the slope .	Prior to commencement.	The Council and the Environmental Manager.
1, 5, 6, 7	Personnel remain aware of risks and issues in the Reserve.	Conduct regular tool box talks at which: - Personnel are made fully aware of the erosion risk on the steep slopes. - Induction material is reviewed. - Current new issues are discussed.	Weekly or as specified by the Environmental Manager during the ongoing works.	The Council and the Environmental Manager.
1, 7	**Cleanliness and minimising risk of pathogens.**	All machinery and loading equipment entering the Reserve, as well as tools and clothing are to be cleaned prior to entry.	Prior to and during works and operations.	Environmental Manager and relevant personnel.
1, 7	**Fencing and protection measures**.	Fencing off areas being close to identified SULE 4 trees may be required, with additional signage explaining the safety risk.	As soon as possible.	The Council and the Environmental Manager.
	Erosion control on upper slopes			
1, 7	**Identify stormwater outlets and existing environmental concerns on the perimeter of the Reserve.**	Inspection of the perimeter of the Reserve with adjoining neighbours.	As soon as practicable.	The Council and the Environmental Manager.

Management Objectives or	Targets	Actions	Time frame	Responsibility
1,3, 5, 6, 7	**Defining Reserve boundaries**	Establish an at least 1 to 2 m strip of dense native tubestock planting (at 0.25 m centres) to provide a living seed bank for use onsite (suggested species in Objective 6).	Post weed control, including removal of SULE 4 and weed trees close at neighbouring properties.	The Council and the Environmental Manager.
1, 4, 7	Removal of all weed trees close to neighbouring properties.	Conduct discussions with adjoining residents to ensure that the perimeter planting meets their expectation. Remove all Priority and weed trees within a 5 to 10 m setback from all neighbouring properties (see details for erosion control on slopes). Trees to be removed are to be clearly identified and their removal supervised by a fauna consultant and council.	Prior to dense tubestock panting on permeter.	Bushcare Officer in consultation with Environmental Manager, as required.
	Erosion control on slopes – **Initial priority to establish series of weed-free erosion controlled areas of approximately 100 m^2 on the slopes** – **followed progressively by the entire slope having high flora diversity, providing diverse fauna habitats and erosion controlled**			
1, 7	**Formalised access path on slopes.**	Discuss potential locations of formalised pathway with local Police about safety by design. The approximate location of the formalised track is to be marked onsite using timber stakes. This will assist in determining placement of cut tree trunks and branches on the highly erodible slopes.	Prior to removal of Priority and weed trees on the slope.	The Council, the Environmental Manager and Police Officer, as required.
1, 3, 5, 7	Re-establish local native vegetation.	Weed species (including weed trees) are to be controlled and replaced with preferably with local provenance plants in order to reduce erosion risk, increase soil fungal binding capacity and improve nutrient cycling.	Progressively during the staged works.	Bushcare Officer in consultation with Environmental Manager, as required.

Management Objectives or	Targets	Actions	Time frame	Responsibility
1, 7	Sediment/erosion control measures in place.	Install sediment control measures: Biodegradable timber-staked windrows of Priority and weed trees being removed placed along the contour on the slope, followed by maintained dense tubestock planting. Sediment fencing is to be erected as required. Use of machinery on the steep slopes is to be avoided, where practicable. Re-establishment of local native vegetation is essential to increase the slope stability.	As soon as practicable	The Council and the Environmental Manager.
3, 5, 7	Removal all Priority trees identified by the consulting Arborist.	Many of the trees to be removed are located on steep loose sandy slopes, hence removal must be carefully staged to minimise the risk of erosion. Concurrently to staged tree removal, there must be a staged re-establishment of a diverse native vegetation, which forms part of the strategy for slope stabilisation. Priority should be given to local provenance pioneer species, particularly those with related soil fungal hyphae, which will colonise/establish quickly and reduce erosion. Trees to be removed are to be clearly identified and their removal supervised by a fauna consultant and council.	Priority 1 trees removed first, then Priority 2, 3 then weed trees.	The Council and the Environmental Manager.
1, 5, 7	Preparation for establishing 5 m wide strip of reduced erosion risk on	Order sufficient tubestock of local provenance, preferably pioneer species for planting (at 0.25 m centres) a 2-3 m wide strip upslope of the tree	Prior to removal of Priority and weed trees.	Bushcare Officer in consultation with Environmental Manager, as

Management Objectives or	Targets	Actions	Time frame	Responsibility
	the slope.	trunks to be placed on the slope in weed controlled soil.		required.
1, 3, 5, 7	Weed management on slopes associated with tree removals.	Weeds be herbicide controlled in an approximately 5 m wide strip along the contour in the area of the proposed trunk placement.	At least 2 weeks prior to tree removals.	Bushcare Officer in consultation with Environmental Manager, as required.
1, 7	Weed management on slopes associated with tree removals.	Any weed re-growth in the proposed area where the tree trunk/s are to be placed be spot sprayed.	Immediately prior to tree removal.	Bushcare Officer in consultation with Environmental Manager, as required.
1, 3, 7	Removal of Priority and large weed tree	Cut trees and branches are to be pegged as required along the contour on the weed-controlled soil on the slopes.	At time of tree removals	The Council and the Environmental Manager.
1, 3, 7	Ongoing weed management on slopes associated with tree removals.	Careful spot spray any weed regrowth, if required, followed by secondary weed control as part of management of the slope.	4-6 weeks post tubestock planting.	Bushcare Officer in consultation with Environmental Manager, as required.
	Fauna protection			
	Fauna protection during tree removals.	Trees to be removed are to be checked by a qualified fauna expert to ensure that no native fauna are harmed. If native fauna are encountered, these are to be managed as specified by the fauna expert.	Immediately prior to tree removal.	Fauna expert in consultation with Environmental Manager, as required.
3, 4, 5, 6, 7	Protect fauna habitat.	Faunal habitat such as dense Lantana stands are to be considered with staged removal.	Prior to and during works.	Fauna expert in consultation with Environmental Manager, as required.
	Improving amenity of central area			

Management Objectives or	Targets	Actions	Time frame	Responsibility
2, 7	Removal of the 11 *Cinnamomum camphora* near community centre.	These 11 trees (Trees 160-170) of which one (Tree 168 with SULE 4 rating) are to be cut and removed from the Reserve.	As part of Priority tree removals.	The Council and the Environmental Manager.
2, 4, 7	Additional planting, paths and barbeques in the central area.	Design and install (see example of intensely used Shelly Beach). Additional palm planting, especially of the local native species *Livistona australis*, should be considered at the base of the slope where there are existing problems of soil slip.	When considering the Central Area.	The Council and the Environmental Manager.
2, 7	Establish durable turf.	*Cyndon dactylon* (Common Couch) can tolerate some shade with reduced pedestrian traffic and less frequent mowing. *Cyndon dactylon* is a cosmopolitan species and its invasion in garden beds is generally more acceptable than exotic grasses. Other grasses to considered include the shade tolerant *Stenotaprum secundatum* (Buffalo Grass).	Post installing planting, paths and barbeques, and controlling existing sand downwash from slopes.	The Council and the Environmental Manager.
	Weed control			
1, 3, 7	Primary control of woody weeds	Priority and weed tree removal of large individuals involve cutting and placement on weed controlled ground surface with follow up tubestock planting, resulting in approximately 5 m wide strip of weed-free erosion control areas of approximately 100 m^2. Smaller individuals are to be herbicide controlled insitu.	During priority and weed tree removal.	Bushland Officer in consultation with Environmental Manager.
3, 7	Secondary and maintenance control of woody weeds.	Careful weed control with small seedlings removed by hand, where appropriate, and saplings or suckering plants scraped and painted with undiluted glyphosate herbicide. These actions will	Following primary control of woody weeds.	Bushland Officer in consultation with Environmental Manager.

Management Objectives or	Targets	Actions	Time frame	Responsibility
		require regular implementation to exhaust the weed seed bank and prevent any new seedlings maturing and seeding. Techniques can be varied.		
1, 3, 7	Primary control of groundlayer weeds.	Herbicide control at 2 weeks prior to tree removals and spot spraying immediately prior to tree removals.	During priority and weed tree removal.	Bushland Officer in consultation with Environmental Manager.
3, 7	Primary control of groundlayer weeds.	Individuals are to be herbicide controlled insitu or hand weeded.	During staged weed control of schedule areas.	Bushland Officer in consultation with Environmental Manager.
3, 7	Secondary and maintenance control of groundlayer weeds.	Careful weed control with additional planting and direct-seeding in bare areas.	Following primary control.	Bushland Officer in consultation with Environmental Manager.
	Enhancing the area of heritage landscape significance.			
1, 3, 4, 7		Careful removal weeds and complimentary plantings required. Additional palm planting, especially of the local native species *Livistona australis*, should be considered at the base of the slope where there are existing problems of soil slip and identified moist gullies.	Following careful removal of Priority and weed trees close to palms and figs.	Bushland Officer, the Council and the Environmental Manager.
	Monitoring and reporting			
7	Monitoring photographs from fixed points.	Set up fixed monitoring photographic points.	Prior to commencement of the works and during the monitoring period.	Environmental Manager.
7	All rehabilitation works are monitored and reported regularly.	Monitor all rehabilitation works and prepare reports detailing the progress and success of revegetation and rehabilitation works, and to ensure that corrective actions are undertaken promptly as	Month 1, month 3, month 6, then yearly; or as each progressive stage is completed.	Environmental Manager and Ecological/environmental consultant

Management Objectives or	Targets	Actions	Time frame	Responsibility
	Monitoring, maintenance, reporting and corrective action requests.	required. Include in reports: - details of rainfall and stormwater; - fauna sightings and associated works; - works done and further works required; - photographic record of works and photographs from the fixed monitoring points; - data on vegetation structure and species - composition recorded from fixed transects. Monitoring reports are used to assess the success of the works. Results of the monitoring are to be publicly available for discussion, for planning the next stage and re-assessing targets.		
7	Maintenance and corrective actions are carried out as required. Maintenance and corrective actions are documented.	Address any issues that arise through the monitoring process and implement corrective actions. Document outcomes of implementation in the next monitoring report.	Month 1, month 3, month 6 then 12 monthly for at least two years after planting. Completion of the monitoring period is contingent upon achieving the targets.	Environmental Manager

Table A1

Species recorded in sampling locations in the 2015 survey

Table A1 — Species recorded in all Transect and Spot locations at Thomas Hogan Reserve

Notes: 1. Asterisk (*) before botanical name signifies exotic species. Hash symbol (#) signifies a non-local native, planted or naturalised
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 Subquadrats show percentage coverage by which the species occurs in each 10m x 10m quadrat, each at 10m intervals, along a 40m transect line. For Spot Locations, presence only is indicated.

Botanical name	Common name	Subquadrat												Spot location		
		T1-1	T1-2	T1-3	T1-4	T2-1	T2-2	T2-3	T2-4	T3-1	T3-2	T3-3	T3-4	A	B	C
1. Pteridophytes																
Adiantaceae																
Adiantum aethiopicum	Common Maidenhair Fern						<1									
Aspleniaceae																
Asplenium australasicum	Birds-nest Fern			1			<1									
Davalliaceae																
# Nephrolepis cordifolia	Fishbone Fern		3	1	3											X
Pteridaceae																
Pteris tremula	Tender Brake				1											
2. Gymnosperms																
Araucariaceae																
* Araucaria columnaris	New Caledonian Pine, Pin Colonnaire													X		
Podocarpaceae																
# Podocarpus elatus	Plum Pine, Brown Pine															X
3. Dicotyledons																
Apocynaceae																
* Nerium oleander	Oleander									2						
Araliaceae																
* Hedera helix	Ivy, English Ivy		1					1								X
Asteraceae																
* Hypochaeris radicata	Catsear, False Dandelion												<1			

Botanical name	Common name	Subquadrat												Spot location		
		T1-1	T1-2	T1-3	T1-4	T2-1	T2-2	T2-3	T2-4	T3-1	T3-2	T3-3	T3-4	A	B	C
* Conyza sumatrensis	Tall Fleabane													X		
* Bidens pilosa	Cobbler's Pegs													X		
* Taraxacum officinale	Dandelion													X		
* Ageratina riparia	Mistflower			1			<1									
* Soliva sessilis	Bindi-eye, Jo-Jo								<1				1			
Basellaceae																
* Anredera cordifolia	Madeira Vine, Lamb's Tail									1	1	1	1			X
Bignoniaceae																
* Jacaranda mimosifolia	Jacaranda													X		
Caryophyllaceae																
* Polycarpon tetraphyllum	Four-leaf Allseed													X		
* Stellaria media	Chickweed								<1							
Convolvulaceae																
* Ipomoea indica	Blue Morning Glory	<1	0	<1		2	1	2								
Euphorbiaceae																
Glochidion ferdinandi	Cheese Tree			1							1					X
Homalanthus populifolius	Bleeding heart, Native Poplar				1											
Breynia oblongifolia	Coffee Bush													X		
Fabaceae Caesalpinioideae																
* Senna pendula	Easter cassia									1	1					
Lauraceae																
* Cinnamomum camphora	Camphor Laurel	30	40	40	20		30	5			10	25	20		X	X
Liliaceae																
* Aspidistra elatior	Cast-Iron Plant, Aspidistra			<1	<1											
Malaceae																
* Eriobotrya japonica	Loquat										1			X		
Malvaceae																
* Sida rhombifolia	Paddy's Lucerne					<1	1	1	1				1			
Moraceae																
Ficus rubiginosa	Port Jackson Fig, Rusty Fig	1														

Botanical name	Common name	Subquadrat												Spot location		
		T1-1	T1-2	T1-3	T1-4	T2-1	T2-2	T2-3	T2-4	T3-1	T3-2	T3-3	T3-4	A	B	C
# Ficus macrophylla	Moreton Bay Fig														X	
* Ficus lyrata	Fiddle-leaf Fig									1						
Myrtaceae																
# Corymbia citriodora	Lemon-scented Gum													X		
# Lophostemon confertus	Brush Box	50		1	1						50			X		X
# Callistemon salignus	White Bottlebrush, Pink-tips									3						
Eucalyptus botryoides	Bangalay													X		X
# Syzygium oleosum	Blue Cherry				10											
Nyctaginaceae																
* Mirabilis sp.	Four o'clock													X		
Ochnaceae																
* Ochna serrulata	Mickey Mouse Plant	1									<1	1				
Oleaceae																
* Ligustrum lucidum	Broad-leaved Privet, Glossy Privet						15	3			1					
* Ligustrum sinense	Small-Leaved Privet, Chinese Privet					<1	<1	1		1	1					
Oxalidaceae																
* Oxalis debilis	Pink Oxalis								<1							
* Oxalis corniculata	Yellow Wood-sorrel														X	
Oxalis exilis	Creeping Oxalis												<1			
Pittosporaceae																
Pittosporum undulatum	Pittosporum					3						10				X
Polygonaceae																
* Acetosa sagittata	Rambling Dock, Turkey Rhubarb													X		
Proteaceae																
# Grevillea robusta	Silky Oak	1		1	1											
# Stenocarpus sinuatus	Firewheel Tree			1	1											X
Sapindaceae																
Cupaniopsis anacardioides	Tuckeroo			<1												
Scrophulariaceae																
* Veronica persica	Creeping Speedwell								<1							

Botanical name	Common name	Subquadrat												Spot location		
		T1-1	T1-2	T1-3	T1-4	T2-1	T2-2	T2-3	T2-4	T3-1	T3-2	T3-3	T3-4	A	B	C
Sterculiaceae																
# Brachychiton sp.	Flame tree															X
# Brachychiton acerifolius	Illawarra Flame-tree, Flame Kurrajong		1	3			<1	1		1				X		
Ulmaceae																
* Celtis sinensis	Chinese Hackberry, Chinese Nettle-tree					<1	1	<1		1	5	1		X		
Urticaceae																
* Parietaria judaica	Wall Pellitory, Kirribilli Curse, Stickywee	1		<1	2	1	<1	2		1						
Verbenaceae																
* Lantana camara	Lantana					80										
4. Monocotyledons																
Amaryllidaceae																
* Clivia miniata	Kaffir Lily									20	2	5				
Anthericaceae																
* Chlorophytum comosum	Spider Plant	1	2	2							1	2				X
Araceae																
* Syngonium podophyllum										<1						
Arecaceae																
* Phoenix canariensis	Canary Island Date	1				20				10	15	1	3	X	X	
* Sabal sp.	Palmetto															X
* Syagrus romanzoffiana	Cocos Palm, Queen Palm		3						5						X	
* Butia capitata	Butia Palm, Jelly Palm								5							
# Archontophoenix cunninghamiana	Bangalow Palm	<1	2	1	5		50	40								X
* Phoenix reclinata	African Wild Date, Senegal Date		5	3						2			1			X
Asparagaceae																
* Asparagus plumosus	Climbing Asparagus Fern									2						
* Asparagus aethiopicus	Asparagus Fern	2		<1												
Cannaceae																
* Canna indica	Indian Shot					3										

Botanical name	Common name	Subquadrat												Spot location		
		T1-1	T1-2	T1-3	T1-4	T2-1	T2-2	T2-3	T2-4	T3-1	T3-2	T3-3	T3-4	A	B	C
Commelinaceae																
* Tradescantia fluminensis	Wandering Jew	60	90	15	75	20	5	20	3	70	20	20	2	X		X
Cyperaceae																
Cyperus mirus									<1							
Dracaenaceae																
* Dracaena warneckii	Striped dracaena									<1						
Iridaceae																
* Dietes sp.	Butterfly Iris	2														
Lomandraceae																
# Lomandra longifolia	Honey Reed, Spike Mat-rush							<1								
Poaceae																
* Poa annua	Winter Grass								2							
* Ehrharta erecta	Panic Veld-grass	10	2	3	5		1	5	2			2	3	X	X	X
Microlaena stipoides	Weeping Grass, Meadow Rice-grass												30	X	X	
* Dactylis glomerata	Cocksfoot, Cocksfoot Grass													X		
* Lolium perenne	Perennial Ryegrass								80						X	
* Stenotaphrum secundatum	Buffalo Grass								<1	3				X		
* Pennisetum clandestinum	Kikuyu Grass, Kikuyu													X		
Oplismenus aemulus	Australian Basket Grass, Wavy Beard G			<1	<1			1	3					X		
* Setaria palmifolia	Palm Grass					2	2	15	3			1			X	
* Bambusa balcooa	Giant Bamboo											5	40			

Table A2

Number of individuals and maximum height (H) of trees greater than 2 m tall in each 10 m x 10 m quadrat (1 to 4) for the transects (T1 to T3)

Table A2
Number of individuals and maximum height (H) of trees greater than 2m tall in each 10 m x 10 m quadrat (1 to 4) for the transects (T1 to T3).

	Species	No.	H	No.	H	No.	H	No.	H
	Transect 1	**T1-1**		**T1-2**		**T1-3**		**T1-4**	
#	*Archontophoenix cunninghamiana*							2	5m
#	*Brachychiton acerifolius*			1	3m	1	6m		
*	*Cinnamomum camphora*	*2*	13m	3	13m	4	20m	1	15m
*	*Ficus rubiginosa*	1	3m						
	Homalanthus populifolius							1	5m
#	*Lophostemon confertus*	2	18m			1	3m	1	2
*	*Phoenix reclinata*					1	3m		
*	*Syagrus romanzoffiana*			1	18m				
#	*Syzygium oleosum*							1	11m
	Number of trees recorded	**5**		**5**		**7**		**6**	
	Transect 2	**T2-1**		**T2-2**		**T2-3**		**T2-4**	
#	*Archontophoenix cunninghamiana*			7	12m	12	13m		
#	*Brachychiton acerifolius*					1	3m		
*	*Butia capitata*							1	8m
*	*Cinnamomum camphora*			1	18m	1	20m		
*	*Ligustrum lucidum*			1	12m				
*	*Phoenix canariensis*	1	7m						
	Pittosporum undulatum	1	3m						
*	*Syagrus romanzoffiana*							1	15m
	Number of trees recorded	**2**		**9**		**14**		**2**	
	Transect 3	**T3-1**		**T3-2**		**T3-3**		**T3-4**	
*	*Bambusa balcooa*					1	18m	1	18m
#	*Callistemon salignus*	2	9m						
*	*Celtis sinensis*	1	8m	1	7m				
*	*Cinnamomum camphora*			1	17m	1	20m	4	20m
*	*Ficus lyrata*	1	4m						
	Glochidion ferdinandi			1	4m	1	13m		
#	*Lophostemon confertus*			2	23m				
*	*Phoenix canariensis*	1	3m						
	Pittosporum undulatum					1	6m		
	Number of trees recorded	**5**		**5**		**4**		**5**	

= non-local native
* = exotic

Table A3

Tree species recorded with tree number and number individual trees, with SULE ratings

Table A3
Tree species recorded with tree number and number individual trees, with SULE ratings

Species	Tree numbers	Total
Agonis flexuosa	178, 241, 247, 248	4
A. flexuosa (Group of)	243, 244	2
Angophora costata	135, 246	2
Araucaria bidwillii	291	1
Araucaria columnaris	188, 242	2
Archontophoenix cunninghamiana	12, 15, 27, 39, 41, 43, 55, 56, 81, 84, 95, 109, 120, 125, 126, 132, 194, 219, 222, 223, 231, 232, 233, 235, 236, 245, 249, 267, 268, 269, 271, 272, 273, 274, 276, 277, 280, 281, 282, 283, 284, 286, 289, 290, 292, 293, 296, 297, 298, 299	50
A. cunninghamiana (Group of 10x)	278	10
Backhousia myrtifolia	139, 259, 261	3
Bamboo clump (50x)	158	1
Banksia integrifolia	294	1
Brachychiton acerifolius	42, 44, 49, 72, 106, 108, 133, 180, 217, 253, 257, 262, 295	13
Butia sp.	33	1
Callicoma serratifolia	303	1
Callistemon salignus	153, 154, 155, 156, 173, 190, 191, 192	8
Casuarina cunninghamiana	264, 265	2
Cedrus deodara	151	1
Celtis sinensis	176, 215, 227	3
Cinnamomum camphora	6, 36, 37, 38, 40, 45, 47, 48, 50, 51, 52, 59, 60, 61, 63, 64, 65, 68, 70, 78, 80, 82, 83, 86, 88, 89, 90, 92, 93, 94, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 107, 112, 114, 113, 115, 116, 117, 118, 119, 123, 124, 128, 129, 131, 157, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 180, 171, 195, 199, 208, 212, 279, 285, 287	75
Corymbia citriodora	187, 200, 202	3
Cupaniopsis anacardioides	10, 11	2
Dead stump	76, 77, 100	3
Elaeocarpus reticulatus	140	1
Erythrina X sykesii	67, 79, 91, 250	4
Eucalyptus botryoides	57, 62, 186, 197, 198, 203, 206	7
Eucalyptus saligna	237	1
Ficus macrophylla	134, 182	2
Ficus rubiginosa	7, 201, 225	3
Ficus sp.	258	1
Grevillea robusta	35, 136, 177, 221, 260	5
Harpephyllum caffrum	234	1
Leptospermum petersonii	3, 5	2
Ligustrum lucidum	145, 266, 288	3
Livistona chinensis	24,137,142, 146, 148, 158, 229	7
Livistona chinensis var. subglobosa	143, 144	2
Livistona spp.	30, 31, 85	3

Species	Tree numbers	Total
Lophostemon confertus	1, 2, 4, 13, 14, 16, 17, 18, 19, 20, 21, 22, 32, 58, 66, 69, 71, 73, 74, 174, 175, 179, 184, 185, 189, 193, 204, 209, 210, 211, 213, 214, 216, 220, 224, 254, 255, 256, 263	39
Melaleuca quinquenervia	228, 230	2
Palm Stump	26	1
Phoenix canariensis	75, 110, 130, 127, 141, 147, 183, 239, 275	9
Phoenix reclinata	149	1
Pinus radiata	8, 9,	2
Pittosporum undulatum	87, 138, 205, 207, 218, 251, 302	7
Podocarpus elatus	23, 300	2
Populus sp.	270	1
Sapium sebiferum	181	1
Stenocarpus sinuatus	121, 301	2
Syagrus romanzoffiana	25, 28, 29, 34, 46, 150, 172, 226	8
Syzygium oleosom	54, 111, 122	3
Unknown Palm species	238, 240	2
Unknown species	53, 252	2

SULE 1 trees

Species	SULE 1	SULE 1B
Angophora costata	135	
Araucaria bidwillii		291
Araucaria columnaris	188	
Archontophoenix cunninghamiana		39
Backhousia myrtifolia	139	
Cupaniopsis anacardioides		10, 11
Elaeocarpus reticulatus	140	
Eucalyptus botryoides	198	
Ficus rubiginosa	201	7, 225
Livistona chinensis	137	
Livistona chinensis var. *subglobosa*	143, 144	
Podocarpus elatus		300

SULE 2

Species	SULE 2	SULE 2B	SULE 2D
Agonis flexuosa	178	241, 247, 248	
A. flexuosa (Group of)		243, 244	
Angophora costata		246	
Araucaria columnaris		242	
Archontophoenix cunninghamiana	125, 126, 132, 194, 219	12, 15, 27, 41, 43, 55, 56, 81, 84, 95, 109, 120, 222, 223, 231, 232, 233, 235, 236, 245, 249, 267, 268, 269, 271, 272, 273, 274, 276, 277, 280, 281, 282, 283, 284, 286, 289, 290, 292, 293, 296, 297, 298, 299	
A. cunninghamiana (Group of 10x)		278	
Backhousia myrtifolia		259, 261	
Banksia integrifolia		294	
Brachychiton acerifolius	133, 180, 217	42, 44, 49, 72, 106, 108, 253, 257, 262, 295	

Butia spp.		33	
Callicoma serratifolia		303	
Callistemon salignus	153, 154, 155, 156, 173, 190, 191, 192		
Casuarina cunninghamiana		264, 265	
Cedrus deodara	151		
Celtis sinensis	176	227	
Cinnamomum camphora	159, 171	37, 38, 40, 45, 47, 50, 59, 65, 78, 80, 88, 89, 92, 93, 97, 98, 103, 104, 105, 107,112,113, 114, 123	
Corymbia citriodora	187, 200, 202		
Eucalyptus botryoides	186, 197, 203, 206	57, 62	
Eucalyptus saligna		237	
Ficus macrophylla	134, 182		
Ficus spp.		258	
Grevillea robusta		221	
Harpephyllum caffrum		234	
Leptospermum petersonii		3, 5	
Ligustrum lucidum		266	
Livistona chinensis	142, 146, 148, 158	24, 229	
Livistona spp.		30, 31, 85	
Lophostemon confertus	174,175, 184, 189, 193, 204, 209, 210, 211, 213, 214, 216, 220	1, 2, 4, 13, 14, 16, 17, 18, 19, 20, 21, 22, 32, 58, 66, 69, 71, 73, 74, 224, 254, 255, 256, 263	
Melaleuca quinquenervia		228, 230	
Phoenix canariensis	127, 130, 141, 147, 183	75, 110, 239, 275	
Phoenix reclinata	149		
Pittosporum undulatum	138, 205, 207, 218	87, 251, 302	
Podocarpus elatus		23	
Populus spp.		270	
Sapium sebiferum	181		
Stenocarpus sinuatus		121, 301	
Syagrus romanzoffiana	172, 150	25, 28, 29, 34, 46, 226	
Syzygium oleosom		54, 111	
Unknown Palm species		238, 240	
Unknown species		53, 252	

SULE 3

Species	**SULE 3**	**SULE 3B**
Bamboo clump (50x)	158	
Cinnamomum camphora	157,160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 199	36, 48, 51, 52, 60, 61, 63, 64, 68, 70, 83, 86, 90, 94, 96, 99, 116, 117, 118, 119
Erythrina X sykesii		67, 79
Grevillea robusta	136, 177	35, 260
Ligustrum lucidum		288
Lophostemon confertus	185	
Pinus radiata		8

Syzygium oleosom		122

SULE 4

Species	SULE 4	SULE 4A	SULE 4B	SULE 4C
Celtis sinensis		215		
Cinnamomum camphora	6, 128, 129, 131, 168, 195, 196, 208, 212	101, 115		82, 102, 124
Dead stump		76, 77, 100		
Erythrina X sykesii	250			91
Ligustrum lucidum	145			
Lophostemon confertus	179			
Palm Stump		26		

Appendicies

Appendix 1

Company Profile and Brief CVs

ANNE CLEMENTS & ASSOCIATES PTY. LIMITED
(ABN 41 077 242 365, ACN 077-160-939)
Environmental and Botanical Consultants
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September 2015

Anne Clements & Associates is a group of botanists, ecologists and restoration ecologists who specialise in botanical conservation assessment, as well as developing and implementing optimal conservation strategies. The company has more than 25 years of experience in:

- flora surveys of a wide range of ecosystems;
- flora assessments;
- assessments of impacts;
- vegetation plans of management;
- the implementation of rehabilitation/conservation programs as part of sustainable development of sites; and
- environmental management of development sites.

The company works closely with community groups, fauna consultants, town planners, geologists, engineers, lawyers, land developers and mining companies in planning and implementing optimal conservation strategies as part of sustainable development of sites.

Four of the company's environmental managed sites have won excellence awards for their quality and innovations, including "Excellence of Excellence" in 2000, Gold and Silver in NSW Rivercare 2000, Silver and Excellence in NSW Mineral Resources Excellence Awards and Excellence in the Earthmovers Awards, 2006 Environment Award for Australian Property Industry and 2007 International Green Apple Award.

Brief CVs

The group provides a broad variety of skills and a high level of experience:

Dr AnneMarie Clements
Senior restoration ecologist with M.Sc. (Macquarie Univ.) Thesis - *The vegetation of bushland in the northern Sydney area* and a Ph.D. (Univ. of Sydney) Thesis - *The vegetation of the sand masses of the mid-north coast of New South Wales*. She has more than 25 years experience.

Her major research interests include the re-establishment of native ecosystems, impacts of urban development on vegetation and soil, pattern analysis, effects of inundation and salinity on the plant communities, metal concentrations on plant growth and bioaccumulation. She has utilised her research in designing and

implementing rehabilitation / conservation programs as part of sustainable developments.

Anne is a specialist Certified Environmental Practitioner under the Environmental Institute of Australia and New Zealand CEnvP Program and has been a member of the CEnvP NSW certification panel. She is a certified BioBank Assessor.

Rosemary Snowdon
Environmental Scientist with a M.Sc. (University of Sydney) Thesis: "The Geochemistry of Soils in the IronCove Catchment"; a Graduate Diploma of Environmental Science (Sydney University) and a B.Sc. majoring in Environmental Geography and Plant Ecology (Sydney University). Previous positions include five years as an Environmental Scientist for Sydney Water, four years as an Environmental Scientist (water quality) at Hornsby Shire Council, one year as an Environmental Officer with the NSW Roads and Traffic Authority, four years as an Environmental Scientist with Anne Clements & Associates and one year as a data analyst at MapInfo Australia.

Tony Rodd
Taxonomic botanist with B.Sc. (University of Sydney) with extensive experience in plant identification. Tony was the Horticultural Botanist at the Royal Botanic Gardens, Sydney for 13 years (1970-82). After leaving the Gardens, he continued as an occasional consultant, including preparation of interpretative material and collection of plants from the wild for the living collections at the Mount Annan and Mount Tomah Botanic Gardens. He has also worked extensively with book publishers, most recently in the role of Chief Consultant for *Botanica* (Random House 1997) and *Flora* (Timber Press / ABC Gardening Australia 2003), and co-author of *Trees: a visual guide* (Weldon Owen 2008). He has a long-standing interest in the taxonomy of Australian palms and has had a major revision of the palm genus *Livistona* published in the journal *Telopea*. For more than 15 years, he has worked with Anne Clements & Associates on many flora surveys and rehabilitation projects.

Dr Margaret Donald
Margaret hold a Ph.D from the Queensland University of Technology; Thesis: *Using Bayesian methods for the estimation of uncertainty in complex statistical models*. She has been a co-author of several published journal articles and currently has additional articles in press. Margaret's previous positions include a Senior research statistician, responsible for the development and design of databases and acquisition of machine data for Polartechnics Pty.Ltd, in addition to, a Biometrician for Sydney Water. Margaret has been engaged previously by Anne Clements and Associates to undertake statistical analysis of field collected data for the purposes of threatened species recruitment assessment and for advice regarding field experiments.

Ruth Palsson
Ruth Palsson holds a B. Sc. in Botany and Mathematics and a Dip. Ed. (University of Queensland). She taught Mathematics and Science for many years in several states (Tasmania, Queensland and New South Wales) before returning to study. Ruth is studying a Post Graduate Diploma of Science (Botany) at the University of New England and is a graduate of the 2015 Student's Volunteer Botanical Internship Program at the Australian Herbarium in Canberra. Since joining Anne Clements & Associates in February 2015, Ruth has worked on a vegetation survey, a

determination of “top of bank”, a regeneration site and a native title claim.

Jessica Gardner
Jess is a recent graduate from a B Science (University of New South Wales). In the final year of her bachelor’s degree, Jess completed a special project, ‘*A phylogenetic analysis of select lastreopsid ferns (Dryopteridaceae)’*. Jess has completed the 2015 Student’s Volunteer Botanical Internship Program at the CSIRO/Australian National Herbarium/Centre for Australian National Biodiversity Research. Additionally she has been a volunteer junior botanist at the New South Wales Herbarium under Dr Nathalie Nagalingum’s tutelage. Jess has over four years experience in administration and customer service. Since joining Anne Clements and Associates in May 2015, Jess has worked on various projects, including bushland regeneration (planting and weeding), survey, MapInfo mapping and report writing.

Appendix 2

Soil Report by Dr Pam Hazelton

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13 January,2016

Soil Report for Thomas Hogan Reserve

1.0 Introduction

Thomas Hogan Reserve bounded by Francis, Martin and Penkivil St Bondi, was inspected on 25 September, 2015.

1.1 Background Information

According to the Soil Landscape Map of the Sydney 1:100 000 sheet, Thomas Hogan Reserve (the Site) is located in the Hornsby Soil Landscape described as "gently undulating rises to steep low hills on deeply weathered basaltic breccia"(Chapman and Murphy 1989). The field investigation showed that the Site lies within a moderately steep sided (on the western and southern boundary) gully. The outcropping rock is Hawkesbury Sandstone (refer Figure 3a), a medium to coarse grained quartz sandstone with minor shale and laminate lenses. From the soil materials described (refer Appendix 1), Thomas Hogan Reserve is more probably located in the Newport Soil Landscape (map unit np). This landscape is described as a "landform influenced by the shape of the underlying bedrock" in which the westerly and southerly slopes (10-30% gradient) have a distinctly concave slope profile (Chapman and Murphy 1989).

1.2 Site Investigation

Three transects were set up for the vegetation and soil investigation (refer Figure 3c).

2.0 Sampling Methodology

The soil was sampled using a either a sand auger or shovel to a depth of between 30-40cm. The location of the sites recorded by GPS (refer Appendix1). A total of 13 soil sites were sampled and collected by staff from Anne Clements and Associates. Samples were taken at approximately 10 m intervals, 4 samples in Transect 1, 5 samples in Transect 2 and 4 samples in Transect 3 (refer Figure 3c).

The field properties of texture and colour were described for all the samples using field texture grade criteria (Northcote 1979, McDonald *et al.*, 1990) and the *International Munsell Colour Chart* (Munsell 2009) by Dr Pam Hazelton.

3.0 Soil Material Description

Transect 1 (soil sites 1 to 4 at 10, 20, 30 and 40 m on the tape) was located along a moderately steep slope in the north. The texture of the topsoil and subsoil material

was loose fine-grained sand. The colour of the topsoil is black from organic staining similar to Newport np 1 (aeolian material). The subsoil colour varies from brownish grey to yellowish brown similar to Newport np 2 (Chapman and Murphy 1989).

Transect 2 (soil sites 6 to 9 at 10, 20, 30 and 40 m on the tape) was dominated by a cliff line of sandstone with large sandstone "floaters" which have moved downslope. Site 5 at the base of the slope near Transect 2 and site 7 have a clayey sand topsoil overlying a fine to coarse sand subsoil. Sandy loam is the texture of both the topsoil and subsoil of site 6 (similar to the soil material of Lambert la 4) described in Lambert Soil Landscape with sandstone pieces at a depth >25 cm. Site 8 and site 9 have been disturbed. Lambert la 4 is described as blackish-brown loose sandy loam with sandstone and charcoal fragments (Chapman and Murphy 1989).

Transect 3 (soil sites 10 to 13 at 10, 20, 30, 40 m on the tape) was located along a moderately steep slope in the south. The soil texture of the topsoil and subsoil of sites 10,11 12 and 13 is sand similar to the soil material description of Newport np 1 (Chapman and Murphy 1989).

The soil sites 5, 8, 9, 12, 13 sampled were located on the flat area, The texture of the soil at site 5 was clayey sand derived from sandstone. The soil at site 8, 9 had been disturbed. The texture of the soil sampled at sites 12, 13 is sand.

4.0 Discussion

The topsoil and subsoil of Transect 1 and 3 is windblown sand on the crest and sideslopes similar to np 1. It appears that in Transect 2 the blackish-brown loose sandy loam topsoil is similar to la 4 of Lambert Soil Landscape an associated soil material within Newport Soil Landscape.

5.0 Conclusions

Hawkesbury sandstone outcrops as a cliff-line at the western end of Thomas Hogan Reserve, with cascading rock ledges down the steeper area of the gully wall. The topsoil and subsoil in Transect 2 has a higher percentage of clay (sandy loam) compared with Transect 1 and 3 in which the topsoil and subsoil texture was predominately sand. The soil in Transect 2 has been weathered in-situ from the Hawkesbury sandstone.

The soil in Transects 1 and 3 was formed from wind-blown aeolian sands as described in Newport Soil Landscape (Chapman and Murphy 1989). The soil in Transects 1 and 3 is consistent with that characteristic of the endangered ecological community *Eastern Suburbs Banksia Scrub* as described in the Final Determination, namely:

2. The Eastern Suburbs Banksia Scrub is the accepted name for the ecological community occurring on nutrient poor sand deposits in the Sydney Basin Bioregion.

7. The Community has been reported from areas of sand deposits in the local government areas of Botany, Manly, Randwick, Waverley and Woollahra which are all within the Sydney Basin Bioregion. On North Head, within Manly local

government area the ecological community occurs on a sand sheet of similar age and composition to that on which the ecological community occurs further south.

References

Chapman G.A. and Murphy C.L., 1989, *Soil Landscapes of the Sydney 1:100,000 Sheet* report, Department of Conservation and Land Management, Sydney

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. & Hopkins, M.S. (1990) *Australian Soil and Land Survey Field Handbook*. 2nd edition. Inkata Press, Melbourne.

Munsell Soil Colour Charts 2009 edition.

Northcote NH (1979) A Factual Key for the Recognition of Australian Soils CSIRO 4th edition Rellim Technical Publications Adelaide, South Australia.

TRANSECT 1

Soil sample 1 (10.0m along Transect)

0339368 6248824

Depth cm	Colour	Texture	Comments
0-6			Organic matter with many roots, charcoal and fine sand
6-20	10YR 2/1 black	Sand loose fine grained	Inclusions charcoal pieces Slightly moist
20-37	10YR 5/1 brownish grey	Sand (fine)	Slightly moist

Soil sample 2 (20.0m along Transect)

0339364 6248818

Depth cm	Colour	Texture	Comments
0-5	10YR 2/1 black	Sand (fine)	Loose sand with many fine roots, charcoal
5-35+	10YR 5/2 greyish yellow brown	Sand (fine)	Slightly moist Roots (few)

Soil sample 3 (30.0 m along the Transect)

0339361 6248808

Depth cm	Colour	Texture	Comments
0-5	10YR 4/1 brownish grey	Sand to sandy loam	Fine and coarse sand Few roots

Depth cm	Colour	Texture	Comments
5-35+	10YR 5/2 greyish yellow	Sand	

Soil sample 4 (40.0 m along the Transect)

0339362 6248806

Depth cm	Colour	Texture	Comments
0-13	10YR 2/1 black	Sand	Fine and coarse sand, slight organic stain Slightly moist Few roots
13-43	10YR 5/3-5/4 dull yellowish brown	Sand	Fine and coarse sand Very few roots

Soil sample 5 (Centre of western third of central clearing)

0339374 6248778 +/- 6m

Depth cm	Colour	Texture	Comments
0-13	10YR 1.7/1 black	Clayey sand	Sandstone fragments
13-38	10YR 4/3 dull yellowish brown	Sand	Loose slightly moist coarse sand

TRANSECT 2

Soil sample 6 (10.0 m along the Transect)

0339349 6248761

Depth cm	Colour	Texture	Comments
0-12	10YR 1.7/1 black	Sandy loam	Slightly moist
12-24.5	10YR 4/4 brown	Sandy loam	Slightly moist Sandstone pieces (approx 2cm)

Soil sample 7 (20.0m along Transect)

0339361 6248768+/-8m

Depth cm	Colour	Texture	Comments
0-5	10YR 1.7/1 black	Clayey sand	Many roots, sandstone pieces 2-3 cm
5-15	10YR 1.7/1 black	Sand (fine)	Many roots
15-30	10YR 4/3 dull yellowish brown	Sand	Fine and coarse sand, slightly moist, Abundant roots

Soil sample 8 (30.0m along Transect)

0339364 6248770 +/-6m

Depth cm	Colour	Texture	Comments
0-5	10YR 1.7/1 black	Sand	**Disturbed site** Fine and coarse sand Charcoal

Depth cm	Colour	Texture	Comments
			inclusions, dry Many roots
5-15	10YR 2/1 black	Sand	Fine and coarse sand, organic matter, dry Many roots
15-30	10YR 2/1 black	Sand	Fine and coarse sand Glass pieces

Soil sample 9 (40.0m along Transect)

0339366 6248778 +/-4m

Depth cm	Colour	Texture	Comments
0-5	10YR 1.7/1 black	Sand (fine)	**Disturbed site** dry few roots
5-15	10YR 2/2 brownish black	Sand (fine)	
15-30	10YR 3/3 dark brown	Sand (fine)	Sandstone pieces Glass pieces

TRANSECT 3

Soil sample 10 (10.0m along Transect)

0339399 6248736 +/-4m

Depth cm	Colour	Texture	Comments
0-5	10YR 1.7/1 black	Sand (fine)	Few roots, charcoal pieces
5-30	10YR 2/1 black	Sand (fine)	Many very fine roots

Soil sample 11 (20.0m along Transect)

0339406 6248735 +/-4m

Depth cm	Colour	Texture	Comments
0-5	10YR 2/1 black	Sand (fine)	many roots, charcoal pieces
5-15	10YR 5/1 brownish grey	Sand (fine)	Many roots
15-30	10 YR 6/1 brownish grey	Sand (fine)	Few roots

Soil sample 12 (30.0m along Transect)

0339404 6248737 +/-7m

Depth cm	Colour	Texture	Comments
0-5	10YR 2/1 black	Sand (fine)	many roots, charcoal pieces
			Many roots

Depth cm	Colour	Texture	Comments
5-15	10YR 6/1 brownish grey	Sand (fine)	
15-30	10 YR 3/1 brownish black	Sand (fine)	Many roots Sandstone fragments

Soil sample 13 (40.0m along Transect)

0339404 6248739 +/-8m

Depth cm	Colour	Texture	Comments
0-5	10YR 2/1 black	Loamy sand	Fine sand many roots, dry
5-15	10YR 5/2 greyish yellow brown	Sand	Coarse sand, dry
15-30	10 YR 5/3 dull yellowish brown	Sand	Coarse sand, dry

Soil photographic record

Soil sample 1	**GPS co-ordinates**
Transect 1, 10m on tape	**E** 0339368 **N** 6248824
Depth in cm	
0-13	
13-37	

Soil sample 2	GPS co-ordinates
Transect 1, 20m on tape	**E** 0339364 **N** 6248818
Depth in cm	
0-13	
13-38	

Soil sample 3	GPS co-ordinates
Transect 1, 30m on tape	**E** 0339361 **N** 6248808
Depth in cm	
0-13	
13-38	

Soil sample 4	**GPS co-ordinates**
Transect 1, 40m on tape	**E** 0339362 **N** 6248806
Depth in cm	
0-13	
13-43	

Soil sample 5	GPS co-ordinates
Center of western third of central clearing	**E** 0339374 **N** 6248778 +/- 6m
Depth in cm	
0-13.5	
13.5-44.5	

Soil sample 6	GPS co-ordinates
Transect 2, 10m on tape	**E** 0339349 **N** 6248761
Depth in cm	
0-12	
12-24.5	

Soil sample 7	GPS co-ordinates
Transect 2, 20m on tape	**E** 0339361 **N** 6248768 +/- 8m
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 8	GPS co-ordinates
Transect 2, 30m on tape	**E** 0339364 **N** 6248770 +/- 6m
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 9	GPS co-ordinates
Transect 2, 40m on tape	**E** 0339366 **N** 6248778 +/- 4m
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 10	GPS co-ordinates
Transect 3, 10m on tape	**E** 0339399 **N** 6248736 +/- 4
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 11	**GPS co-ordinates**
Transect 3, 20m on tape	**E** 0339406 **N** 6248735 +/- 4m
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 12	GPS co-ordinates
Transect 3, 30m on tape	**E** 0339404 **N** 6248737 +/- 7m
Depth in cm	
0-5	
5-15	
15-30	

Soil sample 13	GPS co-ordinates
Transect 3, 40m on tape	**E** 0339404 **N** 6248739 +/- 8m
Depth in cm	
0-5	
5-15	
15-30	


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Appendices 3a, and 3b

Photographic record in Thomas Hogan Reserve

and

Photographic record at other parks in the eastern suburbs

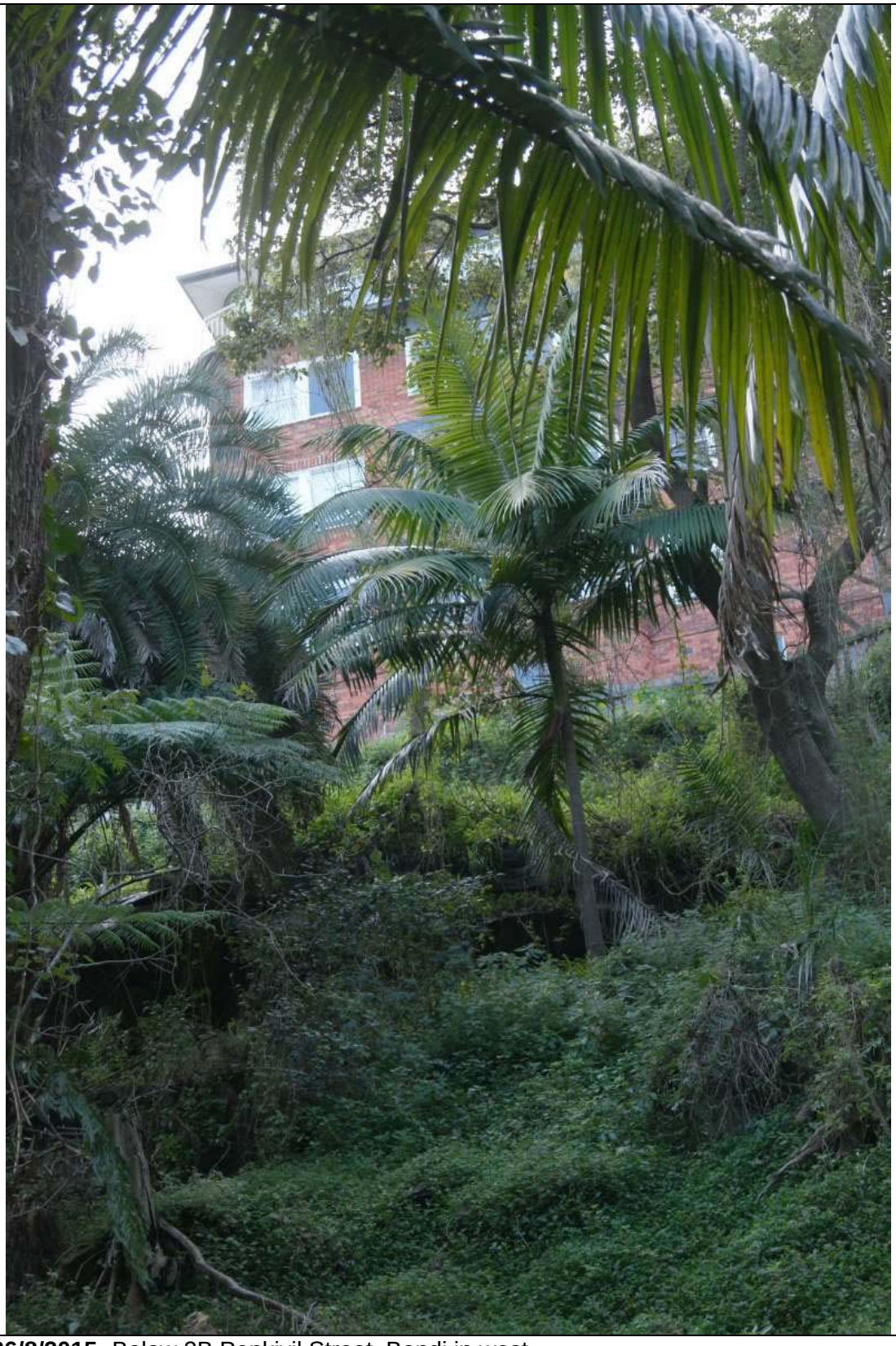
Appendix 3a
Photographic record in Thomas Hogan Reserve

26/8/2015: Beginning of Transect 1 (0 m to right), looking West up an informal path

26/8/2015: Transect 1, subquadrat 2, showing canopy species

26/8/2015: Transect 1, subquadrat 3, showing informal pathway and cut sandstone stepping stones, steep slope and erosion

26/8/2015: Far north-western corner of gully, west of 40 m mark of Transect 1



26/8/2015: Below 2B Penkivil Street, Bondi in west

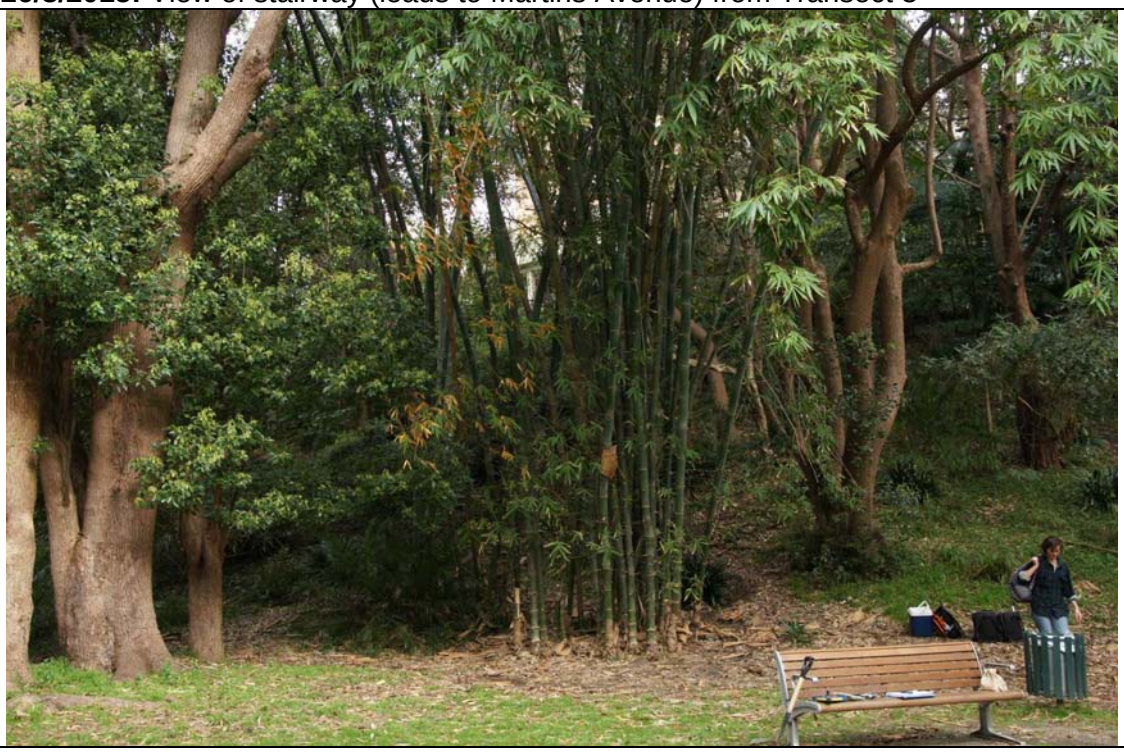
26/8/2015: Subquadrat 2 of Transect 2, facing in a westerly direction, looking up the sandstone slope

26/8/2015: Subquadrat 3 of Transect 2, facing in a westerly direction, looking up the sandstone slope

26/8/2015: Transect 3, subquadrat 1, facing in an easterly direction on the sandstone slope

26/8/2015: Transect 3, subquadrat 2, facing downslope in a northerly direction

26/8/2015: View of stairway (leads to Martins Avenue) from Transect 3



26/8/2015: Panorama 1, standing in the central flat area of gully, facing in a south-easterly direction, with a view upslope of Transect 3

26/8/2015: Panorama 2, facing in a southerly direction, with a view of the stairway

26/8/2015: Panorama 3, facing in a south westerly direction

26/8/2015: Panorama 4, facing in a west south westerly direction, view of Transect 2

26/8/2015: Panorama 5, facing in a westerly direction

26/8/2015: Panorama 6, facing in a west north westerly direction

26/8/2015: Panorama 7, facing in a north westerly direction

26/8/2015: Panorama 8, facing in a northerly direction

26/8/2015: Panorama 9, facing in a north east northerly direction

26/8/2015: Panorama 10, facing in a north easterly direction

26/8/2015: Spot Location A

26/8/2015: Spot Location B

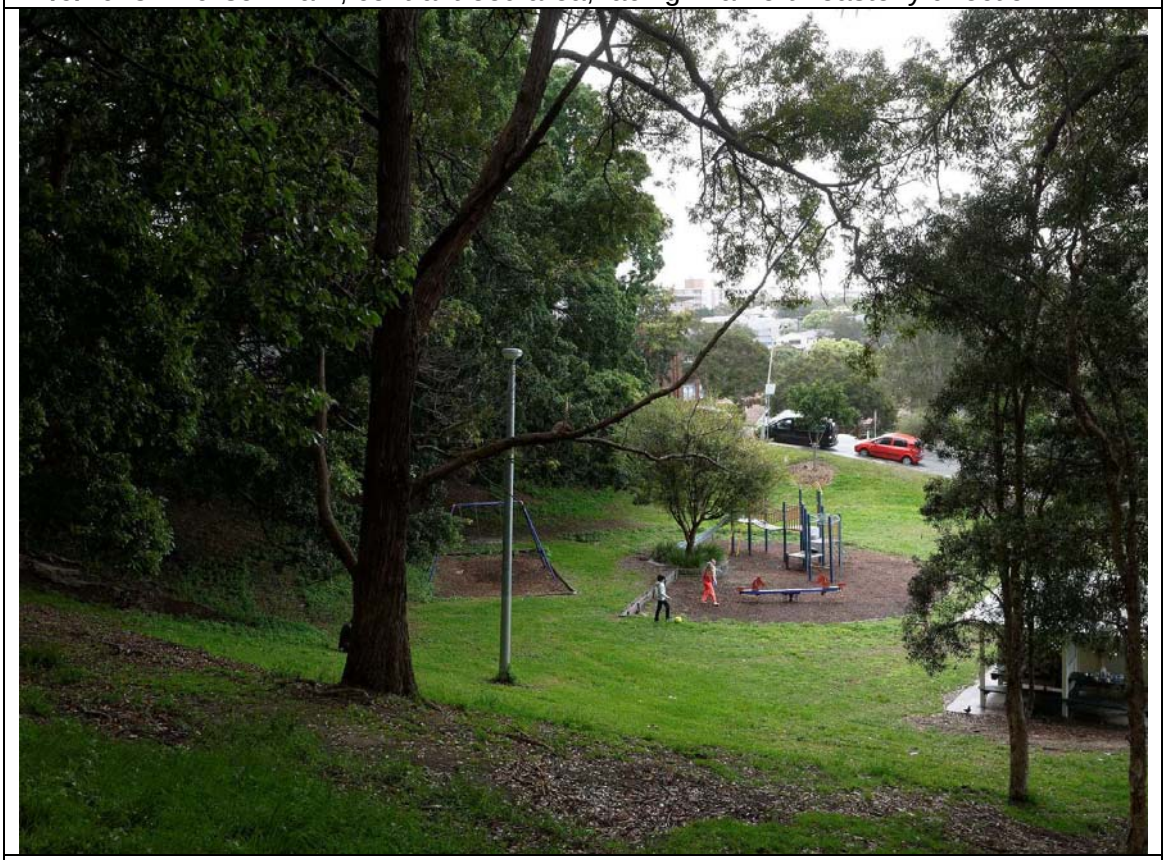
26/8/2015: Spot Location C

Appendix 3b
Photographic record at other parks in the eastern suburbs

24/9/2015: Dickson Park; central treed area, facing in a westerly direction

24/9/2015: Dickson Park; central treed area, facing in a easterly direction

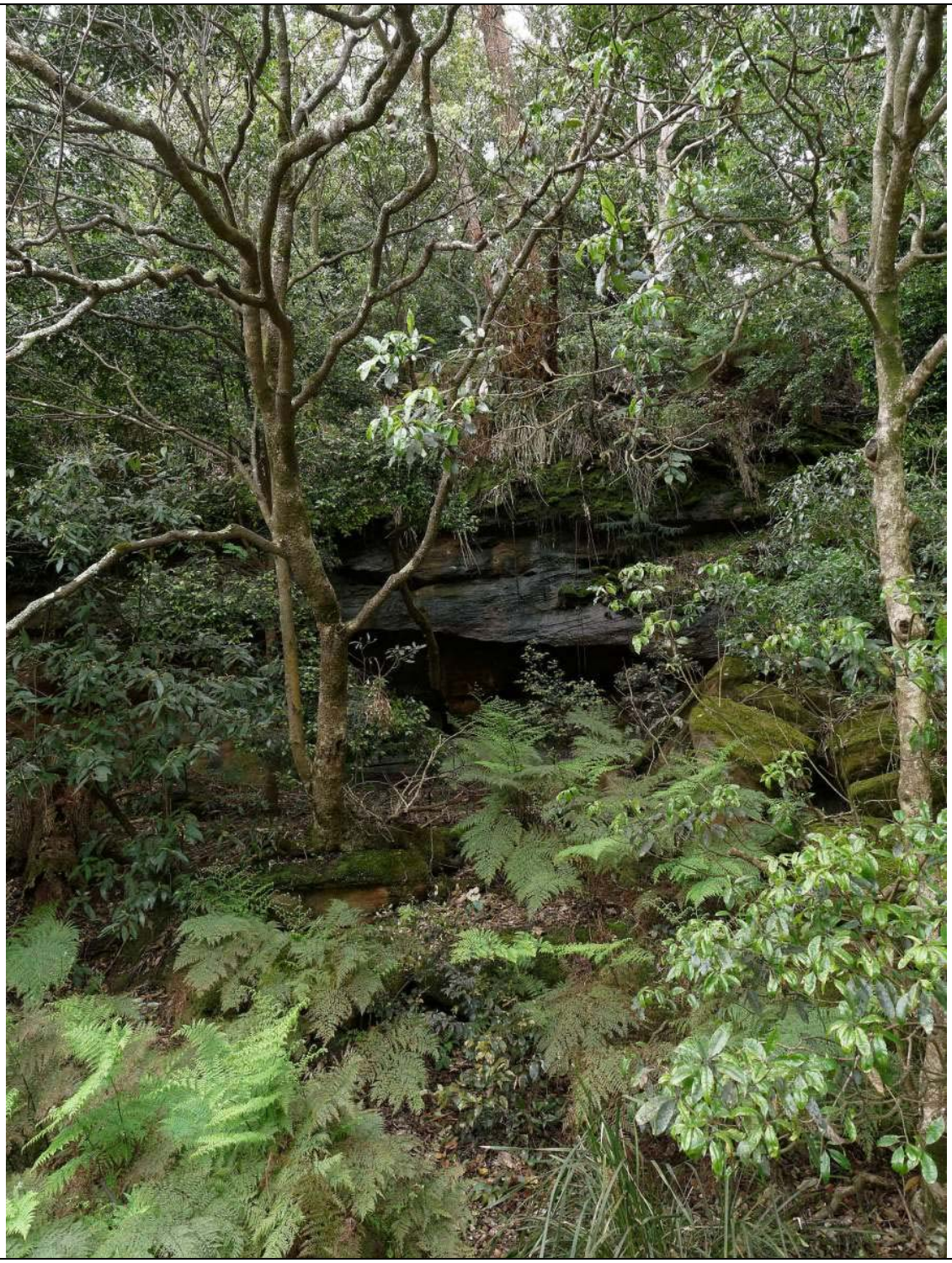
24/9/2015: Dickson Park; central treed area, facing in a north easterly direction



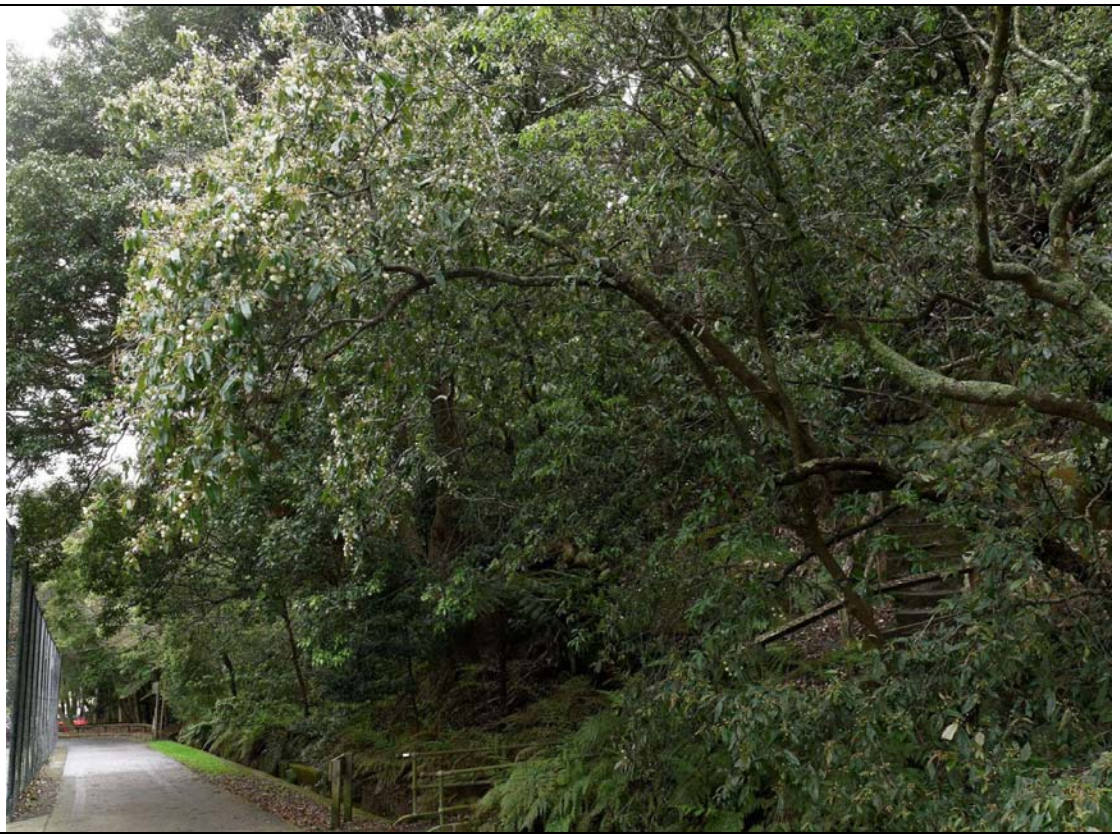
24/9/2015: Dickson Park; central treed area, facing in a north westerly direction

24/9/2015: Thornton Park; easterly facing slope on northern side of entrance stairway, erosion mesh used to reduce erosion risk on the steep sand deposit

24/9/2015: Thornton Park; view from top of slide, showing central flat area with natural light and successfully growing lawn (except in areas of high use) on sand deposit



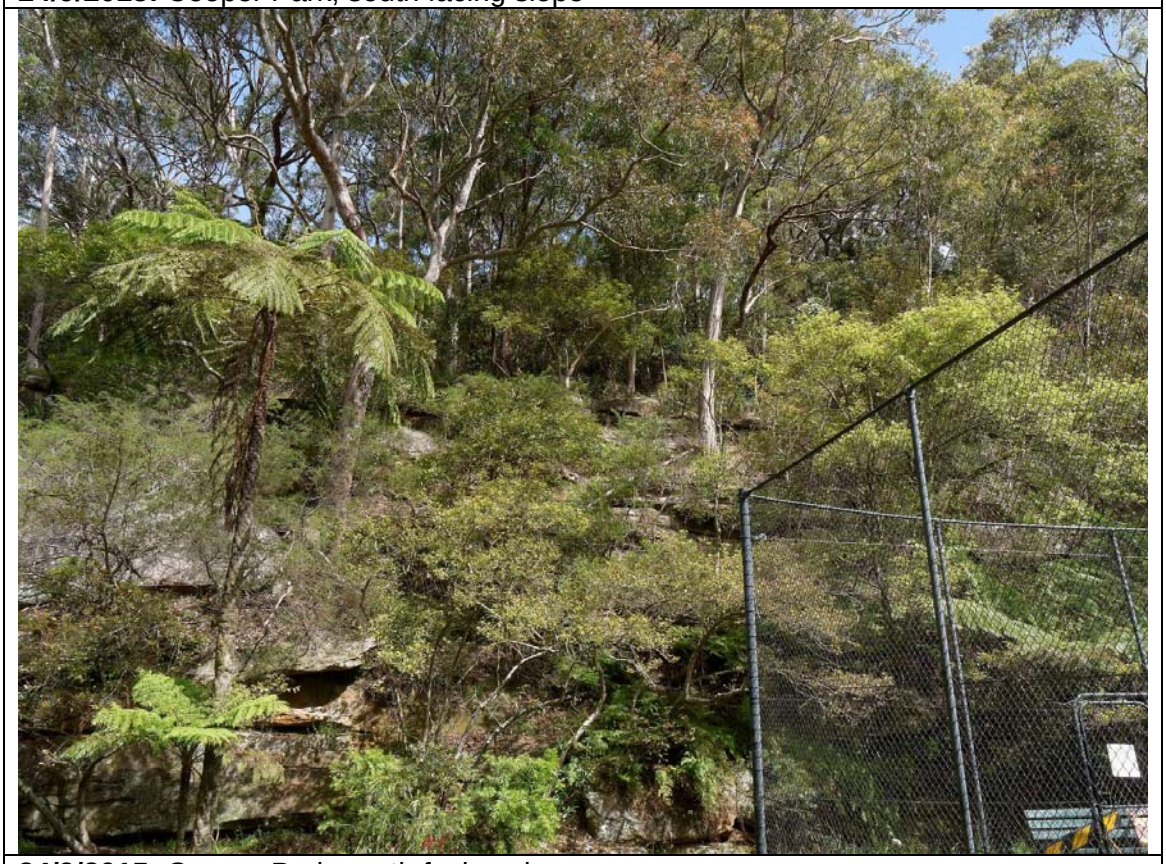
24/9/2015: Cooper Park; south facing sandstone slope (bush regenerated)



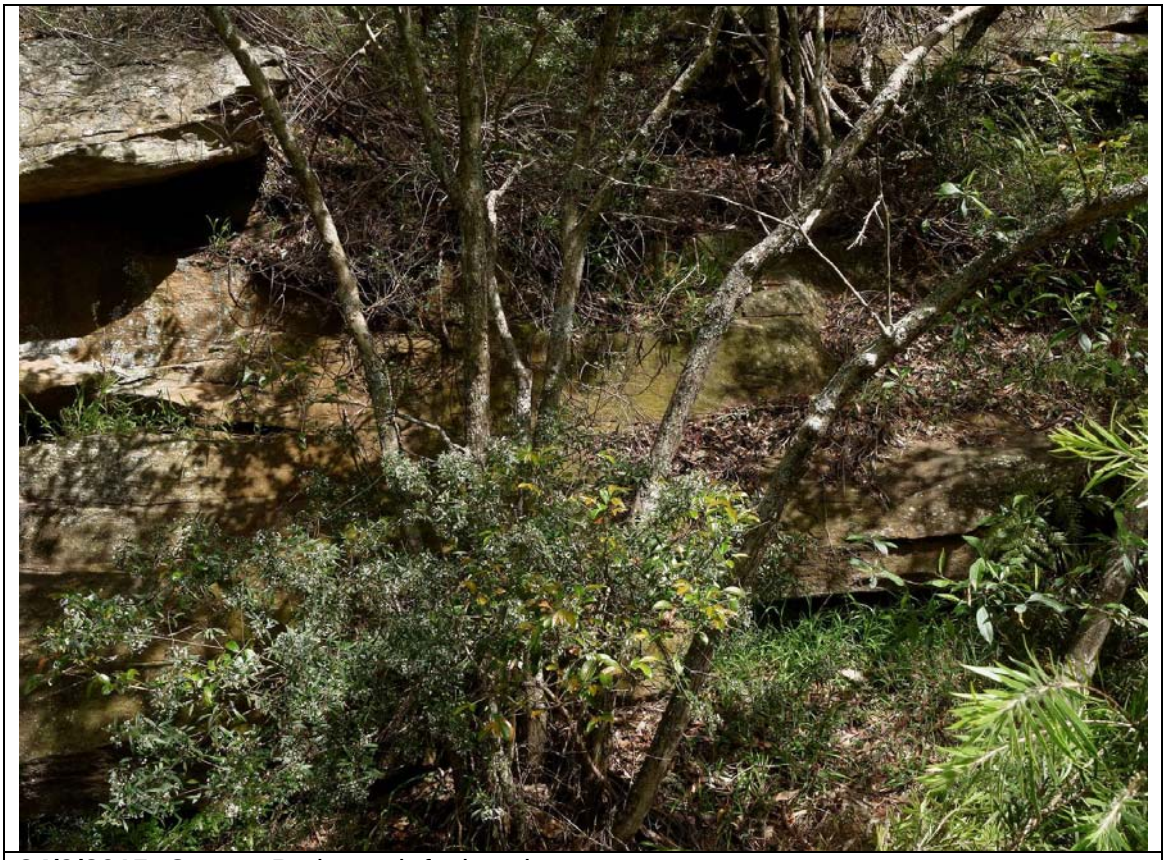
24/9/2015: Cooper Park; south facing slope

24/9/2015: Cooper Park; south facing slope

24/9/2015: Cooper Park; south facing slope



24/9/2015: Cooper Park; north facing slope



24/9/2015: Cooper Park; north facing slope

24/9/2015: Cooper Park; north facing slope

24/9/2015: Cooper Park; north facing slope

24/9/2015: Cooper Park; area to the south west of tennis courts

24/9/2015: Bird Sanctuary, Centennial Parklands on sand deposit

24/9/2015: Bird Sanctuary, Centennial Parklands on sand deposit

24/9/2015: Bird Sanctuary, Centennial Parklands

24/9/2015: York Road on sand deposit

24/9/2015: York Road on sand deposit

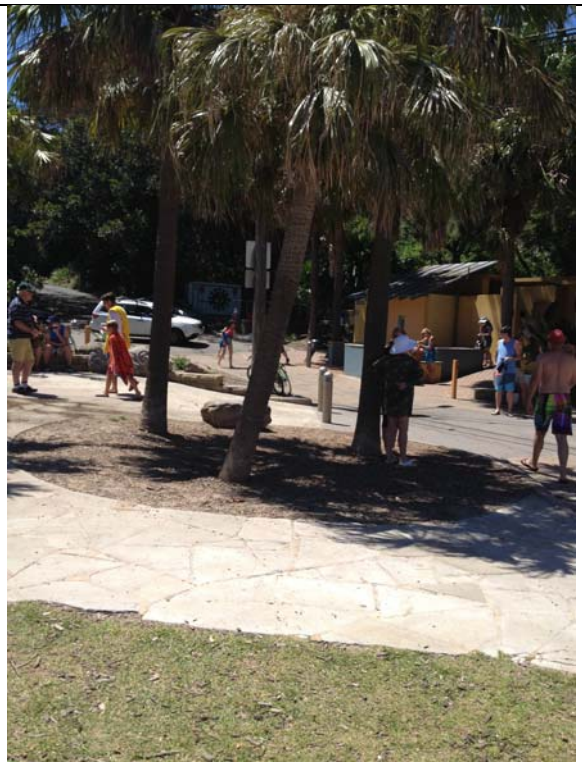
24/9/2015: Jennifer St, Little Bay on sand deposit (bund and roadside planting to protect native vegetation)

Appendix 3c

Photographs of Shelly Beach Reserve in Manly Local Government Area

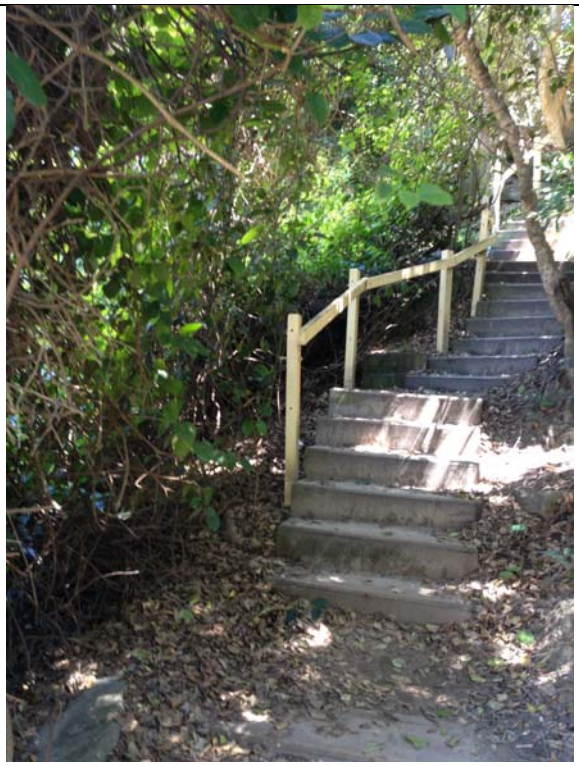
Appendix 3c
Photographs of Shelly Beach Reserve in Manly Local Government Area

Garden beds used to protect lawn from high useage



Paths used to protect lawn from high useage

	
Paths used to protect lawn from high useage	
	
Sandstone lower slope	*Livistona australis* on edge of lower slope

	
Livistona australis on edge of lower slope	Formalised path
	
Lawn damage from high use	Kikuyu Grass growing into garden bed

	
Imperata cylindrica used on edge of path on upslope area	*Lomandra longifolia* used on edge of path on upslope area
	
Dense *Banksia integrifolia* on upslope and mid-slope	

Appendix 4

Arborist report by Russell Kingdom of Advanced Treescape Consulting

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Preliminary Assessment (Audit) of Existing Trees

Thomas Hogan Reserve
BONDI NSW 2026

requested by
Anne Clements & Associates Pty Ltd

prepared by
Russell Kingdom
Qualified AQF5

27/01/2016

Principal: Russell Kingdom
Fully Insured: Public Liability $20M, Professional Indemnity $5M & Personal Accident.
Advanced Treescape Consulting is committed to providing a safe working environment for its employees in accordance with The Occupational Health & Safety Act NSW 2000.

FOUNDING MEMBER OF INSTITUTE OF AUSTRALIAN CONSULTING ARBORICULTURISTS

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1.0 Proposal

Anne Clements has commissioned Advanced Treescape Consulting to prepare a Preliminary Assessment (Audit) of Existing Trees at Thomas Hogan Reserve, Bondi. This site is located in the Waverley Local Government Area where there is a Tree Preservation Order in force.

The subject site was inspected on 18/11/2015. The plans supplied are from 'Landscape Surveys'. The site plan in Appendix 1a, 1b and 1c illustrate the location of all surveyed trees.

This assessment has been carried out by Russell Kingdom: Graduate Diploma of Horticulture, Diploma of Horticulture, Diploma of Horticulture/Arboriculture - AQF5 (see Appendix 12).

1.1 Scope of Report

To identify trees within the site. The relevant data collected will allow the owner to ensure that the development of the land complies with complies with AS4970-2009 *Protection of trees on development sites.*

2.0 Method of Assessment

An objective visual inspection was made from the ground of the health and condition of the trees based upon the *Visual Tree Assessment* (VTA) technique described by Mattheck, Breloer (1994). The Tree Schedule (provided in Appendix 3) was based upon:

- Estimation of tree heights by Silva Clinomaster/Heightmeter™ plus visual estimates of canopy spreads.
- Distances of trees, etc. are measured using a Leica Disto™ D2 Laser Distance Meter.
- All digital images which appear in this report are unaltered originals which were taken during site inspection (see Appendix 2).
- Hazard ratings for all trees (see Appendix 4) refer to Failure Potential, Size of Defective Part & Target Rating = Hazard Rating is out of 12.
- Significance Rating (see Appendix 5).
- Calculation of Tree Protection Zones (TPZ) and Structural Root Zones (SRZ) using Australian Standards 4970-2009 (AS4970-2009) Protection of trees on development sites (Appendix 6 and 7).
- The application of TPZs and SRZs on sites using Institute of Australian Consulting Arboriculturists (IACA) adapted AS4970-2009 drawings and protocol (Appendix 8 and 9).
- Glossary (see Appendix 10).
- Trees were numbered with aluminium tags for easy identification.

It should be noted that this objective assessment and related VTA assessments are based upon health and condition that were observed at the time of inspection.

The recommendations of this report regarding retention, works or removal are based upon Safe & Useful Life Expectancy (SULE – see Appendix 11) and hazard ratings being applied.

This information has guided the conclusions in this report.

3.0 Site Inspection

Thomas Hogan Reserve is an area of undeveloped land.

I have been advised by the local residents, whilst on site, that it was previously used as a quarry.

This site has a flat entrance from the north and then it is like an amphitheatre for the rest of the park with steep sides and a flat centre.

The centre of the park has some trees that include a row of very mature *Cinnamomum camphora* (Camphor Laurel) trees and a very large *Ficus macrophylla* (Moreton Bay Fig).

On the boundaries of the park are various trees which include native and exotic species.

3.1 Site Assessment

- The microclimate is considered good as all trees appear to have reached their genetic potential.
- There are no re-reflected heat load issues.
- There are no sunlight level issues.
- There is no irrigation visible on site.
- The site is protected from winds with a south-east and south-west orientation.

3.2 Discussion of Site Assessment

The site conditions allow all vegetation to achieve its genetic potential.

3.3 Soil Factors

The soil texture was observed to be Hornsby Plateau clay based soils[1]. Hornsby Plateau clay based soil limitations are: seasonal waterlogging (localised), moderately fertile, poor aeration, nutrients held in soil for long periods, moderately fertile and difficult to work.

Drainage characteristics are considered to be poor.

3.4 Other Soil Considerations

- There has been no recent soil disturbance, no recent construction and no previous construction debris visible.
- There is no damage to any tree roots.
- There are noxious weeds within this site.
- There is salt injury and soil erosion.
- There was usage that would compact the soil in the site - vehicles access the site.
- Compaction of flat land at the centre of the site is present regularly.

[1] Chapman, Murphy (2002)

4.0 Tree Schedule

Appendix 3 summarises existing trees upon the site in terms of species, height and canopy spread, structural condition, health, hazard rating and SULE (Safe and Useful Life Expectancy).

Appendix 4 provides explanations of abbreviations and assessment criteria.

The trees contained within the Tree Schedule (see Appendix 3) range from having short to long SULEs. These trees also have a broad range of hazard ratings which limits the retention of such trees within development sites.

4.1 Discussion

A tree schedule has been prepared and each tree individually assessed (refer to Appendix 3).

Contained within the park are many *Cinnamomum camphora* (Camphor Laurel) and *Ligustrum spp.* (Privet) trees. These trees are generally regarded as weed species and are strongly recommended to be removed and replaced with suitable native species, or similar.

Some of the *C. camphora* (Camphor Laurel) trees are recommended for retention due to the fact that they are performing soil stabilisation functions within the landscape.

It is recommended that removal of the *C. camphora* (Camphor Laurel) trees is staged so that the shade, that these trees currently provide, will not be reduced too much to cause a negative impact on surrounding vegetation. A dramatic increase in light levels can cause damage, retarding the regeneration of more appropriate tree species.

At the front of the site there is a *Ficus rubiginosa* (Port Jackson Fig) - Tree 7. This tree is significant in the landscape and is currently being impacted by a *C. camphora* (Camphor Laurel) which is located to the north. This *C. camphora* (Camphor Laurel) is the major cause of an adjacent retaining wall to develop a significant lean. It is recommended that Tree 6 - *C. camphora* (Camphor Laurel) be removed to enhance the life expectancy of the *F. rubiginosa* (Port Jackson Fig).

The *C. camphora* (Camphor Laurel) has an allelopathic effect on the Ficus and it is also suppressing the canopy. The removal of this tree will enhance this significant tree's amenity. The fig is less likely to have a significant impact on a new retaining wall.

Tree 9 is the *Pinus radiata* (Radiata Pine) located at the front of the park. These trees do provide streetscape amenity. This tree would require one large branch to be removed to the collar, which is currently over the play equipment. The removal of Tree 8 and Tree 9 could also be considered.

Tree 182 is a very large *Ficus macrophylla* (Moreton Bay Fig) tree. This very mature tree is a fine specimen of the species and is one of the large trees within the park. To the west of this tree is a row of very mature *C. camphora* (Camphor Laurel) trees that will have a negative impact on this Moreton Bay Fig.

Trees 160 through to Tree 171 have individual issues. Serious consideration should be given to removing these trees as many of them only have a useful life expectancy of SULE 3 (see Appendix 11).

4.2 Tree Significance (Appendix 5)

The trees listed in this report are of low to medium to high significance.

5.0 Guidelines for Future Design

It is recommended that:

- Trees to be retained: All trees not listed below, unless they are weed species i.e. Camphor Laurel.
- Trees to be removed:
    - Priority 1, SULE 4 Dangerous: 76, 77, 91, 250 & 279 = 5 trees.
    - Priority 2, SULE 4: 6, 26, 82, 100, 101, 102, 115, 124, 128, 129, 131, 145, 168, 179, 195, 196, 208, 212, 215, 285 & 287 = 21 trees.
    - Priority 3, SULE 3: 8, 35, 48, 51, 52, 60, 61, 63, 64, 67, 68, 70, 79, 83, 86, 90, 94, 96, 99, 116, 117, 118, 119, 122, 136, 157, 158, 160, 161, 162, 163, 164, 165, 166, 167, 169, 170, 177, 185, 260 & 288 = 43 trees.
- Generally, there should be no construction of buildings or services within any Tree Protection Zone (TPZ) unless approved by Waverley Municipal Council.
- No fill is to be placed within any TPZ unless approved by Waverley Municipal Council.
- There is to be no cutting of soil within any TPZ unless approved by Waverley Municipal Council.
- Tradespeople working on-site should not wash down equipment within or near TPZs unless approved by Waverley Municipal Council.
- Any future Site Office, Toilets, Materials Storage should not be within or near TPZs.
- **Note: There is to be no encroachment (no activities) of the Structural Root Zone (SRZ) as per measurement below in 6.0 unless approved by Waverley Municipal Council.**
- **Only 10% of the TPZ can be encroached by a building or similar unless approved by Waverley Municipal Council.**

6.0 Tree Protection Zones using AS4970-2009[2]

DBH – Diameter at Breast Height (1.4 metres)
DGL – Diameter at Ground Level
TPZ = DBH (stem) x 12 (radius)
SRZ radius = $(D \times 50)^{0.42} \times 0.64$

See Appendix 6 and Appendix 7
Refer to Appendix 3 for TPZ and SRZ details

* Minimum TPZ is 2 metres – Maximum TPZ is 15 metres
\# Minimum SRZ is 1.5 metres

[2] AS4970-2009 *Protection of trees on development sites.*

6.1 Tree Protection Works

- TPZ fences are to be erected around the retained trees if required. (Refer to Appendix 8 and Appendix 9)
- The distance from the tree trunk to the TPZ fence is specified in Appendix 3. Trees that pass the VTA (Visual Tree Assessment) and are to be retained are highlighted in yellow in Appendix 3. N.B: This is a radius, not diameter.
- The TPZ fence is to be constructed of two (2) metres high temporary chain wire fencing. This is preferable to star pickets as it would require them to be hammered into the ground which could damage roots.
- This action will greatly reduce the stress on the trees. The TPZ fence should be left in place until the landscaping phase of construction begins.

6.2 Tree Works

Any tree work is to be carried out by a suitably qualified and insured Arborist. (AQF 3) to AS4373-2007 *Pruning of amenity trees*.

7.0 Replacement Trees

Suitable replacement trees must be included in the Landscape Plan.

All trees removed should, where practicable, be replaced at the landscaping phase as part of the proposed Development Application (DA).

At the landscaping phase the retained trees will not be impacted.

8.0 Conclusions

The works to remove weeds species and improve the general safety of Thomas Hogan Reserve will need to be scheduled and conducted over several years. This park is greatly loved by many people that use it. The necessary tree removal will need to be conducted in orderly manner.

Suitable replacement trees must be included in the first stage of works to ensure that the residents can see the park is being enhanced and not just merely cleared of trees.

9.0 Recommendations

Implement all recommendations contained in clauses 4.1, 4.2, 4.3, 5.0, 6.0, 6.1, 6.2 and 7.0.

Russell Kingdom
AQF5 Arboriculturist & Horticulturist

MIACA MAIH MAA
Graduate Diploma of Horticulture
Diploma of Horticulture
Diploma of Horticulture/Arboriculture

DISCLAIMER

The author and Advanced Treescape Consulting take no responsibility for actions taken and their consequence if contrary to those expert and professional instructions given as recommendations pertaining to safety. The conclusions and recommendations contained in this report refer to the tree(s) condition on the inspection day. All care has been taken using the most up-to-date Arboricultural information in the preparation of this report. The report is based on a visual inspection only. Tree health and environmental conditions can change irreversibly at any time due to unforeseen circumstances or events. Due to *Myrtaceae* family hybridisation some tree species are difficult to accurately identify. Unless trees are in full flower identification is only probable.

REFERENCE LIST

AS 4373-2007 *Pruning of amenity trees.*

AS 4970-2009 *Protection of trees on development sites.*

Barrell, J. (1993-95) '*Pre-planning Tree Surveys: Safe Useful Life Expectancy (SULE) is the Natural Progression*' Arboricultural Journal Vol. 17, PP 33-46, Academic Publishers, Great Britain.

Chapman, G. A. and Murphy, C. L. (2002) Edition 2 *Soil Landscapes of the Sydney 1:100 000 Sheet.* Department of Land & Water Conservation.

Costermans, L. F. (1994) *Native Trees and Shrubs of South-eastern Australia* Rev. ed. Landsdowne Publishing Pty Ltd.

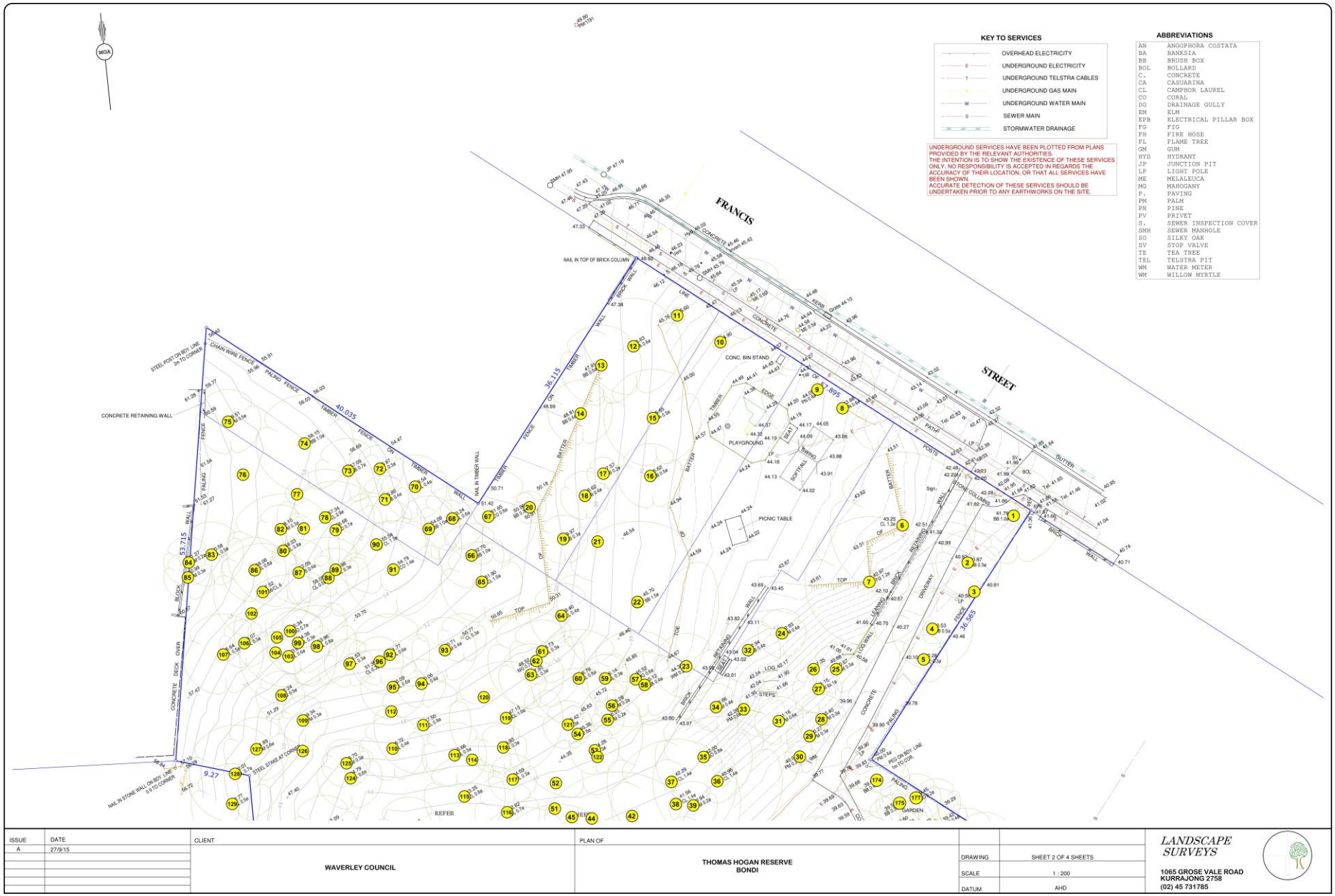
Draper, B. D. and Richards, P. A. (2009) *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.

Harris, R. W.; Clark, J. R. and Matheny, N. P. (2004) *Arboriculture – Integrated Management of Landscape Trees, Shrubs, and Vines*, Fourth Edition, Prentice Hall.

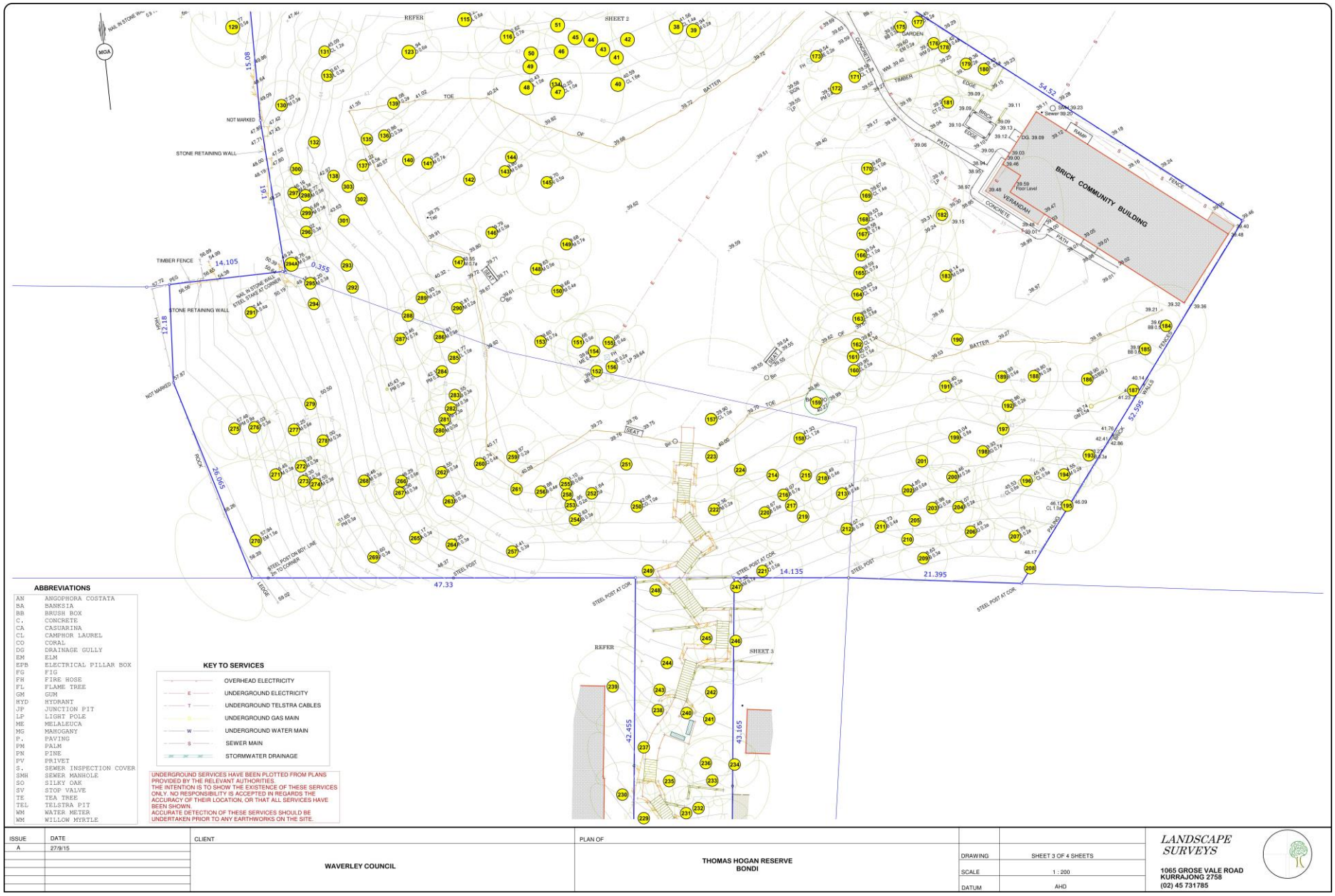
IACA Adapted AS4970 Drawings and Protocol.

Mattheck, C and Breloer, H (1994) *The Body Language of Trees. A Handbook for Failure Analysis.* Research for Amenity Trees, The Stationary Office, London, England.

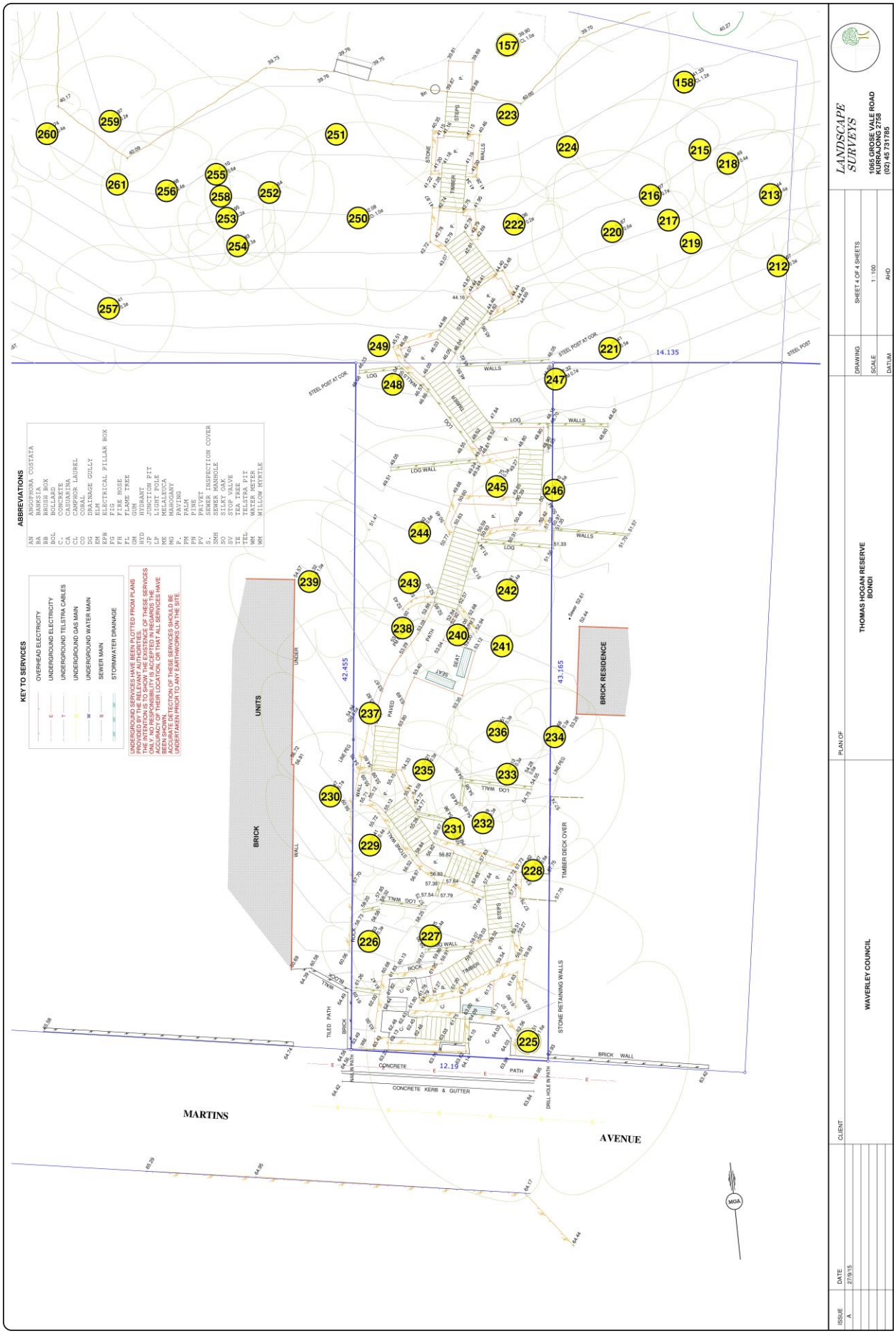
Appendix 1a: Site Plan with Trees



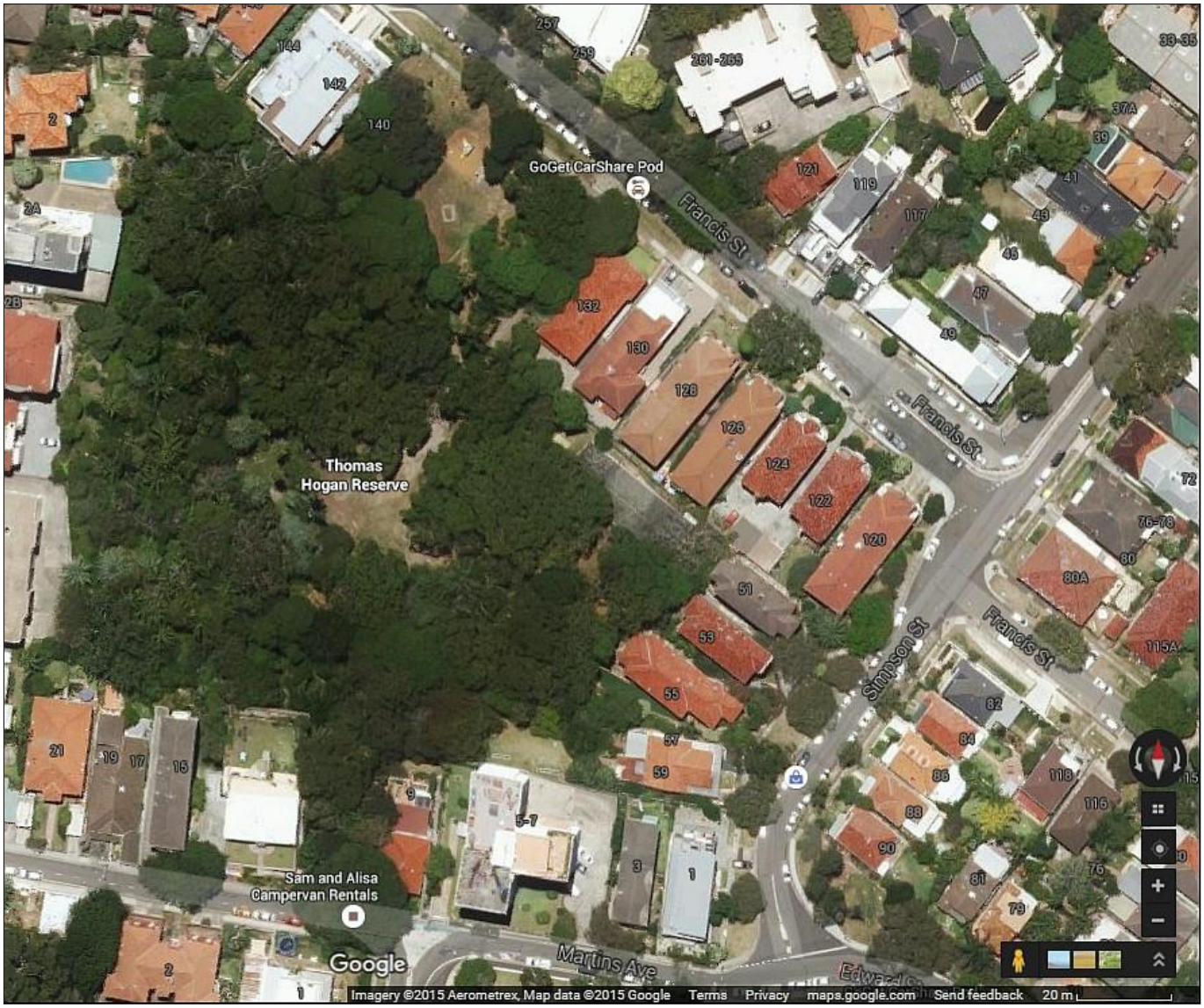
Appendix 1b: Site Plan with Trees



Appendix 1c: Site Plan with Trees



Appendix 2: Google Earth Satellite Image



Appendix 3: Tree Schedule

ABBREVIATIONS: m-metres, **mm**-millimetres, **DBH**-trunk diameter @ 1.4m, **DGL**-trunk diameter at ground level, **VP**-very poor, **P**-poor, **F**-fair, **G**-good, **VG**-very good, **CD**-co-dominant trunk, **TD**-tri-dominant trunk, **QD**-4x trunk, **TL**-trunk lean, **TW**-trunk wound, **Insp**-inspect, **L**-longicorns, **E**-epicormics, **K**-Kino, **FA**-forest architecture, **FR**-Forest Remnant, **dw**-deadwood small, **DW**-deadwood large, **TDB**-tip dieback, **PFS**-previous failure site, **RFS**-recent failure site, **BEW**-branch end weight, **MTU**-multi tree union, **MFU**-main fork union, **IFU**-inclusive fork union, **IMFU**-inclusive main fork union, **IMBU**-inclusive main branch union, **MBA**-Multiple branch attachments, **FB**-fruiting body, **BF**-bracket fungus, **U/C**-under canopy, **Decl**-declining, **B**-borers, **PD**-parrot damage, **LD**-leaf damage, **CMP**-chewing mouth piece, **RW**-reaction wood, **H/D**-Height/Diameter ratio test [Mattheck, Breloer (1994)], **J**-juvenile, **YM**-young mature, **SM**-semi mature, **M**-mature, **OM**-over mature, **HFP**-high failure potential, **D**-dangerous, **VD**-very dangerous, **X**-no room to grow/unsuitable, **H**-habitat, **HB**-habitat box, **Rec.**-recommendation, **S**-save, **R**-remove, **T**-transplant, **C**-council determination, **W**-work needed to be carried out, **mon**-monitor, **TPO**-tree preservation order, **HV**-high voltage, **PL**-power lines, **VTA** (P-pass, F-fail) **Hazard Rating**-**3**=low hazard, **12**=dangerous, **N/A**-not applicable, **SULE**-Safe & Useful Life Expectancy.

Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
1	*Lophostemon confertus* (Brushbox)	14	600	800	7.2	3.0	G	G	6 4 4 6	M	Crown reduced - managed.	P	4	2B	S
2	*L.confertus* (Brushbox)	14	200	300	2.4	2.0	G	G	3 3 3 3	YM		P	3	2B	S
3	*Leptospermum petersonii* (Lemon-scented Tea Tree)	4	90	140	2.0	1.5	G	G	1 - - -	M	500mm to fence.	P	3	2B	S
4	*L.confertus* (Brushbox)	15	260	440	3.1	2.3	G	G	4 radial	M	Crown reduced, crown raised.	P	3	2B	S
5	*L. petersonii* (Lemon-scented Tea Tree)	6	CD 80 100 (130)	300	2.0	2.0	G	G	- 2 - 1	M	Crown reduced.	P	3	2B	S
6	*Cinnamomum camphora* (Camphor Laurel)	18	1000	1400	12.0	3.8	G	G	10 radial	VM	3m to retaining wall - tree is causing wall to fail.	F	8	4	R
7	*Ficus rubiginosa* (Port Jackson Fig)	16	700	1100	8.4	3.4	G	G	10 radial	M	3.5m to retaining wall, crown reduced, suppressed by Tree 6.	P	4	1A	S
8	*Pinus radiata* (Radiata Pine)	15	400	620	4.8	2.7	F	F	2 2 10 -	VM	Low branch senescing, 5° TL to the east, unbalanced.	F	6	3B	R
9	*P. radiata* (Radiata Pine)	18	680	1050	8.2	3.8	G	F	8 10 8 8	VM	1x leader over play equipment. *Works required: R 1x branch to collar over equipment.*	P	5	2D	R/S-W
10	*Cupaniopsis anacardioides* (Tuckeroo)	3	50	90	2.0	1.5	G	G	1 radial	J		P	3	1B	S
11	*C. anacardioides* (Tuckeroo)	3	50	90	2.0	1.5	G	G	1 radial	J		P	3	1B	S
12	*Archontophoenix cunninghamiana* (Bangalow Palm)	18	420	650	7.0	N/A	G	G	6 radial	M		P	4	2B	S

ABBREVIATIONS: **m**-metres, **mm**-millimetres, **DBH**-trunk diameter @ 1.4m, **DGL**-trunk diameter at ground level, **VP**-very poor, **P**-poor, **F**-fair, **G**-good, **VG**-very good, **CD**-co-dominant trunk, **TD**-tri-dominant trunk, **QD**-4x trunk, **TL**-trunk lean, **TW**-trunk wound, **Insp**-inspect, **L**-longicorns, **E**-epicormics, **K**-Kino, **FA**-forest architecture, **FR**-Forest Remnant, **dw**-deadwood small, **DW**-deadwood large, **TDB**-tip dieback, **PFS**-previous failure site, **RFS**-recent failure site, **BEW**-branch end weight, **MTU**-multi tree union, **MFU**-main fork union, **IFU**-inclusive fork union, **IMFU**-inclusive main fork union, **IMBU**-inclusive main branch union, **MBA**-Multiple branch attachments, **FB**-fruiting body, **BF**-bracket fungus, **U/C**-under canopy, **Decl**-declining, **B**-borers, **PD**-parrot damage, **LD**-leaf damage, **CMP**-chewing mouth piece, **RW**-reaction wood, **H/D**-Height/Diameter ratio test [Mattheck, Breloer (1994)], **J**-juvenile, **YM**-young mature, **SM**-semi mature, **M**-mature, **OM**-over mature, **HFP**-high failure potential, **D**-dangerous, **VD**-very dangerous, **X**-no room to grow/unsuitable, **H**-habitat, **HB**-habitat box, **Rec.**-recommendation, **S**-save, **R**-remove, **T**-transplant, **C**-council determination, **W**-work needed to be carried out, **mon**-monitor, **TPO**-tree preservation order, **HV**-high voltage, **PL**-power lines, **VTA** (P-pass, F-fail) **Hazard Rating**-**3**=low hazard, **12**=dangerous, **N/A**-not applicable, **SULE**-Safe & Useful Life Expectancy.

Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
13	*L.confertus* (Brushbox)	18	400	540	4.8	2.6	G	G	6 6 6 8	M	Crown over adjacent building.	P	4	2B	S
14	*L.confertus* (Brushbox)	16	380	450	4.6	2.4	G	G	6 radial	M		P	4	2B	S
15	*A. cunninghamiana* (Bangalow Palm)	16	440	500	7.0	N/A	G	G	6 2 6 6	M		P	4	2B	S
16	*L.confertus* (Brushbox)	14	TD 100 200 350 (420)	600	2.3	2.7	G	G	6 4 4 6	M	2° TL to the west.	P	4	2B	S
17	*L.confertus* (Brushbox)	12	180	240	2.2	1.8	G	G	2 2 1 4	J		P	3	2B	S
18	*L.confertus* (Brushbox)	16	260	400	3.1	2.3	G	G	4 radial	M		P	4	2B	S
19	*L.confertus* (Brushbox)	18	420	500	5.0	2.5	G	G	4 4 2 6	M	IMFU.	P	4	2B	S
20	*L.confertus* (Brushbox)	14	220	340	2.6	2.1	G	G	3 2 6 1	YM	Crown suppressed by Tree 67.	P	4	2B	S
21	*L.confertus* (Brushbox)	12	180	260	2.2	1.9	G	G	2 radial	J		P	3	2B	S
22	*L.confertus* (Brushbox)	24	2000	2500	15.0	4.9	G	G	15 radial	VM		P	4	2B	S
23	*Podocarpus elatus* (Plum Pine)	15	200	280	2.4	1.9	G	G	3 2 2 2	M		P	3	2B	S
24	*Livistona chinensis* (Chinese Fan Palm)	20	260	540	3.0	N/A	G	G	2 radial	VM		P	4	2B	S

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25	*Syagrus romanzoffiana* (Cocos Palm)	10	220	480	3.0	N/A	G	G	2 radial	M	Exotic species.	P	3	2B	S
26	Palm Stump	8	240	360	N/A	N/A	Dead	P	-	DEAD	BF/FB in trunk.	F	5	4A	R
27	*A. cunninghamiana* (Bangalow Palm)	6	100	220	3.0	N/A	G	G	2 radial	M		P	3	2B	S
28	*S. romanzoffiana* (Cocos Palm)	16	280	340	3.0	N/A	G	G	2 radial	VM	Exotic species.	P	4	2B	S
29	*S. romanzoffiana* (Cocos Palm)	12	240	280	3.0	N/A	G	G	2 radial	VM	Exotic species.	P	4	2B	S
30	*Livistona spp.* (Fan Palm)	8	160	220	2.0	N/A	G	G	1 radial	M		P	3	2B	S
31	*Livistona spp.* (Fan Palm)	25	360	500	3.0	N/A	G	G	2 radial	VM		P	4	2B	S
32	*L.confertus* (Brushbox)	18	360	480	4.3	2.4	G	G	6 4 6 6	M		P	4	2B	S
33	*Butia spp.* (Feather Palm)	10	350	520	4.2	N/A	G	F	2 2 3 1	M	10° TL to the east, dead fronds (remove).	P	5	2B	S
34	*S. romanzoffiana* (Cocos Palm)	22	360	500	3.0	N/A	G	G	2 radial	M		P	4	2B	S
35	Grevillea robusta (Silky Oak)	30+	750	1200	9.0	3.6	F	F	8 8 15 8	OM	Basal TW, hanging branch, scaffold branch failure.	F	6	3B	R
36	*C. camphora* (Camphor Laurel)	24	TD 440 450 500 (800)	1800	9.6	4.2	G	F	10 4 12 4	VM	Wound in scaffold branches, tropism to the east, DW, crown reduced, basal decay.	F	8	3B	R

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37	*C. camphora* (Camphor Laurel)	24	950	1500	11.4	3.9	G	F	15 8 8 12	OM	DW. 37&38 are best of a bad bunch in the area.	P	6	2B	S
38	*C. camphora* (Camphor Laurel)	24	960	1300	11.5	3.7	G	F	15 15 - -	OM	DW, unbalanced, tropism to the east. 37&38 are best of a bad bunch in the area.	P	6	2B	S
39	*A. cunninghamiana* (Bangalow Palm)	6	90	160	3.0	N/A	G	G	2 radial	J		P	3	1B	S
40	*C. camphora* (Camphor Laurel)	26	1200	1800	14.4	4.2	F	G	- - 15 -	OM	Sparse upper crown, RFS - storm damage.	P	4	2B	S
41	*A. cunninghamiana* (Bangalow Palm)	8	CD 2x80 (110)	400	3.0	N/A	G	G	2 radial	YM		P	3	2B	S
42	*Brachychiton acerifolius* (Illawarra Flame Tree)	15	160	240	2.0	1.8	G	G	2 radial	M	FA.	P	4	2B	S
43	*A. cunninghamiana* (Bangalow Palm)	7	70	240	3.0	N/A	G	G	2 radial	M		P	4	2B	S
44	*B. acerifolius* (Illawarra Flame Tree)	12	140	200	2.0	1.7	G	G	2 radial	M		P	3	2B	S
45	*C. camphora* (Camphor Laurel)	15	200	320	2.4	2.1	G	F	3 radial	YM	FA.	P	4	2B	R
46	*S. romanzoffiana* (Cocos Palm)	16	220	320	4.0	N/A	G	G	3 radial	VM		P	4	2B	S
47	*C. camphora* (Camphor Laurel)	24	CD 2x500 (710)	1200	8.5	3.6	G	F	10 14 14 14	VM	1x leader dead - strangler fig 134 growing on dead leader. *Exercise tree for residents (rope on tree)	P	4	2B	S
48	*C. camphora* (Camphor Laurel)	26	760	1000	9.1	3.3	F	F	10 12 4 6	VM	DW, TDB in crown.	P	5	3B	S

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Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
49	*B. acerifolius* (Illawarra Flame Tree)	12	100	120	2.0	1.5	G	G	1 radial	J	Crown suppressed.	P	3	2B	S
50	*C. camphora* (Camphor Laurel)	16	210	320	2.5	2.1	G	F	2 2 1 3	YM	FA.	P	4	2B	S
51	*C. camphora* (Camphor Laurel)	15	160	220	2.0	1.8	F	P	2 radial	YM	Axe wounds, FA, E.	F	4	3B	R
52	*C. camphora* (Camphor Laurel)	22	800	1050	9.6	3.4	UP	F	- 6 4 -	OM	Possible H, DW, Decl.	F	4	3B	R
53	Unknown species	20	180	300	2.2	2.0	G	G	3 radial	M	FA.	P	4	2B	S
54	*Syzygium Oleosom* (Blue Lilly Pilly)	24	600	1000	7.2	3.3	G	G	8 radial	VM	2 tags 122 - Good Specimen.	P	4	2B	S
55	*A. cunninghamiana* (Bangalow Palm)	6	90	220	3.0	N/A	G	G	2 radial	YM		P	3	2B	S
56	*A. cunninghamiana* (Bangalow Palm)	6	100	200	2.0	N/A	G	G	1 radial	YM		P	3	2B	S
57	*Eucalyptus botryoides* (Bangalay)	26	470	550	5.6	2.6	G	G	6 4 8 4	M	E, TDB.	P	5	2B	S
58	*L.confertus* (Brushbox)	12	CD 110 140 (180)	350	2.2	2.1	G	G	2 1 6 -	YM	Tropism to the east.	P	4	2B	S
59	*C. camphora* (Camphor Laurel)	16	220	350	2.6	2.1	G	F	2 2 3 1	YM	Exposed root buttress.	P	4	2B	R
60	*C. camphora* (Camphor Laurel)	20	750	800	9.0	3.0	F	G	10 6 4 8	M	DW, Decl.	F	5	3B	R
61	*Cinnamomum camphora* (Camphor Laurel)	20	240	300	2.9	2.0	F	F	4 1 1 6	M	FA, impacting Tree 62.	F	5	3B	R

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Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
62	*Eucalyptus botryoides* (Bangalay)	29	500	850	6.0	3.1	G	G	8 radial	M	dw.	P	4	2B	S
63	*C. camphora* (Camphor Laurel)	16	240	350	2.9	2.1	G	F	4 radial	YM	FA, impacting Tree 62.	F	5	3B	R
64	*C. camphora* (Camphor Laurel)	16	CD 480 500 (690)	600	8.3	2.7	G	F	8 1 2 6	M	Exposed root buttress.	F	5	3B	R
65	*C. camphora* (Camphor Laurel)	24	CD 480 500 (690)	1000	8.3	3.3	G	G	10 12 10 8	VM	dw.	P	5	2B	S
66	*L.confertus* (Brushbox)	20	TD 200 300 350 (500)	900	6.0	3.2	G	F	6 6 8 6	M	Fig in fork, suppressed by Tree 67.	P	4	2B	S
67	*Erythrina X sykesii* (Coral Tree)	24	600	900	7.2	3.2	G	P	15 6 10 10	VM	10° TL to the north, PFSs, crown over adjacent building, suckers at base. This tree provides screening for adjacent building - could be trouble if removed.	F	6	3B	R
68	*C. camphora* (Camphor Laurel)	24	TD 2x200 340 (440)	580	5.3	2.6	G	F	10 2 2 6	M	Crown over adjacent building.	F	6	3B	R
69	*L.confertus* (Brushbox)	26	CD 340 440 (560)	1000	6.7	3.3	G	G	6 10 6 8	M		P	4	2B	S

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70	*C. camphora* (Camphor Laurel)	16	360	440	4.3	2.3	F	G	8 radial	M	dw, TDB, crown over building.	F	5	3B	R
71	*L.confertus* (Brushbox)	15	440	500	5.3	2.5	G	F	10 - 3 3	YM	Tropism to the north.	P	3	2B	S
72	*B. acerifolius* (Illawarra Flame Tree)	12	200	300	2.4	2.0	G	G	3 1 2 2	M		P	3	2B	S
73	*L.confertus* (Brushbox)	15	CD 120 420 (440)	800	5.3	3.0	G	G	12 2 4 4	M	Crown over fence, tropism to the north.	P	4	2B	S
74	*L.confertus* (Brushbox)	18	750	1000	9.0	3.3	G	G	10 8 8 8	M		P	4	2B	S
75	*Phoenix canariensis* (Canary Island Date Palm)	12	400	500	4.0	N/A	G	G	3 radial	M		P	3	2B	S
76	Dead stump	10	CD 150 400 (430)	650	5.2	2.8	Dead	P	- - - -	-	Dead, decaying, D.	F	8	4A	R
77	Dead stump	14	CD 300 350 (460)	600	5.5	2.7	Dead	P	- - - -	-	Colonial ironworks in trunk, decay, D.	F	8	4A	R
78	*Cinnamomum camphora* (Camphor Laurel)	22	TD 350 400 500 (730)	1100	8.8	3.4	G	F	8 radial	M	Decay in trunk.	P	5	2B	R
79	*E. X sykesii* (Coral Tree)	19	400	750	4.8	2.9	G	F	6 radial	M	PFSs, weed.	F	6	3B	R

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80	*C. camphora* (Camphor Laurel)	24	1100	1400	13.2	3.8	G	G	8 radial	VM	Suppressed by Tree 87.	P	5	2B	R
81	*Archontophoenix cunninghamiana* (Bangalow Palm)	9	150	280	3.0	N/A	G	G	2 radial	YM		P	3	2B	S
82	*C. camphora* (Camphor Laurel)	14	CD 300 600 (670)	1000	8.0	3.4	P	P	6 4 6 8	M	Crown dead.	F	8	4C	R
83	*C. camphora* (Camphor Laurel)	16	510	700	6.1	2.9	P	F	6 6 4 8	M	Suppressed canopy, crown over western boundary.	F	6	3B	R
84	*A. cunninghamiana* (Bangalow Palm)	12	220	300	3.0	N/A	G	F	2 radial	M	On retaining wall.	P	4	2B	S
85	*Livistona spp.* (Fan Palm)	12	250	300	3.0	N/A	G	F	2 radial	M	On retaining wall.	P	4	2B	S
86	*C. camphora* (Camphor Laurel)	15	480	600	5.8	2.7	G	F	4 8 6 6	M	Exposed root buttress.	F	6	3B	R
87	*Pittosporum undulatum* (Native Daphne)	12	CD 240 280 (370)	450	4.4	2.4	G	G	4 4 6 2	M	Crown suppressed by Tree 80.	P	4	2B	S
88	*C. camphora* (Camphor Laurel)	16	450	550	5.4	2.6	G	G	6 4 6 4	M	Exposed roots.	P	5	2B	R
89	*C. camphora* (Camphor Laurel)	16	220	300	2.6	2.0	G	G	3 4 4 1	M	Suppressing Tree 87.	P	4	2B	R
90	*C. camphora* (Camphor Laurel)	20	1400	1600	15.0	4.0	F	F	8 3 3 8	OM	Crown Decl.	F	8	3B	R

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91	*E. X sykesii* (Coral Tree)	24	CD 500 600 (780)	1400	9.4	3.8	G	VP	6 10 8 8	OM	½ leader damaged, D.	F	8	4C	R
92	*C. camphora* (Camphor Laurel)	22	CD 200 460 (500)	850	6.0	3.1	F	G	6 radial	M		P	5	2B	R
93	*C. camphora* (Camphor Laurel)	15	360	450	4.3	2.4	G	G	6 radial	YM		P	5	2B	R
94	*C. camphora* (Camphor Laurel)	18	300	350	3.6	2.1	F	G	2 4 4 2	YM	Sparse canopy.	P	4	3B	R
95	*A. cunninghamiana* (Bangalow Palm)	18	260	400	4.0	N/A	G	G	3 radial	M		P	4	2B	S
96	*C. camphora* (Camphor Laurel)	16	CD 160 300 (340)	650	4.1	2.8	F	F	6 2 4 2	M	Axe damage to root buttress.	F	6	3B	R
97	*C. camphora* (Camphor Laurel)	22	450	650	5.4	2.8	G	G	6 radial	M	Do not remove. On steep bank - stopping erosion.	P	4	2B	S
98	*C. camphora* (Camphor Laurel)	25	700	1000	8.4	3.3	G	G	6 radial	M	Do not remove. On steep bank - stopping erosion.	P	4	2B	S
99	*C. camphora* (Camphor Laurel)	14	200	300	2.4	2.0	P	G	1 radial	YM	E, stressed.	F	5	3B	R
100	Dead stump	-	220	300	2.6	2.0	DEAD	P	- - - -	OM	Dead, decay in trunk.	F	6	4A	R
101	*C. camphora* (Camphor Laurel)	14	220	300	2.6	2.0	P	F	2 - - 2	YM	Decl.	F	6	4A	R

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102	*C. camphora* (Camphor Laurel)	22	750	1000	9.0	3.3	F	P	4 6 6 4	VM	Decay in trunk, DW, D.	F	8	4C	R
103	*C. camphora* (Camphor Laurel)	16	260	420	3.1	2.3	G	G	4 radial	YM		P	4	2B	R
104	*C. camphora* (Camphor Laurel)	25	800	1200	9.6	3.6	G	G	8 radial	VM	On bank, stopping erosion.	P	5	2B	S
105	*C. camphora* (Camphor Laurel)	20	480	700	5.8	2.9	G	G	4 8 6 4	M	On bank, stopping erosion.	P	5	2B	S
106	*B. acerifolius* (Illawarra Flame Tree)	16	300	540	3.6	2.6	G	G	2 3 2 3	M	On bank, stopping erosion.	P	4	2B	S
107	*C. camphora* (Camphor Laurel)	20	540	900	6.5	3.2	G	G	6 6 4 6	M	On bank, stopping erosion.	P	4	2B	S
108	*B. acerifolius* (Illawarra Flame Tree)	14	200	340	2.4	2.1	G	G	2 3 2 3	M	On bank, stopping erosion.	P	4	2B	S
109	*A. cunninghamiana* (Bangalow Palm)	10	220	350	2.6	2.1	G	G	2 radial	M		P	3	2B	S
110	*P. canariensis* (Canary Island Date Palm)	14	600	1000	7.2	3.3	G	G	3 radial	VM		P	4	2B	S
111	*S. Oleosom* (Blue Lilly Pilly)	14	200	300	2.4	2.0	G	G	2 radial	YM		P	3	2B	S
112	*C. camphora* (Camphor Laurel)	16	380	480	4.6	2.4	G	G	2 6 4 4	M	Exposed root buttress. On bank, stopping erosion.	P	4	2B	S
113	*C. camphora* (Camphor Laurel)	18	CD 280 380 (470)	800	5.6	3.0	G	G	4 6 4 4	M	On bank, stopping erosion.	P	4	2B	R
114	*C. camphora* (Camphor Laurel)	15	260	380	3.1	2.2	G	G	4 radial	M	On bank, stopping erosion.	P	4	2B	R

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115	*C. camphora* (Camphor Laurel)	16	CD 250 360 (440)	750	5.3	2.9	F	F	4 6 4 6	M	Axe wounds, ringbarked.	F	6	4A	R
116	*C. camphora* (Camphor Laurel)	20	CD 100 360 (370)	700	4.4	2.9	G	G	4 6 4 6	M	dw.	P	5	3B	R
117	*C. camphora* (Camphor Laurel)	18	260	400	3.1	2.3	F	G	2 2 3 2	M	dw, E.	F	6	3B	R
118	*C. camphora* (Camphor Laurel)	18	220	340	2.6	2.1	F	P	2 radial	M	FA.	F	6	3B	R
119	*C. camphora* (Camphor Laurel)	24	850	1300	10.2	3.7	F	F	8 radial	VM	DW.	F	6	3B	R
120	*A. cunninghamiana* (Bangalow Palm)	15	200	300	3.0	N/A	G	G	2 radial	YM		P	3	2B	S
121	*Stenocarpus sinuatus* (QLD Firewheel Tree)	12	140	200	2.0	1.7	G	G	1 - - 1	YM		P	3	2B	S
122	*S. Oleosom* (Blue Lilly Pilly)	20	650	900	7.8	3.2	G	G	8 6 6 8	VM	2x tags - 54 & 122.	P	5	3B	R
123	*C. camphora* (Camphor Laurel)	18	380	480	4.6	2.4	F	F	4 radial	M	FA.	P	4	2B	S
124	*C. camphora* (Camphor Laurel)	14	700	980	8.4	3.3	P	VP	4 - - 4	OM	8m TW, Decl.	F	8	4C	R
125	*A. cunninghamiana* (Bangalow Palm)	9	150	350	3.0	N/A	G	G	2 radial	M		P	4	2	S
126	*A. cunninghamiana* (Bangalow Palm)	11	180	380	3.0	N/A	G	G	2 radial	M		P	4	2	S

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127	*Phoenix canariensis* (Canary Island Date Palm)	12	600	950	4.0	N/A	G	G	3 radial	M		P	4	2	S
128	*C. camphora* (Camphor Laurel)	18	650	850	7.8	3.1	P	G	4 8 6 6	VM	On bank, sparse canopy.	F	6	4	R
129	*C. camphora* (Camphor Laurel)	15	700	920	8.4	3.2	F	G	6 radial	VM	On bank, sparse canopy.	F	6	4	R
130	*P. canariensis* (Canary Island Date Palm)	12	550	700	4.0	N/A	G	G	3 radial	M		P	4	2	S
131	*C. camphora* (Camphor Laurel)	16	1100	1300	13.2	3.7	VP	P	6 radial	OM	Decl, decay in trunk.	F	8	4	R
132	*A. cunninghamiana* (Bangalow Palm)	12	200	350	2.4	2.1	G	G	3 radial	M		P	3	2	S
133	*B. acerifolius* (Illawarra Flame Tree)	15	220	340	2.6	2.1	G	G	4 radial	M		P	4	2	S
134	*Ficus macrophylla* (Moreton Bay Fig)	20	400	800	4.8	3.0	G	G	4 radial	YM	Smothering Tree 147, bees in Tree 147.	P	3	2	S
135	*Angophora costata* (Smooth-barked Apple)	10	120	180	2.0	1.6	G	G	2 radial	J		P	3	1	S
136	*G. robusta* (Silky Oak)	14	220	340	2.6	2.1	F	F	1 3 2 2	YM	5° TL to the south, TDB.	F	5	3	R
137	*L. chinensis* (Chinese fan palm)	10	450	600	3.0	N/A	G	G	2 radial	M		P	3	1	S
138	*P. undulatum* (Native Daphne)	8	80	140	2.0	1.5	G	G	2 radial	YM		P	3	2	S
139	*Backhousia myrtifolia* (Ironwood)	8	100	160	2.0	1.5	G	G	2 radial	YM		P	3	1	S

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140	*Elaeocarpus reticulatus* (Blueberry Ash)	9	80	140	2.0	1.5	G	G	2 radial	YM		P	3	1	S
141	*P. canariensis* (Canary Island Date Palm)	24	650	800	4.0	N/A	G	G	3 radial	VM	Special.	P	4	2	S
142	*L. chinensis* (Chinese fan palm)	30	380	600	4.0	N/A	G	G	3 radial	VVM		P	4	2	S
143	*Livistona chinensis var. subglobosa* (Dwarf Chinese Fan Palm)	2	TD 3x<140 (240)	200	2.0	N/A	VG	G	1 radial	M	Special.	P	3	1	S
144	*Livistona chinensis var. subglobosa* (Dwarf Chinese Fan Palm)	3.5	Multi 7x<140 (370)	200	2.0	N/A	VG	G	1 radial	M	Special.	P	3	1	S
145	*Ligustrum lucidum* (Glossy Privet)	14	750	900	9.0	3.2	G	F	4 3 3 3	M	Environmental weed.	F	4	4	R
146	*L. chinensis* (Chinese fan palm)	30	300	500	3.0	N/A	G	G	2 radial	VVM	Special.	P	4	2	S
147	*P. canariensis* (Canary Island Date Palm)	25	550	600	4.0	N/A	G	G	3 radial	VM	Special.	P	4	2	S
148	*L. chinensis* (Chinese fan palm)	30	400	700	3.0	N/A	G	G	2 radial	VVM	Special.	P	4	2	S
149	*Phoenix reclinata* (Wild Date Palm)	10	300	480	3.0	N/A	G	G	2 radial	M		P	3	2	S
150	*Syagrus romanzoffiana* (Cocos Palm)	22	360	500	4.0	N/A	G	G	3 radial	M		P	3	2	S
151	*Cedrus deodara* (Deodar Cedar)	26	440	650	5.3	2.8	F	F	6 6 4 3	VM	Exotic, sparse canopy, TW - ground level to 2.5m, Decl.	P	4	2	S
152	*L. chinensis* (Chinese fan palm)	30	360	600	3.0	N/A	G	G	2 radial	VVM	Special.	P	4	2	S

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153	*Callistemon salignus* (Willow Bottlebrush)	14	CD 2x200 (280)	350	3.4	2.1	G	G	3 radial	M	Group.	P	3	2	S
154	*C. salignus* (Willow Bottlebrush)	10	CD 80 240 (250)	400	3.0	2.3	G	G	4 1 4 1	M	Group.	P	3	2	S
155	*C. salignus* (Willow Bottlebrush)	14	230	380	2.8	2.2	G	G	4 radial	M	Group.	P	3	2	S
156	*C. salignus* (Willow Bottlebrush)	14	100	220	2.0	1.8	G	G	1 1 3 1	M	Group.	P	3	2	S
157	*C. camphora* (Camphor Laurel)	24	1300	1500	15.0	3.9	P	G	15 6 8 10	VM	Environmental weed, crown, Decl.	F	4	3	R
158	Bamboo clump (50x)	20	800	1200	9.6	3.6	G	G	8 radial	VM	Environmental weed.	F	5	3	R
159	*C. camphora* (Camphor Laurel)	15	All <100	140	2.0	1.5	G	G	1 radial	M		P	4	2	R
160	*C. camphora* (Camphor Laurel)	12	420	450	5.0	2.4	G	P	1 1 6 1	M	PFS, crown unbalanced, bees, no tag.	F	5	3	R
161	*C. camphora* (Camphor Laurel)	25	840	1000	10.1	3.3	G	P	8 radial	VM	TDB, crown Decl.	P	5	3	R
162	*C. camphora* (Camphor Laurel)	25	900	900	10.8	3.2	G	P	4 4 8 8	VM	TDB, crown Decl, decay in trunk.	F	5	3	R
163	*C. camphora* (Camphor Laurel)	25	500	800	6.0	3.0	G	F	2 2 8 1	VM	Crown reduced, E, dw.	F	4	3	R
164	*C. camphora* (Camphor Laurel)	25	600	1000	7.2	3.3	G	P	4 4 4 8	VM	Decay in trunk.	P	5	3	R

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165	*C. camphora* (Camphor Laurel)	25	CD 2x300 (420)	600	5.0	2.7	G	P	- - 6 6	VM	IMFU, decay in trunk.	P	4	3	R
166	*C. camphora* (Camphor Laurel)	25	650	1100	7.8	3.4	G	P	4 4 2 10	VM	TDB in crown, decay in trunk.	F	5	3	R
167	*C. camphora* (Camphor Laurel)	26	CD 220 300 (370)	640	4.4	2.7	G	P	4 radial	VM	Decay in trunk, crown suppressed by Tree 168.	F	5	3	R
168	*C. camphora* (Camphor Laurel)	25	780	860	9.4	3.1	G	P	4 4 6 12	VM	Scaffold has cracks.	F	6	4	R
169	*C. camphora* (Camphor Laurel)	24	1200	1400	14.4	3.8	G	P	4 4 4 10	VM	TDB in crown, decay in trunk, declining.	P	5	3	R
170	*C. camphora* (Camphor Laurel)	25	750	900	9.0	3.2	G	F	8 4 8 10	VM	TDB in crown, IMFU.	P	5	3	R
171	*C. camphora* (Camphor Laurel)	26	820	1210	9.8	3.6	G	F	10 radial	VM	Environmental weed, MBA@5m, PFSs.	P	4	2	R
172	*S. romanzoffiana* (Cocos Palm)	24	260	500	4.0	N/A	G	G	3 radial	OM		P	4	2	S
173	*C. salignus* (Willow Bottlebrush)	7	120	210	2.0	1.7	G	G	2 radial	M		P	3	2	S
174	*Lophostemon confertus* (Brushbox)	12	200	340	2.4	2.1	G	G	3 radial	YM		P	3	2	S
175	*L. confertus* (Brushbox)	12	210	350	2.5	2.1	G	G	3 radial	YM		P	3	2	S

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176	*Celtis sinensis* (Chinese Hackberry)	8	CD 120 150 (190)	220	2.3	1.8	G	G	3 3 4 4	YM	Weed, good shade for Cliveas.	P	3	2	S/R
177	*G. robusta* (Silky Oak)	12	180	240	2.2	1.8	G	G	5 1 3 3	YM	600mm to fence, crown over fence.	P	4	3	R
178	*Agonis flexuosa* (Willow Myrtle)	5	CD 140 150 (210)	300	2.5	2.0	G	F	3 3 4 1	M	In garden bed, crown supressed.	P	4	2	S
179	*L. confertus* (Brushbox)	14	260	400	3.1	2.3	G	VP	6 - - 10	YM	25° TL north-west, heaving soil, partly lodged.	F	6	4	R
180	*B. acerifolius* (Illawarra Flame Tree)	15	450	600	5.4	2.7	G	G	3 3 5 3	VM	Crown over fence.	P	4	2	S
181	*Sapium sebiferum* (Chinese Tallow)	8	80	120	2.0	1.5	G	G	2 radial	YM		P	3	2	S
182	*Ficus macrophylla* (Moreton Bay Fig)	4	3000	5000	15.0	6.5	G	G	12 10 15 10	VM	Crown reduced, E, fine old tree.	P	5	2	S
183	*P. canariensis* (Canary Island Date Palm)	14	480	700	4.0	N/A	G	G	3 radial	M		P	3	2	S
184	*L. confertus* (Brushbox)	16	TD 60 100 320 (340)	450	4.1	2.4	G	G	6 4 4 4	YM		P	3	2	S
185	*L. confertus* (Brushbox)	16	420	560	5.0	2.6	P	G	8 6 8 8	M	Sparse canopy.	P	4	3	S
186	*Eucalyptus botryoides* (Bangalay)	15	250	340	3.0	2.1	G	F	12 - 1 3	M	E, unbalanced, tropism to the north.	P	4	2	S

187	*Corymbia citriodora* (Lemon-scented Gum)	18	500	680	6.0	2.8	G	G	10 - 12 4	M	Tropism to the north.	P	4	2	S
188	*Araucaria columnaris* (Cook Island Pine)	12	200	300	2.4	2.0	G	G	2 radial	J		P	3	1	S
189	*L. confertus* (Brushbox)	14	360	420	4.3	2.3	G	G	6 4 4 4	M		P	3	2	S
190	*C. salignus* (Willow Bottlebrush)	8	110	160	2.0	1.5	G	G	2 radial	M		P	3	2	S
191	*C. salignus* (Willow Bottlebrush)	6	80	140	2.0	1.5	G	G	2 radial	M		P	3	2	S
192	*C. salignus* (Willow Bottlebrush)	6	CD 2x60 (80)	140	2.0	1.5	G	G	1 0.5 1 1	M		P	3	2	S
193	*L. confertus* (Brushbox)	18	260	350	3.1	2.1	G	G	6 2 4 2	YM		P	3	2	S
194	*A. cunninghamiana* (Bangalow Palm)	6	110	250	3.0	N/A	G	G	2 radial	YM		P	3	2	S
195	*C. camphora* (Camphor Laurel)	24	CD 440 500 (670)	850	8.0	3.1	G	P	8 radial	VM	In fence, decay in trunk. crown declining, environmental weed.	F	6	4	R
196	*C. camphora* (Camphor Laurel)	20	CD 600 800 (1000)	3000	12.0	5.3	G	F	10 radial	VM	2 trees grafted together, dw, TDB in crown, environmental weed.	F	6	4	R
197	*E. botryoides* (Bangalay)	15	220	300	2.6	2.0	G	F	10 - 15 -	M	15° TK north-east, natural tropism.	P	5	2	S
198	*E. botryoides* (Bangalay)	25	450	650	5.4	2.8	G	G	8 radial	M	Best tree on site.	P	4	1	S
199	*C. camphora* (Camphor Laurel)	20	QD 4x<200 (400)	1000	4.8	3.3	G	G	10 6 8 8	M	Environmental weed, TDB in crown.	P	4	3	R
200	*C. citriodora* (Lemon-scented Gum)	20	200	340	2.4	2.1	G	G	2 2 4 1	YM	FA.	P	4	2	S
201	*F. rubiginosa* (Port Jackson Fig)	12	120	200	2.0	1.7	G	G	2 radial	YM		P	3	1	S

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Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
202	*C. citriodora* (Lemon-scented Gum)	22	450	700	5.4	2.9	G	G	8 6 6 8	M		P	3	2	S
203	*E. botryoides* (Bangalay)	24	500	680	6.0	2.8	G	G	4 6 15 2	M	BF@8m, tropism to the east.	P	3	2	S
204	*L. confertus* (Brushbox)	14	150	220	2.0	1.8	G	G	4 radial	J		P	3	2	S
205	*P. undulatum* (Native Daphne)	10	100	150	2.0	1.5	G	G	3 radial	YM		P	3	2	S
206	*E. botryoides* (Bangalay)	16	220	300	2.6	2.0	G	F	- 4 10 -	YM	Tropism to the east.	P	4	2	S
207	*P. undulatum* (Native Daphne)	15	200	250	2.4	1.9	G	G	4 radial	M		P	3	2	S
208	*C. camphora* (Camphor Laurel)	15	CD 80 140 (160)	240	2.0	1.8	G	G	4 4 2 2	YM	Environmental weed.	F	4	4	R
209	*L. confertus* (Brushbox)	14	210	340	2.5	2.1	G	G	3 radial	J		P	4	2	S
210	*L. confertus* (Brushbox)	14	140	240	2.0	1.8	G	G	3 3 3 1	J		P	4	2	S
211	*L. confertus* (Brushbox)	14	260	380	3.1	2.2	G	G	4 radial	YM		P	3	2	S
212	*C. camphora* (Camphor Laurel)	15	220	340	2.6	2.1	G	G	4 radial	M	Environmental weed.	P	3	4	R
213	*L. confertus* (Brushbox)	18	280	400	3.4	2.3	G	G	6 radial	M		P	3	2	S

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Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
214	*L. confertus* (Brushbox)	20	280	400	3.4	2.3	G	G	4 4 12 -	M	Tropism to the east.	P	4	2	S
215	*C. sinensis* (Chinese Hackberry)	10	260	300	3.1	2.0	G	F	2 - 8 -	M	Tropism to the east, environmental weed.	P	4	4	R
216	*L. confertus* (Brushbox)	22	460	720	5.5	2.9	G	G	8 radial	M		P	4	2	S
217	*B. acerifolius* (Illawarra Flame Tree)	6	80	100	2.0	1.5	G	G	2 radial	J		P	3	2	S
218	*P. undulatum* (Native Daphne)	6	60	90	2.0	1.5	G	G	2 1 1 1	J		P	3	2	S
219	*A. cunninghamiana* (Bangalow Palm)	8	180	260	3.0	N/A	G	G	2 radial	YM		P	3	2	S
220	*L. confertus* (Brushbox)	22	CD 320 400 (510)	620	6.1	2.7	G	G	6 6 4 8	M	IMFU.	P	4	2	S
221	*G. robusta* (Silky Oak)	24	400	500	4.8	2.5	G	G	6 6 6 8	VM	This species is exempt from Willoughby City Council's TPO.	P	5	2B	S
222	*A. cunninghamiana* (Bangalow Palm)	12	180	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
223	*A. cunninghamiana* (Bangalow Palm)	8	80	120	3.0	N/A	G	G	2 radial	J		P	3	2B	S
224	*L. confertus* (Brushbox)	10	60	100	2.0	1.5	G	G	2 radial	J		P	3	2B	S
225	*F. rubiginosa* (Port Jackson Fig)	24	2500	4000	15.0	5.9	G	G	10 15 15 15	VM	Crown reduced over residence. Significant tree.	P	4	1A	S

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226	*S. romanzoffiana* (Cocos Palm)	20	200	400	2.4	2.3	G	G	3 radial	VM		P	4	2B	S
227	*C. sinensis* (Chinese Hackberry)	18	260	420	3.1	2.3	G	G	8 radial	M	Listed weed. Forms canopy cover for stairs.	P	4	2B	S
228	*Melaleuca quinquenervia* (Broad-leaved Paperbark)	22	430	500	5.2	2.5	G	G	8 2 6 8	VM	Crown reduced away from residence.	P	4	2B	S
229	*L. chinensis* (Chinese fan palm)	8	200	420	3.0	N/A	G	G	2 radial	VM		P	3	2B	S
230	*Melaleuca quinquenervia* (Broad-leaved Paperbark)	26	600	850	7.2	3.1	G	G	8 4 2 8	M	Crown reduced to west on adjacent site.	P	4	2B	S
231	*A. cunninghamiana* (Bangalow Palm)	16	240	460	3.0	N/A	G	G	2 radial	M		P	3	2B	S
232	*A. cunninghamiana* (Bangalow Palm)	14	220	400	3.0	N/A	G	G	2 radial	M		P	3	2B	S
233	*A. cunninghamiana* (Bangalow Palm)	16	240	420	3.0	N/A	G	G	2 radial	M		P	3	2B	S
234	*Harpephyllum caffrum* (Kaffir Plum Tree)	18	400	520	4.8	2.5	G	G	6 2 6 6	M		P	4	2B	S
235	*A. cunninghamiana* (Bangalow Palm)	15	200	350	3.0	N/A	G	G	2 radial	M		P	4	2B	S
236	*A. cunninghamiana* (Bangalow Palm)	16	220	320	3.0	N/A	G	G	2 radial	M		P	4	2B	S
237	*Eucalyptus saligna* (Sydney Blue Gum)	24	480	600	5.8	2.7	G	F	8 2 8 8	M	3° TL to the north.	P	4	2B	S
238	Palm species	16	240	450	4.0	N/A	G	G	3 radial	M	Fruit from head, radial leaf arrangement	P	4	2B	S
239	*Phoenix canariensis* (Canary Island Date Palm)	12	550	700	5.0	N/A	G	G	4 radial	M	On adjacent site, 5° TL north-east.	P	4	2B	S

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240	Palm species	14	250	360	4.0	N/A	G	G	3 radial	M	Fruit from head, radial leaf arrangement	P	4	2B	S
241	*A. flexuosa* (Willow Myrtle)	8	200	350	2.4	2.1	G	F	2 - 8 -	M	Trunk growing horizontal to the east, crown over boundary.	P	5	2B	S
242	*A. columnaris* (Cook Island Pine)	16	320	450	3.8	2.4	G	G	2 radial	M		P	3	2B	S
243	Group of *A. flexuosa* (Willow Myrtle)	8	300 (ea)	400 (ea)	3.6	2.3	4x G 1x Dead	G	6 - 6 -	M	All have TL 30° to the east, Ivy in crown, 1x dead over path.	P	4	2B	S
244	Group of *A. flexuosa* (Willow Myrtle)	10	CD 200 250 (320)	400	3.8	2.3	G	G	6 2 6 -	M	Ivy in crown, 5° TL to the east - remove ivy.	P	4	2B	S
245	*A. cunninghamiana* (Bangalow Palm)	10	220	300	3.0	N/A	G	G	2 radial	M		P	3	2B	S
246	*A. costata* (Smooth-barked Apple)	15	360	520	4.3	2.5	G	G	6 radial	YM		P	3	2B	S
247	*A. flexuosa* (Willow Myrtle)	16	460	500	5.5	2.5	G	F	10 2 4 6	VM	PFS to the west, tropism to the north.	P	5	2B	S
248	*A. flexuosa* (Willow Myrtle)	10	TD 60 100 150 (190)	300	2.3	2.0	G	G	6 - 2 -	YM	Tropism to the north.	P	4	2B	S
249	*A. cunninghamiana* (Bangalow Palm)	8	100	220	3.0	N/A	G	G	2 radial	J		P	3	2B	S
250	*E. X sykesii* (Coral Tree)	24	800	950	9.6	3.2	G	P	10 8 10 12	VM	Multiple failure sites, possible H sites, D.	F	7	4	R
251	*P. undulatum* (Native Daphne)	8	160	160	2.0	1.5	G	G	3 1 2 3	M	E.	P	3	2B	S

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252	Unknown species	14	280	360	3.4	2.1	G	G	4 2 4 4	M	Native species.	P	4	2B	S
253	*B. acerifolius* (Illawarra Flame Tree)	14	220	300	2.6	2.0	G	G	4 radial	M		P	4	2B	S
254	*L. confertus* (Brushbox)	15	250	320	3.0	2.1	G	G	4 radial	YM		P	4	2B	S
255	*L. confertus* (Brushbox)	20	440	550	5.3	2.6	G	G	6 radial	M		P	4	2B	S
258	*Ficus spp.*	4	140	180	2.0	1.6	G	F	- 10 - -	YM	Tropism to the south.	P	4	2B	S
256	*L. confertus* (Brushbox)	20	300	380	3.6	2.2	G	G	4 radial	M		P	4	2B	S
257	*B. acerifolius* (Illawarra Flame Tree)	15	250	340	3.0	2.1	G	F	4 radial	M	IMFU@8m.	P	5	2B	S
259	*Backhousia myrtifolia* (Ironwood)	12	200	300	2.4	2.0	G	G	4 2 4 4	YM		P	4	2B	S
260	*G. robusta* (Silky Oak)	18	300	420	3.6	2.3	F	G	3 2 2 3	M	Sparse canopy.	P	5	3B	S
261	*B. myrtifolia* (Ironwood)	12	140	200	2.0	1.7	G	G	2 radial	YM		P	3	2B	S
262	*B. acerifolius* (Illawarra Flame Tree)	10	180	220	2.2	1.8	G	G	3 1 2 1	YM		P	3	2B	S
263	*L. confertus* (Brushbox)	12	210	340	2.5	2.1	G	G	2 2 3 3	YM		P	3	2B	S
264	*Casuarina cunninghamiana* (River She-Oak)	16	300	400	3.6	2.3	G	G	4 radial	M		P	3	2B	S
265	*C. cunninghamiana* (River She-Oak)	14	250	320	3.0	2.1	G	G	8 - 2 2	M	Vine in crown, tropism to the north.	P	3	2B	S

ABBREVIATIONS: **m**-metres, **mm**-millimetres, **DBH**-trunk diameter @ 1.4m, **DGL**-trunk diameter at ground level, **VP**-very poor, **P**-poor, **F**-fair, **G**-good, **VG**-very good, **CD**-co-dominant trunk, **TD**-tri-dominant trunk, **QD**-4x trunk, **TL**-trunk lean, **TW**-trunk wound, **Insp**-inspect, **L**-longicorns, **E**-epicormics, **K**-Kino, **FA**-forest architecture, **FR**-Forest Remnant, **dw**-deadwood small, **DW**-deadwood large, **TDB**-tip dieback, **PFS**-previous failure site, **RFS**-recent failure site, **BEW**-branch end weight, **MTU**-multi tree union, **MFU**-main fork union, **IFU**-inclusive fork union, **IMFU**-inclusive main fork union, **IMBU**-inclusive main branch union, **MBA**-Multiple branch attachments, **FB**-fruiting body, **BF**-bracket fungus, **U/C**-under canopy, **Decl**-declining, **B**-borers, **PD**-parrot damage, **LD**-leaf damage, **CMP**-chewing mouth piece, **RW**-reaction wood, **H/D**-Height/Diameter ratio test [Mattheck, Breloer (1994)], **J**-juvenile, **YM**-young mature, **SM**-semi mature, **M**-mature, **OM**-over mature, **HFP**-high failure potential, **D**-dangerous, **VD**-very dangerous, **X**-no room to grow/unsuitable, **H**-habitat, **HB**-habitat box, **Rec.**-recommendation, **S**-save, **R**-remove, **T**-transplant, **C**-council determination, **W**-work needed to be carried out, **mon**-monitor, **TPO**-tree preservation order, **HV**-high voltage, **PL**-power lines, **VTA** (P-pass, F-fail) **Hazard Rating**-**3**=low hazard, **12**=dangerous, **N/A**-not applicable, **SULE**-Safe & Useful Life Expectancy.

Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
266	*Ligustrum lucidum* (Glossy Privet)	14	450	700	5.4	2.9	G	F	6 4 6 6	M	Weed, possible H site.	P	4	2B	R
267	*A. cunninghamiana* (Bangalow Palm)	10	250	440	3.0	N/A	G	G	2 radial	M		P	3	2B	S
268	*A. cunninghamiana* (Bangalow Palm)	14	220	450	3.0	N/A	G	G	2 radial	M		P	3	2B	S
269	*A. cunninghamiana* (Bangalow Palm)	12	220	400	3.0	N/A	G	G	2 radial	M		P	3	2B	S
270	*Populus spp.*	22	1400	1600	15.0	4.0	G	F	12 radial	OM	PFSs, TDB, n top of slope, possible H sites.	P	5	2B	S
271	*A. cunninghamiana* (Bangalow Palm)	14	220	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
272	*A. cunninghamiana* (Bangalow Palm)	12	200	320	3.0	N/A	G	G	2 radial	M		P	3	2B	S
273	*A. cunninghamiana* (Bangalow Palm)	10	180	300	3.0	N/A	G	G	2 radial	M		P	3	2B	S
274	*A. cunninghamiana* (Bangalow Palm)	10	200	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
275	*Phoenix canariensis* (Canary Island Date Palm)	18	1000	1400	4.0	N/A	G	G	3 radial	M		P	4	2B	S
276	*A. cunninghamiana* (Bangalow Palm)	12	200	360	3.0	N/A	G	G	2 radial	M		P	3	2B	S
277	*A. cunninghamiana* (Bangalow Palm)	10	180	300	3.0	N/A	G	G	2 radial	M		P	3	2B	S
278	Group of 10x *A. cunninghamiana* (Bangalow Palm)	up to 10	<200	<300	3.0	N/A	G	G	2 radial	YM	Group of 10.	P	4	2B	S
279	*C. camphora* (Camphor Laurel)	20	500	700	6.0	2.9	Dead	VP	- - - -	OM	Dead, D.	F	10	4A	R

ABBREVIATIONS: **m**-metres, **mm**-millimetres, **DBH**-trunk diameter @ 1.4m, **DGL**-trunk diameter at ground level, **VP**-very poor, **P**-poor, **F**-fair, **G**-good, **VG**-very good, **CD**-co-dominant trunk, **TD**-tri-dominant trunk, **QD**-4x trunk, **TL**-trunk lean, **TW**-trunk wound, **Insp**-inspect, **L**-longicorns, **E**-epicormics, **K**-Kino, **FA**-forest architecture, **FR**-Forest Remnant, **dw**-deadwood small, **DW**-deadwood large, **TDB**-tip dieback, **PFS**-previous failure site, **RFS**-recent failure site, **BEW**-branch end weight, **MTU**-multi tree union, **MFU**-main fork union, **IFU**-inclusive fork union, **IMFU**-inclusive main fork union, **IMBU**-inclusive main branch union, **MBA**-Multiple branch attachments, **FB**-fruiting body, **BF**-bracket fungus, **U/C**-under canopy, **Decl**-declining, **B**-borers, **PD**-parrot damage, **LD**-leaf damage, **CMP**-chewing mouth piece, **RW**-reaction wood, **H/D**-Height/Diameter ratio test [Mattheck, Breloer (1994)], **J**-juvenile, **YM**-young mature, **SM**-semi mature, **M**-mature, **OM**-over mature, **HFP**-high failure potential, **D**-dangerous, **VD**-very dangerous, **X**-no room to grow/unsuitable, **H**-habitat, **HB**-habitat box, **Rec.**-recommendation, **S**-save, **R**-remove, **T**-transplant, **C**-council determination, **W**-work needed to be carried out, **mon**-monitor, **TPO**-tree preservation order, **HV**-high voltage, **PL**-power lines, **VTA** (P-pass, F-fail) **Hazard Rating**-**3**=low hazard, **12**=dangerous, **N/A**-not applicable, **SULE**-Safe & Useful Life Expectancy.

Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
280	*A. cunninghamiana* (Bangalow Palm)	12	180	260	3.0	N/A	G	G	2 radial	M		P	3	2B	S
281	*A. cunninghamiana* (Bangalow Palm)	10	180	260	3.0	N/A	G	G	2 radial	M		P	3	2B	S
282	*A. cunninghamiana* (Bangalow Palm)	10	180	260	3.0	N/A	G	G	2 radial	M		P	3	2B	S
283	*A. cunninghamiana* (Bangalow Palm)	10	200	260	3.0	N/A	G	G	2 radial	M		P	3	2B	S
284	*A. cunninghamiana* (Bangalow Palm)	11	180	260	3.0	N/A	G	G	2 radial	M		P	3	2B	S
285	*C. camphora* (Camphor Laurel)	22	750	1000	9.0	3.3	VP	F	10 radial	OM	Decl, sparse canopy, possible H sites.	F	8	4A	R
286	*A. cunninghamiana* (Bangalow Palm)	10	170	240	3.0	N/A	G	G	2 radial	M		P	3	2B	S
287	*C. camphora* (Camphor Laurel)	24	460	700	5.5	2.9	VP	F	10 radial	OM	Decl, spare canopy.	F	6	4A	R
288	*Ligustrum lucidum* (Glossy Privet)	20	CD 240 250 (350)	500	4.3	2.5	F	F	6 radial	M	Weed, E.	P	4	3B	R
289	*A. cunninghamiana* (Bangalow Palm)	12	200	360	3.0	N/A	G	G	2 radial	M		P	3	2B	S
290	*A. cunninghamiana* (Bangalow Palm)	10	180	340	3.0	N/A	G	G	2 radial	M		P	3	2B	S
291	*Araucaria bidwillii* (Bunya Pine)	12	150	220	2.0	1.8	G	G	2 radial	J	Nice young tree.	P	3	1B	S

ABBREVIATIONS: **m**-metres, **mm**-millimetres, **DBH**-trunk diameter @ 1.4m, **DGL**-trunk diameter at ground level, **VP**-very poor, **P**-poor, **F**-fair, **G**-good, **VG**-very good, **CD**-co-dominant trunk, **TD**-tri-dominant trunk, **QD**-4x trunk, **TL**-trunk lean, **TW**-trunk wound, **Insp**-inspect, **L**-longicorns, **E**-epicormics, **K**-Kino, **FA**-forest architecture, **FR**-Forest Remnant, **dw**-deadwood small, **DW**-deadwood large, **TDB**-tip dieback, **PFS**-previous failure site, **RFS**-recent failure site, **BEW**-branch end weight, **MTU**-multi tree union, **MFU**-main fork union, **IFU**-inclusive fork union, **IMFU**-inclusive main fork union, **IMBU**-inclusive main branch union, **MBA**-Multiple branch attachments, **FB**-fruiting body, **BF**-bracket fungus, **U/C**-under canopy, **Decl**-declining, **B**-borers, **PD**-parrot damage, **LD**-leaf damage, **CMP**-chewing mouth piece, **RW**-reaction wood, **H/D**-Height/Diameter ratio test [Mattheck, Breloer (1994)], **J**-juvenile, **YM**-young mature, **SM**-semi mature, **M**-mature, **OM**-over mature, **HFP**-high failure potential, **D**-dangerous, **VD**-very dangerous, **X**-no room to grow/unsuitable, **H**-habitat, **HB**-habitat box, **Rec.**-recommendation, **S**-save, **R**-remove, **T**-transplant, **C**-council determination, **W**-work needed to be carried out, **mon**-monitor, **TPO**-tree preservation order, **HV**-high voltage, **PL**-power lines, **VTA** (P-pass, F-fail) **Hazard Rating**-**3**=low hazard, **12**=dangerous, **N/A**-not applicable, **SULE**-Safe & Useful Life Expectancy.

Tree No.	Type	Height (m)	DBH (mm)	DGL (mm)	Radius of full TPZ (m)	Radius of full SRZ (m)	Health Vigour	Structural Condition	Canopy Spread (m) N S E W	Age Class	Comments	VTA	Hazard Rating 3-12	SULE	Rec
292	*A. cunninghamiana* (Bangalow Palm)	14	240	400	3.0	N/A	G	G	2 radial	M		P	3	2B	S
293	*A. cunninghamiana* (Bangalow Palm)	12	230	360	3.0	N/A	G	G	2 radial	M		P	3	2B	S
294	*Banksia integrifolia* (Coast Banksia)	10	320	450	3.8	2.4	G	G	4 2 2 4	M		P	4	2B	S
294A	*Howea forsteriana* (Kentia Palm)	6	150	300	3.0	N/A	G	G	2 radial	M		P	3	2B	S
295	*B. integrifolia* (Coast Banksia)	9	250	390	3.0	2.2	G	G	3 radial	M		P	4	2B	S
296	*A. cunninghamiana* (Bangalow Palm)	14	280	360	3.0	N/A	G	G	2 radial	M		P	3	2B	S
297	*A. cunninghamiana* (Bangalow Palm)	15	290	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
298	*A. cunninghamiana* (Bangalow Palm)	14	280	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
299	*A. cunninghamiana* (Bangalow Palm)	15	290	350	3.0	N/A	G	G	2 radial	M		P	3	2B	S
300	*Podocarpus elatus* (Plum Pine)	10	100	150	2.0	1.5	G	G	2 radial	YM		P	3	1B	S
301	*Stenocarpus sinuatus* (QLD Firewheel Tree)	12	160	220	2.0	1.8	G	G	2 radial	YM	IMFU.	P	4	2B	S
302	*P. undulatum* (Native Daphne)	10	CD 2x140 (200)	300	2.4	2.0	G	G	4 radial	M		P	3	2B	S
303	*Callicoma serratifolia* (Black Wattle)	8	100	180	2.0	1.6	G	G	2 radial	YM		P	3	2B	S

Appendix 4: Notes on Tree Assessment

Key	Criteria	Comments
Tree No	Must relate to the number on your site diagram	
Species	Botanical name and common name of Tree	
Diameter of trunk	DBH Diameter at Breast Height (1.4 metres) DGL Diameter at Ground Level	
Height	In metres	
Spread	Average diameter of canopy in metres	
Crown Condition	Overall vigour and vitality 0 Dead 1 Severe decline (<20% canopy; major dead wood) 2 Declining (20-60% canopy density; twig and branch dieback) 3 Average/low vigour (60-90% canopy density; twig dieback) 4 Good (90-100% crown cover; little or no dieback or other problems) 5 Excellent (100% crown cover, no deadwood or other problems)	This requires knowledge of species.
Age class	Y Young = recently planted S Semi-mature (< 20% of life expectancy) M Mature (20-80% of life expectancy) O Over-mature (> 80% of life expectancy)	
Special Significance	A Aboriginal C Commemorative Ha Habitat Hi Historic M Memorial R Rare U Unique form O Other	This may require specialist knowledge.
Services/adjacent structures	Bs Bus stop Bu Building within 3m HVo High voltage open-wire construction HVb High Voltage bundled (ABC) LVo Low Voltage open-wire construction LVb Low Voltage bundled (ABC) Na No services above Nb No services below ground Si Signage Sl Street light T Transmission lines (>33KV) U Underground services O Other	More than one of these may apply.
Defects	B Borers C Cavity D Decay dw Deadwood E Epicormics FA Forest Architecture H/D Height/Diameter ratio I Inclusions L Lopped LDCMP Leaf damage by chewing mouthpieced insects	More than one of these may apply. H/D if ratio is higher than 50:1 then tree is defective (Mattheck, Breloer 1994).

Key	Criteria	Comments
	M Mistletoe/Parasites MBA Multiple Branch Attachments PD Parrot Damage PFS Previous Failure Sites S Splits/cracks T Termites TL Trunk Lean TW Trunk Wound O Other	
Root zone	C Compaction D Damaged/wounded roots (eg by mowers) E Exposed roots Ga Tree in garden bed Gi Girdled roots Gr Grass Kb Kerb close to tree L+ Raised soil level L- Lowered soil level M Mulched Pa Paving/concrete/bitumen Pr Roots pruned O Other	More than one of these may apply.
Failure Potential	Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure within the inspection period. 1. Low – defects are minor (eg dieback of twigs, small wounds with good wound wood development) 2. Medium – defects are present and obvious (eg cavity encompassing 10-25% of the circumference of the trunk) 3. High – numerous and or significant defects present (eg cavity encompassing 30-50% of the circumference of the trunk, major bark inclusions) 4. Severe – defects are very severe (eg heart rot fruiting bodies, cavity encompassing more than 50% of the trunk)	This requires specialist knowledge
Size of defective part	Rates the size of the part most likely to fail. The larger the part that fails, the greater the potential for damage. 1. most likely failure less than 150mm in diameter 2. Most likely failure 150-450mm in diameter 3. Most likely failure 450-750mm in diameter 4. Most likely failure more than 750mm in diameter	
Target Rating*	Rates the use and occupancy of the area that would be struck by the defective part 1. Occasional use (e.g. jogging/cycle track) 2. Intermittent use (e.g. picnic area, day use parking) 3. Frequent use, secondary structure (e.g. seasonal camping area, storage facilities) 4. Constant use, structures (e.g. year-round use for a number of hours each day, residences)	
Hazard rating*	Failure potential + size of part + target rating Add each of the above sections for a number out of 12	The final number identifies the degree of risk. The next step is to determine a management strategy. A rating in this column does not condemn a tree but may indicate the need for more investigation and a risk management strategy.

Appendix 5: Rating System for Tree Significance

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating tree significance becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site.

Once landscape significance of an individual tree has been defined, the retention value can then be determined. (Table 1.0 in this Appendix). The terms used in the Assessment Criteria and Tree Retention Value - Priority Matrix, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

TREE SIGNIFICANCE - ASSESSMENT CRITERIA

1. High Significance in landscape

- The tree is in good condition, or normal vigour and form typical of the species,
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of grand age.
- The tree is listed as a Heritage Item, Threatened Species or part of a Threatened Community or listed on council's significant tree register.
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape by bulk and scale and makes a positive contribution to the local amenity.
- The tree has been influenced by historic figures, events or part of the heritage development of the place.
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values.
- The growing environment supports the tree to its full dimensions above and below ground without conflict or constraint.

2. Medium Significance in landscape

- The tree is in fair-good condition, or normal or low vigour and form typical or atypical of the species.
- The tree is a planted locally indigenous or a common species with its taxa readily planted in the local area.
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street.
- The tree provides a fair contribution to the visual character and amenity of the area.
- The tree is moderately constrained by above or below ground influences of the built environment to reach full dimensions.

3. Low Significance in landscape

- The tree is in fair-poor condition, or normal or low vigour and form typical or atypical of the species,
- The tree is not visible or is partly from surrounding properties as obstructed by other vegetation or buildings.
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the area.
- The tree is severely constrained by above or below ground by influences of the built environment and therefore will not reach full dimensions; tree is inappropriate to the site conditions.
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order.
- The tree has a wound or defect that has potential to become structurally unsound.

4. Environmental Pest/Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties.
- The tree is a declared noxious weed by legislation.

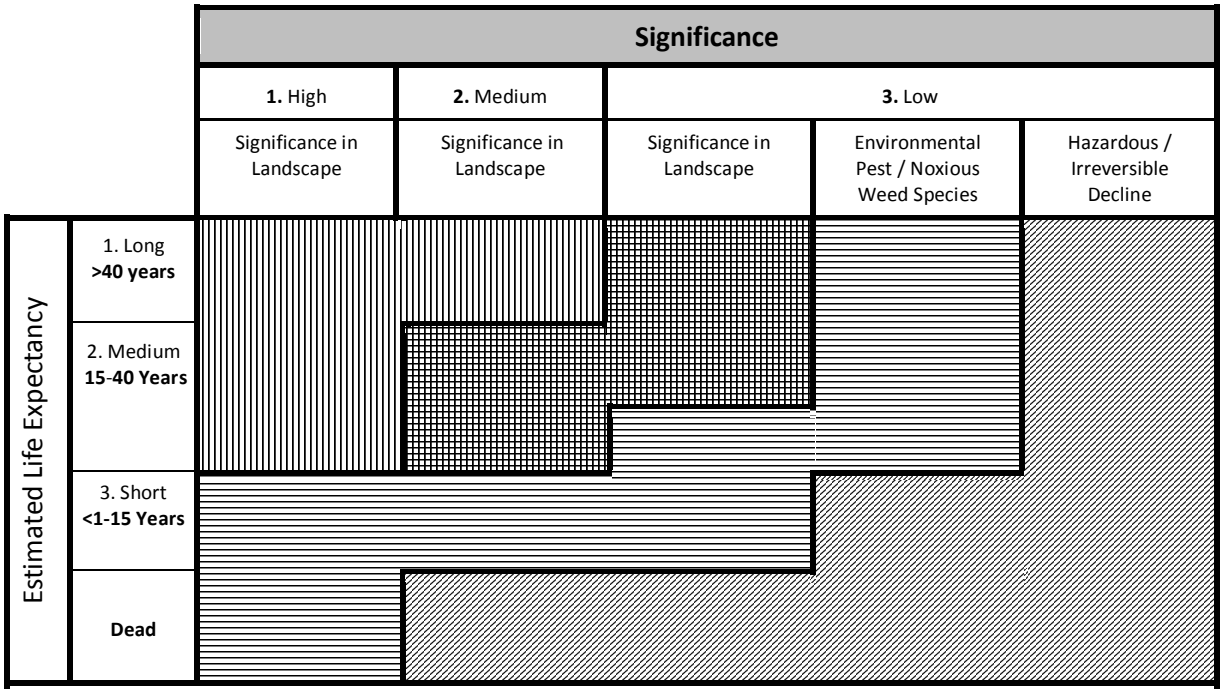
5. Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous.
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to correspond with at least three (3) of the criteria in categories 1, 2 and 3, and one (1) criteria only is required in categories 4 and 5 to be classified in that group.

Note: The assessment criteria are for individual trees only and are not to be applied to stands of trees.

TABLE 1.0 TREE RETENTION VALUE - PRIORITY MATRIX.



Legend for Matrix Assessment

Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as detailed in Table 2. Special construction works must be implemented e.g. pier and beam, etc, if works are to proceed within the Tree Protection Zone.

Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.

Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.

Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

Appendix 6: Extract from AS4970-2009 Protection of trees on development sites, Section 3, Determining the tree protection zones of the selected trees, 3.1 Tree protection zone (TPZ)

3.1 TREE PROTECTION ZONE (TPZ)

"The tree protection zone (TPZ) is the principal means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The TPZ incorporates the structural root zone (SRZ) (refer to Clause 3.3.5)."

3.2 DETERMINING THE TPZ

TPZ for Single Trunked Trees

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.

TPZ = DBH x 12

TPZ for Multiple Trunked Trees

The radius of the TPZ for multiple trunked trees is calculated using the following formula:

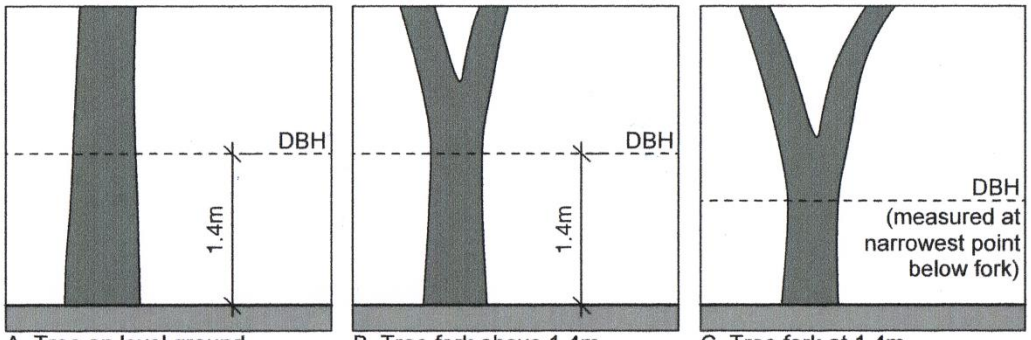
$$\sqrt{(DBH_1)^2+(DBH_2)^2+(DBH_3)^2} = \text{total DBH} \times 12$$

DBH = trunk diameter measured at 1.4 metres above ground.

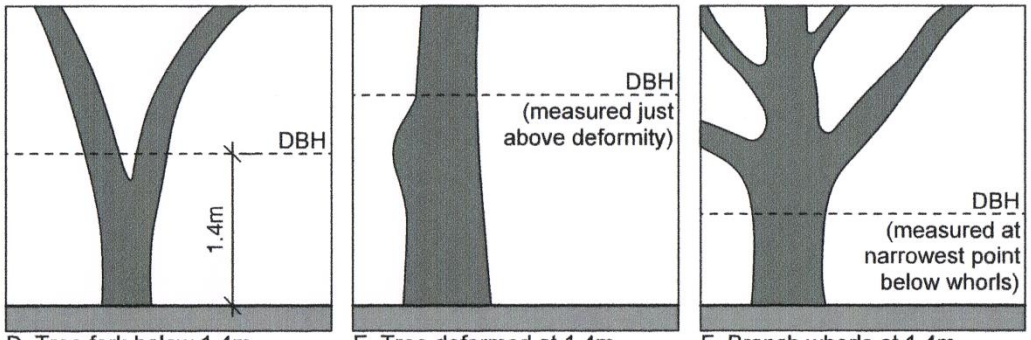
Radius is measured from the centre of the stem at ground level.

A TPZ should not be less than 2 metres nor greater than 15 metres (except where crown protection is required).

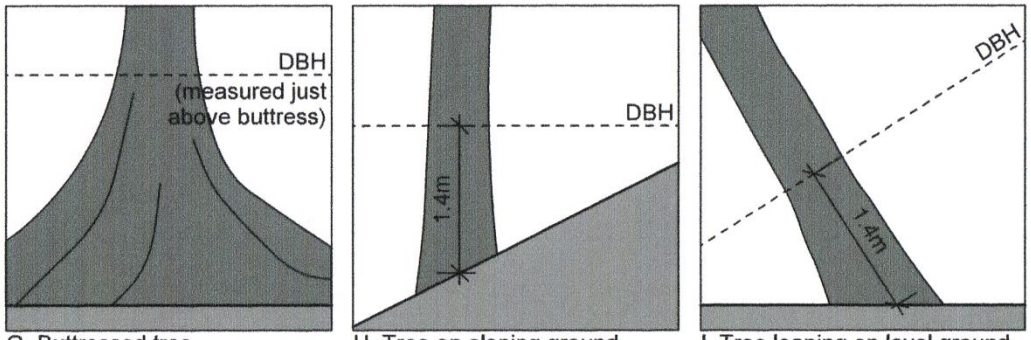
The TPZ of palms, other monocots, cycads and tree ferns should not be less than 1 metre outside the crown projection.



A. Tree on level ground | B. Tree fork above 1.4m | C. Tree fork at 1.4m



D. Tree fork below 1.4m | E. Tree deformed at 1.4m | F. Branch whorls at 1.4m



G. Buttressed tree | H. Tree on sloping ground | I. Tree leaning on level ground

DBH = Diameter at Breast Height
DBH is measured 1.4m above ground level.

Note:
For multi-stemed trees (eg. figure D), the DBH may be calculated using the formula:

$$Total\ DBH = \sqrt{(DBH_1)^2+(DBH_2)^2+(DBH_3)^2}$$

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06

Measurement of Diameter at Breast Height (DBH)

Not to Scale

Appendix 7: Extract from AS4970-2009 Protection of trees on development sites, Section 3, Determining the protection zones of the selected trees, 3.3.5 Structural root zone (SRZ)

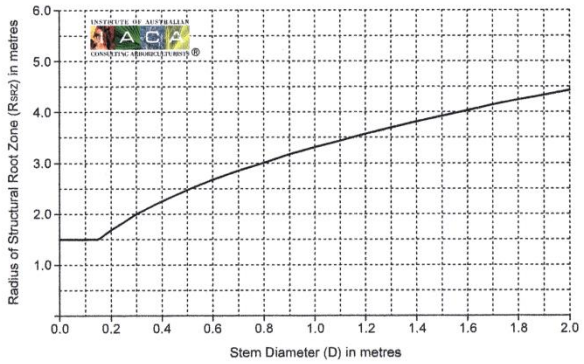
3.3.5 Structural root zone (SRZ)

"The SRZ is the area required for street stability. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated when a major encroachment into a TPZ is proposed. Root investigation may provide more information on the extent of these roots."

Determining the SRZ

Note: The SRZ for trees with trunk diameters less than 0.15 m will be 1.5 m.

(see Figure 01 and 02) and Table 2.0.



SRZ = Structural Root Zone
Referred to as radius in metres.

Note:
a) The SRZ curve can be calculated using the formula:

$$R_{SRZ} = (D \times 50)^{0.42} \times 0.64$$

where:
R_{SRZ} = Radius of Structural Root Zone
D = Stem Diameter (measured directly above root buttress in metres)

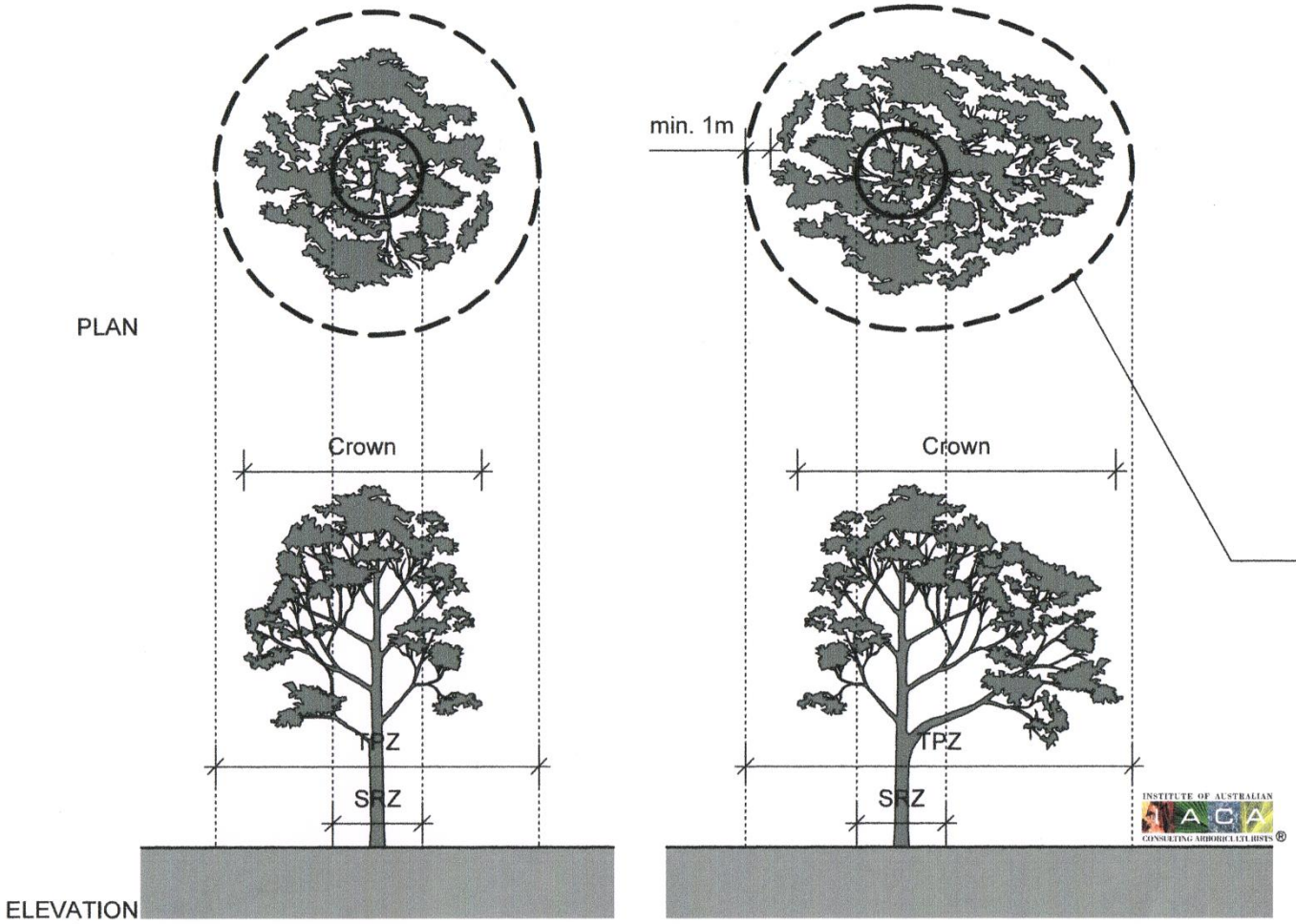
b) SRZ of trees <0.15m diameter is 1.5m.

c) SRZ formula and curve do not apply to trees with an asymmetrical root plate, palms, cycads or tree ferns.

01 Structural Root Zone (SRZ)

Not to Scale

Based on IACA Members licence of AS4970-2009



TPZ = Tree Protection Zone
Referred to as radius in metres and calculated using the formula:

$$TPZ = 12 \times DBH$$

where:
DBH = Diameter at Breast Height (measured 1.4 m above ground level)

SRZ = Structural Root Zone
Referred to as radius in metres and calculated using the formula:

$$R_{SRZ} = (D \times 50)^{0.42} \times 0.64$$

where:
R_{SRZ} = Radius of Structural Root Zone
D = Stem Diameter (measured directly above root buttress in metres)

TPZ adjusted to include crown protection. Adjusted TPZ should be a minimum of 1m outside the perimeter of the crown.

02 Indicative Tree Protection Zone (TPZ)

Scale 1:500 @ A4

TABLE 2.0 TPZ AND SRZ TABLE

DBH for TPZ (mm)	DGL for SRZ (mm)	TPZ (m)	SRZ (m)	DBH for TPZ (mm)	DGL for SRZ (mm)	TPZ (m)	SRZ (m)	DBH for TPZ (mm)	DGL for SRZ (mm)	TPZ (m)	SRZ (m)
100	100	2.0	1.5	500	500	6.0	2.5	900	900	10.8	3.2
110	110	2.0	1.5	510	510	6.1	2.5	910	910	10.9	3.2
120	120	2.0	1.5	520	520	6.2	2.5	920	920	11.0	3.2
130	130	2.0	1.5	530	530	6.4	2.5	930	930	11.2	3.2
140	140	2.0	1.5	540	540	6.5	2.6	940	940	11.3	3.2
150	150	2.0	1.5	550	550	6.6	2.6	950	950	11.4	3.2
160	160	2.0	1.5	560	560	6.7	2.6	960	960	11.5	3.3
170	170	2.0	1.6	570	570	6.8	2.6	970	970	11.6	3.3
180	180	2.2	1.6	580	580	7.0	2.6	980	980	11.8	3.3
190	190	2.3	1.7	590	590	7.1	2.7	990	990	11.9	3.3
200	200	2.4	1.7	600	600	7.2	2.7	1000	1000	12.0	3.3
210	210	2.5	1.7	610	610	7.3	2.7	1010	1010	12.1	3.3
220	220	2.6	1.8	620	620	7.4	2.7	1020	1020	12.2	3.3
230	230	2.8	1.8	630	630	7.6	2.7	1030	1030	12.4	3.4
240	240	2.9	1.8	640	640	7.7	2.7	1040	1040	12.5	3.4
250	250	3.0	1.9	650	650	7.8	2.8	1050	1050	12.6	3.4
260	260	3.1	1.9	660	660	7.9	2.8	1060	1060	12.7	3.4
270	270	3.2	1.9	670	670	8.0	2.8	1070	1070	12.8	3.4
280	280	3.4	1.9	680	680	8.2	2.8	1080	1080	13.0	3.4
290	290	3.5	2.0	690	690	8.3	2.8	1090	1090	13.1	3.4
300	300	3.6	2.0	700	700	8.4	2.9	1100	1100	13.2	3.4
310	310	3.7	2.0	710	710	8.5	2.9	1110	1110	13.3	3.5
320	320	3.8	2.1	720	720	8.6	2.9	1120	1120	13.4	3.5
330	330	4.0	2.1	730	730	8.8	2.9	1130	1130	13.6	3.5
340	340	4.1	2.1	740	740	8.9	2.9	1140	1140	13.7	3.5
350	350	4.2	2.1	750	750	9.0	2.9	1150	1150	13.8	3.5
360	360	4.3	2.1	760	760	9.1	3.0	1160	1160	13.9	3.5
370	370	4.4	2.2	770	770	9.2	3.0	1170	1170	14.0	3.5
380	380	4.6	2.2	780	780	9.4	3.0	1180	1180	14.2	3.6
390	390	4.7	2.2	790	790	9.5	3.0	1190	1190	14.3	3.6
400	400	4.8	2.3	800	800	9.6	3.0	1200	1200	14.4	3.6
410	410	4.9	2.3	810	810	9.7	3.0	1210	1210	14.5	3.6
420	420	5.0	2.3	820	820	9.8	3.0	1220	1220	14.6	3.6
430	430	5.2	2.3	830	830	10.0	3.1	1230	1230	14.8	3.6
440	440	5.3	2.3	840	840	10.1	3.1	1240	1240	14.9	3.6
450	450	5.4	2.4	850	850	10.2	3.1	1250	1250	15.0	3.6
460	460	5.5	2.4	860	860	10.3	3.1				
470	470	5.6	2.4	870	870	10.4	3.1				
480	480	5.8	2.4	880	880	10.6	3.1				
490	490	5.9	2.5	890	890	10.7	3.2				

Appendix 8: Tree Protection Zones – Standard Procedure

1.0 TREE PROTECTION ZONES - STANDARD PROCEDURE

1.1 The Protective fencing where required may delineate the ***TPZ*** and should be located as determined by the project Arborist either in accordance with the specific Council's guidelines or if no guidelines given by the Council then using AS4970 *Protection of trees on development sites*, Section 4, 4.3. *"Fencing should be erected before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, protective fencing must not be removed or altered without approval by the project arborist. The TPZ must be secured to restrict access. AS4687 Temporary fencing and hoardings specifies applicable fencing requirements. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area. Fence posts and supports should have a diameter greater than 20 mm and be located clear of roots. Existing perimeter fencing and other structures may be suitable as part of the protective fencing."*

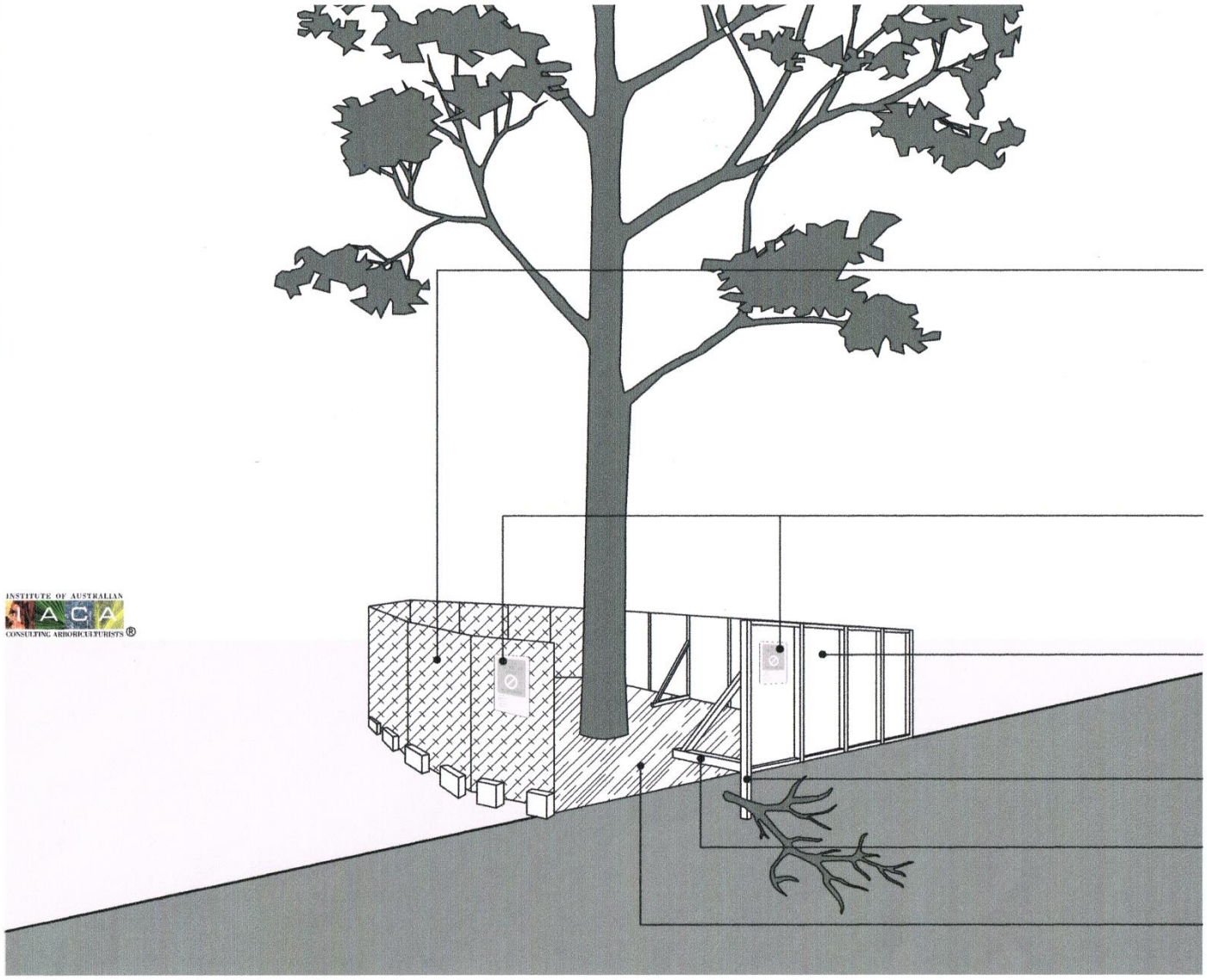
Figure 03 Protective fencing shows examples of such fencing.

1.2 AS4970 Section 4, Tree protection measures, 4.2 Activities restricted within the TPZ

"Activities generally excluded from the TPZ included but are not limited to-

(a) Machine excavation including trenching;
(b) Excavation for silt fencing
(c) Cultivation;
(d) Storage;
(e) Preparation of chemicals, including preparation of cement products;
(f) Parking of vehicles and plant;
(g) Refuelling;
(h) Dumping of waste;
(i) Wash down and cleaning of equipment;
(j) Placement of fill;
(k) Lighting of fires;
(l) Soil level changes;
(m) Temporary or permanent installation of utilities and signs, and
(n) Physical damage to the tree."

Based on IACA Members licence of AS4970-2009



Note:
No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.

Option 1 - Fencing
1.8m high chain wire mesh panels with shade cloth attached (if required), held in place with concrete feet.

Tree Protection Zone (TPZ) sign

Option 2 - Fencing
Plywood or wooden panel paling fence. This type of fencing material also prevents building materials or soil entering the TPZ.

Installation of supports should avoid damaging roots.

Bracing is permissible within the TPZ.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer installed across surface of TPZ.

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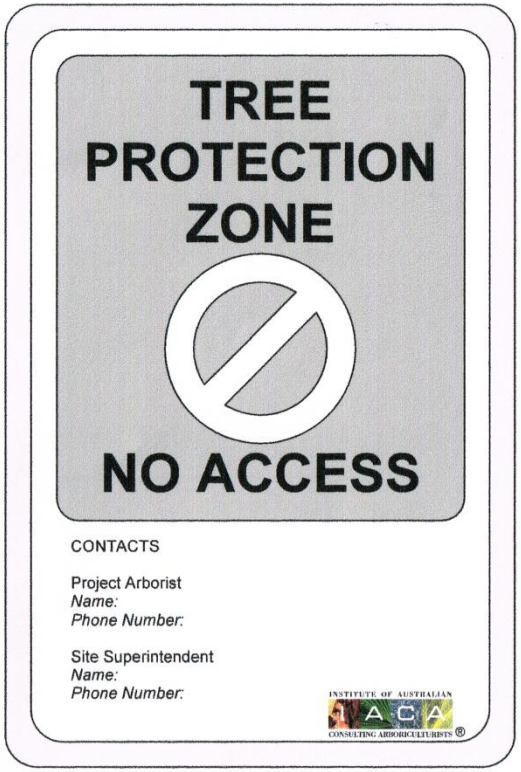
03 Tree Protection Fencing

Not to Scale

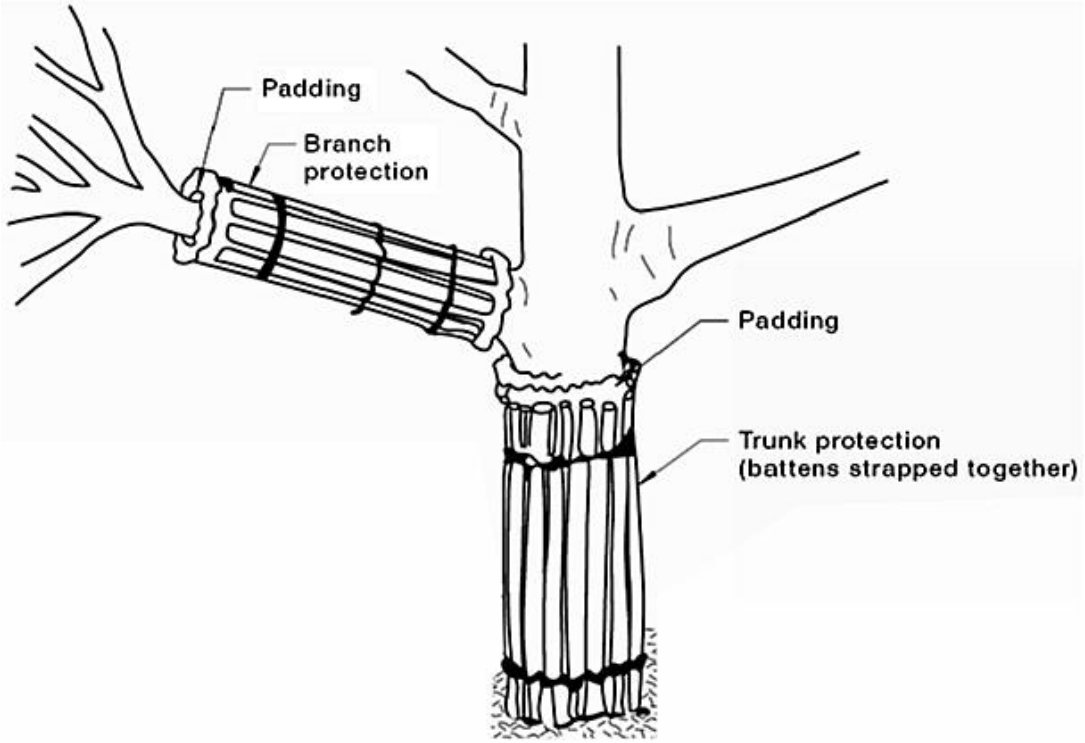
1.3 Tree Protection signage is to be attached to each ***Tree Protection Zone*** and displayed from within the development site in accordance with AS4970-2009 *Protection of trees on development sites*, Section 4.4 and example Figure 08.



08 Example of Tree Protection Zone (TPZ) Signage

Scale 1:5 @ A4

1.4 Where a tree is to be retained and a ***Tree Protection Zone*** cannot be adequately established due to restricted access e.g. tree located along side an access way, the trunk and branches in the lower crown will be protected by wrapping 2 layers of hessian or carpet underfelt around the trunk and branches for a minimum of 2 m or as lower branches permit, then wire or rope secures 75x50x2000 mm hardwood battens together around the trunk (do not nail or screw to the trunk or branches). The number of battens to be used is as required to encircle the trunk and the planks are to extend to the base of the tree (AS4970-2009 *Protection of trees on development sites*, Figure 4 Examples of Trunk, Branch and ground protection below).



1.5 If a tree is growing down slope from an excavation, a silt fence located along the contours of the site in the area immediately above the ***Tree Protection Zone*** fencing may need to be installed and regularly maintained to prevent burial and asphyxiation of the roots of the tree. To allow for the maintenance of both fences, the silt fence must be constructed separately to the tree protection fence and the 2 fences must be constructed independently of each other and standalone. To reduce competition with the tree the area within the ***Tree Protection Zone*** is to be kept free of weeds. These are best removed by the application of foliar herbicide with Glyphosate as the active constituent. This is the preferred method rather than removal by cultivation of the soil within the dripline, to minimise root disturbance to the tree. The removal of woody weeds such as Privet should use the cut and paint method of herbicide application. Weeds are to be controlled within the ***Tree Protection Zone***, for the duration of the project.

1.6 The area of the Tree Protection Zone to be mulched to a depth of 50mm with organic material being 75% leaf litter and 25% wood, and this being composted material. The depth of mulch and type as indicated, to be maintained for the duration of the project. Where deep excavation will expose the soil profile to drying out the root plate is to be protected by pegging jute matting across the ground surface 2 m back from the edge of the profile and 2 m down the face of the profile and is to be in one continuous sheet or layers up to 5 mm thick and overlapped 300 mm and pegged. Pegs are to be a minimum length of 200 mm and spaced at 500 mm increments in a grid pattern. Once installed mulch is to be placed on top of the jute matting previously described.

1.7 No services either temporary or permanent are to be located within the ***Tree Protection Zone***. If services are to be located within the ***Tree Protection Zone***, special details will need to be provided by a qualified Consulting Arboriculturist for the protection of the tree regarding the location of the service/s. Works within the TPZ should be hand dug or tunnelled.

1.8 A tree will not be fertilised during its protection within the ***Tree Protection Zone***, as this may hasten its decline if it were to decline. If a tree is to be fertilised this should be in consultation with a qualified Consulting Arboriculturist.

1.9 In the event of prolonged dry periods, or where a tree has been transplanted, or where excavation nearby, especially up slope, leads to drying out of a soil profile, or modification to ground water flow, or flows across an existing ground surface to the tree and its growing environment; deep root watering thoroughly at least twice a week is to be undertaken to irrigate the tree. The need for such watering is determined readily by observing the dryness of the soil surface within the dripline of the tree by scraping back some mulch. Mulch is to be reinstated afterwards. In the event of disrupted ground or surface water flows to the tree due to excavation, filling or construction, a reticulated irrigation system may be required to be installed within the Tree Protection Zone. If an irrigation system is to be installed, consideration must be given to volume, frequency, and drainage of water delivered, and this should be in consultation with a qualified Consulting Arboriculturist.

Appendix 9: Tree Protection on Construction Sites

1.0 TREE PROTECTION ON CONSTRUCTION SITES

Note: Individual protection measures to be applied where stated as applicable.

1.1.0 General notes
1.2.0 Cautionary notes for the protection of retained trees
1.3.0 Demolition of built structures - precautions to protect trees
1.4.0 Excavation and construction close to Tree Protection Zones

1.1.0 **General notes**

1.1.1 The application of any measures for the protection of trees on development sites is determined by the species characteristics of the subject tree, and the existing physical constraints of the growing environment on site both above and below ground.

1.1.2 This report considers where applicable, Australian Standard AS4970-2009 *Protection of trees on development sites*.

1.1.3 This report applies the ***Tree Protection Zone - Standard Procedure*** However, this does not restrict the author from applying additional or alternative conditions where it is deemed appropriate by the author for the protection of trees on development sites. Such additional or alternative conditions may be founded upon professional judgement based on:

- the experience of the Consulting Arboriculturist
- scientific research
- new technology
- industry best practice
- consideration of the individual tree species and its relative tolerance to development impacts
- the individual or cumulative factors present or proposed to impact upon the growing environment essential for the trees' survival

1.1.4 Where this report makes reference to the retention of subject trees it is for their incorporation into the landscaping works for the site, and they are to be documented on a Landscape Plan for the site.

1.2.0 **Cautionary notes for the protection of retained trees**

1.2.1 **Installing underground services within TPZ**

If an underground utility service is to be located within the area of the TPZ Australian Standard AS4970-2009 *Protection of trees on development sites*, Section 4, 4.5.5 Installing underground services within TPZ provides the following:

"All services should be routed outside the TPZ. If underground services must be routed within the TPZ, they should be installed by directional drilling or in manually excavated trenches.

The directional drilling bore should be at least 600 mm deep. The project Arborist should assess the likely impacts of boring and bore pits on retained trees.

For manual excavation trenches the project Arborist should advise on roots to be retained and should monitor the works. Manual excavation may include the use of pneumatic and hydraulic tools. Refer Clause 4.5.3."

1.2.1.1 **Location of services Option B** (Driveway Construction)

If a service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, and site conditions such as shallow bed rock or if mass rooting has occurred from multiple trees growing in close proximity to each other, the service trench is to be elevated and positioned above natural ground level within the new driveway structure. The existing driveway surface is to be scabbled and a reinforced concrete topping is to be provided with down turned thickened edges constructed under the kerb edging to prevent lateral movement. A suitable sub grade material to manufacturers' recommendations is to be utilised if and where appropriate. Construction is to occur in a manner so as not to cause damage to the subject trees root system. All works to be in accordance with engineers' details.

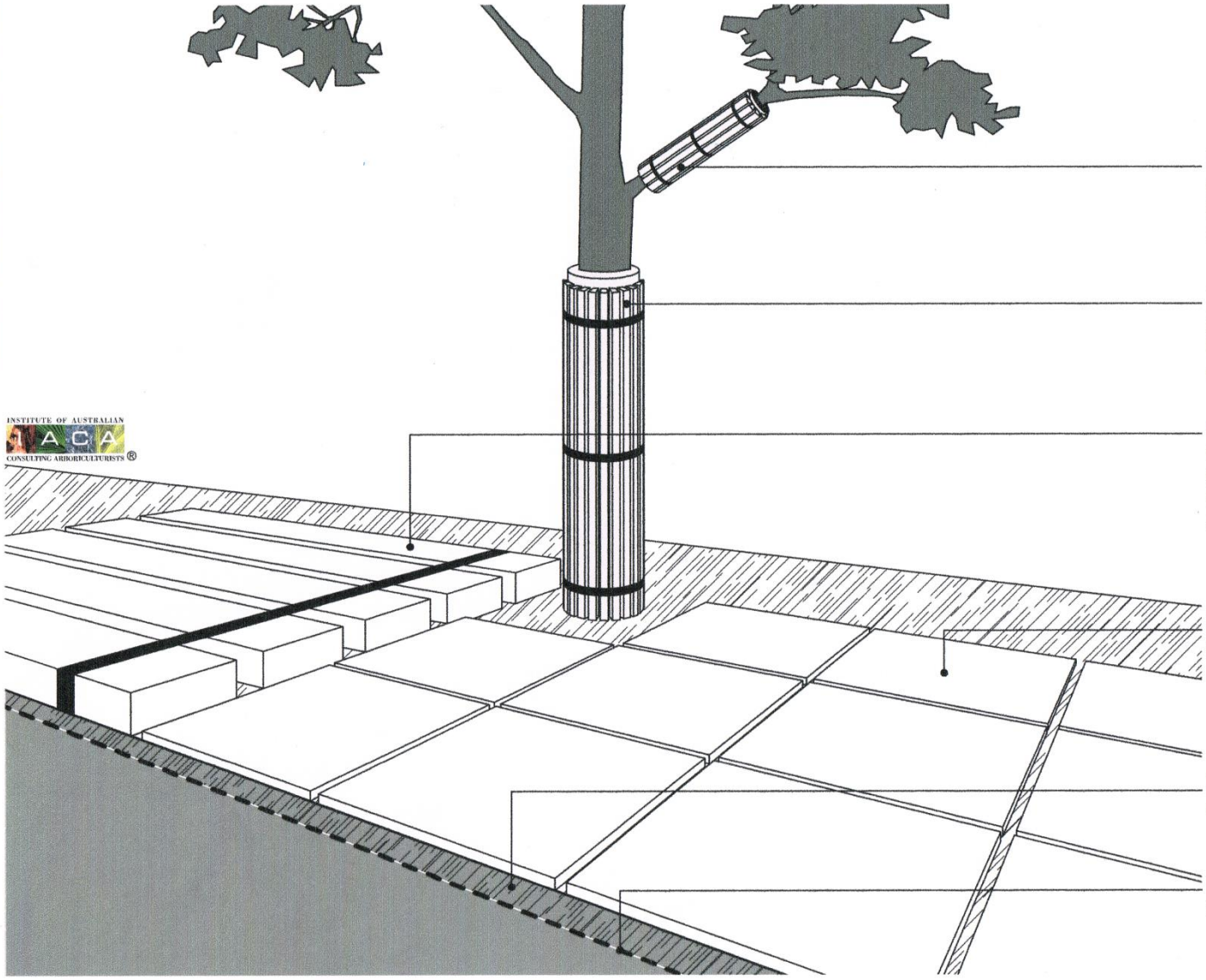
1.2.2 **Precautions in Respect of Temporary Work**

For Precautions in respect of temporary work, Australian Standard AS4970-2009 *Protection of trees on development sites*, Section 4, Tree protection measures, 4.5 Other tree protection measures, provides the following:

"4.5.3 Ground protection

If temporary access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Measures may include a permeable membrane such as geotextile fabric beneath a layer of mulch or crushed rock below rumble boards as per Figure 4. These measures may be applied to root zones beyond the TPZ."

Based on IACA Members licence of AS4970-2009



Branch Protection - use boards and padding to prevent damage to bark on branch. Boards are to be strapped, not screwed or nailed to the branch.

Trunk Protection - use boards and padding to prevent damage to bark (minimum 2m). Boards are to be strapped, not screwed or nailed to the trunk.

Ground Protection - use device strapped over mulch or aggregate layer. Ground protection device should be of a suitable thickness to prevent soil compaction and root damage.

Steel plates (or approved equivalent) with or without mulch or aggregate layer below.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer.

Geotextile fabric underneath mulch or aggregate layer.

04 Examples of Branch, Trunk and Ground Protection

Not to Scale

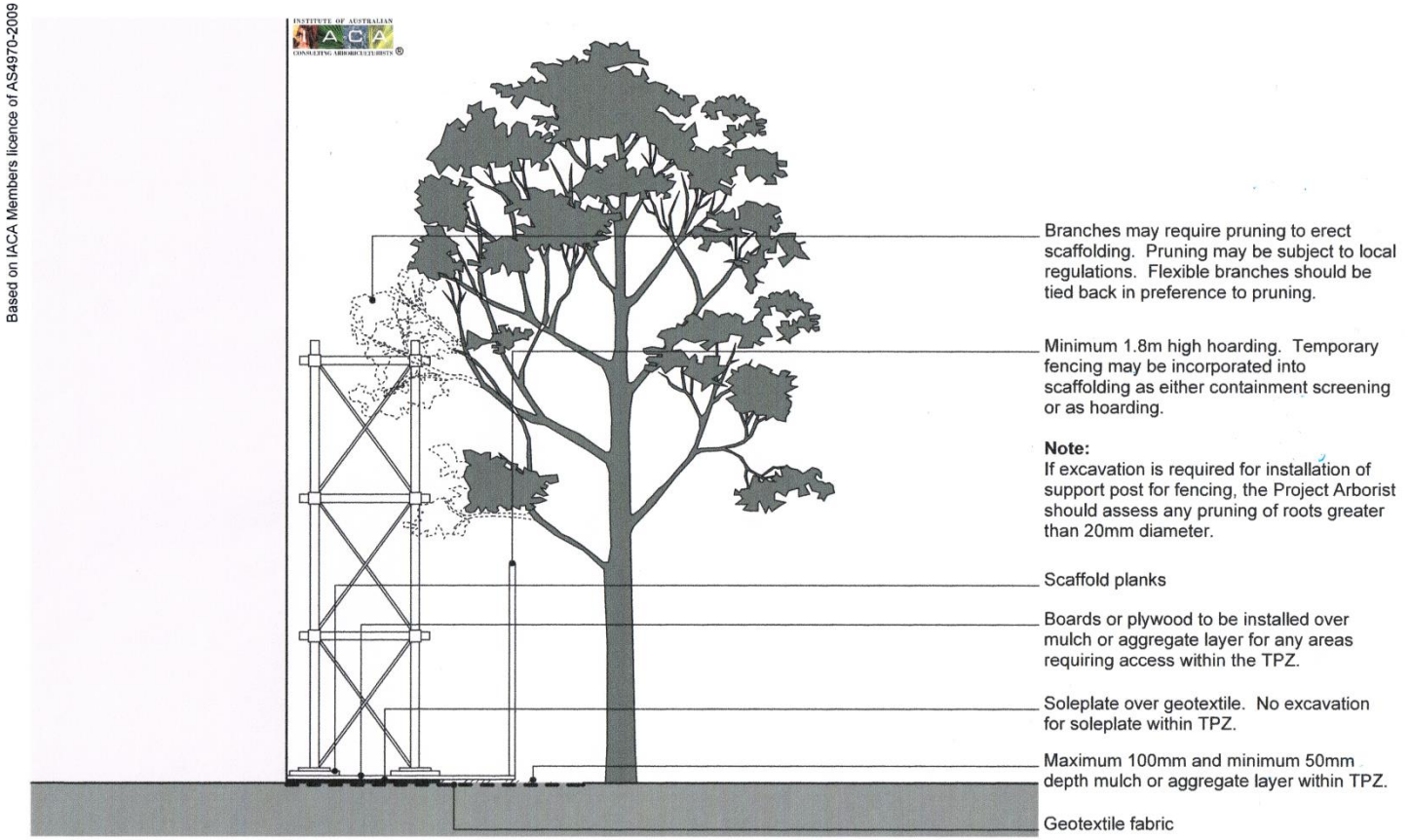
"4.5.6 Scaffolding

Where scaffolding is required it should be erected outside the TPZ. Where it is essential for scaffolding to be erected within the TPZ, branch removal should be minimized. This can be achieved by designing scaffolding to avoid branches or tying back branches. Ground below the scaffolding should be protected by boarding (e.g. scaffolding board or plywood sheeting) as shown in Figure 5. Where access is required, a board walk or other surface material should be installed to minimise soil compaction. Boarding should be placed over a layer of mulch and impervious sheeting to prevent soil contamination. The boarding should be left in place until the scaffolding is removed."

"Notes:

1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.

2 Rumble boards should be a suitable thickness to prevent soil compaction and root damage."



05 Indicative Scaffolding within a Tree Protection Zone (TPZ) Not to Scale

1.3.0 **Demolition of Built Structures - Precautions to Protect Trees**

1.3.1 **Demolition of Existing Buildings**

The demolition of the buildings should be undertaken with access restricted to the driveway and the building platform for each of the existing buildings, or to areas of the land where no trees are growing within 6m of any tree to be retained. Where access or space for a safe working environment is restricted, or where the area of the 6m set back must be compromised, a 100 mm layer of Eucalyptus wood mulch must be laid over the area of encroachment. Where vehicular access is required across the mulch layer further root protection should be provided by laying a temporary pathway over the mulch. The temporary pathway should be constructed of a grated steel material capable of supporting the vehicles used during demolition e.g. similar to ramps used to load vehicles onto the backs of trucks. Trunks of trees are to be protected from vehicular damage as per section 1.2.2 above.

1.3.2 **Demolition of Landscape Structures**

The demolition of walls, driveways retaining walls, paths and pools etc. within 6 m of a tree to be retained should be undertaken manually using hand tools. Where a driveway is to be demolished being of concrete strip or slab type construction, it should be undertaken by working from the end of the driveway closest to the building back towards the street by utilising the driveway as a stable platform to prevent soil compaction. Where a concrete slab driveway passes less than 1 m from the base of a tree and the area beneath the driveway is to be undisturbed and incorporated into the landscape works for the site, the volume of space previously occupied by the driveway must be replaced with local top soil from the site or otherwise a loamy sand, to replace the mass of the concrete on the root plate which may be critical to the ballast and centre of mass for the stability of the tree. If the tree becomes unstable immediately contact the Consultant Arboriculturist.

1.3.3 **Removal of Existing Trees near Trees to be Retained**

Removal of a tree within 6 m of a tree to be retained should be undertaken only by cutting down such a tree without damaging the trees to be retained, and by grinding out its stump. Where possible the structural roots of 20 mm diameter or greater of the tree to be cut down should not be removed, to minimise soil disturbance and to reduce the impact on the roots of any tree to be retained nearby. Where structural roots are to be removed this should be undertaken manually by the use of non-motorized hand tools after the stump has been ground out when such roots are often easier to locate from the site of the stump from which they have been severed.

1.4.0 **Excavation and Construction close to Tree Protection Zones**

1.4.0.1 Where structural woody roots with a diameter of 20 mm or greater are to be pruned outside the area of the Tree Protection Zone, they are to be excavated manually first by using hand tools to determine their location. A Waterknife or Airknife can be used as a mechanised alternative to locate such structural woody roots. Once located those roots to be severed are to be cut cleanly with a final cut to undamaged woody tissue and this will prevent tearing damage to the roots from excavation equipment which can extend beyond the point of excavation back towards the tree.

1.4.0.2 Where a large vigorous tree is to be retained near to a built structure, and dependent upon its taxa, age class and propensity for its roots system to regenerate, it may be prudent to install a root barrier immediately adjacent to the footing of the new building, or to deepen and strengthen the footings themselves to act as a root barrier, but for such structural advice an appropriately qualified chartered structural engineer should be consulted.

1.4.1 **Root Location and Protection where Structures are to be Positioned near a Retained Tree**

1.4.1.1 If walls or a driveway or other structures are to be constructed near a protected tree, careful excavation is to be undertaken manually by using non-motorized hand tools to determine the location of first order and lower order structural roots with a diameter of 20 mm (*structural woody roots*) or greater, without damaging them. Boundary walls or fences should use columns or posts within fill panels, or a wall to be constructed with suspended sections 100 mm clear above or beside any structural woody root or further as required, or any new wall to be built only to the depth of that existing. Structural woody roots to be further protected by utilising the construction techniques of pier or bridge footings, or screw piles between or over them with a minimum clearance above or beside of 100 mm, or further as required to allow for future and on-going growth.

1.4.1.2 Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on gap graded fill. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5 m from the closest edge of trunk, or further depending on the species and its likely further growth to allow for future development and expansion of the trunk, buttresses, and first order and lower order roots as may be advised by a Consultant Arboriculturist. The side of the driveway closest to a tree is to be edged with a concrete kerb of minimum dimensions of 150 x 150 mm, to prevent vehicular collision with the trunk. Here a *Waterknife* or an *Airknife* can be used as a mechanised alternative to locate first order and lower order structural woody roots.

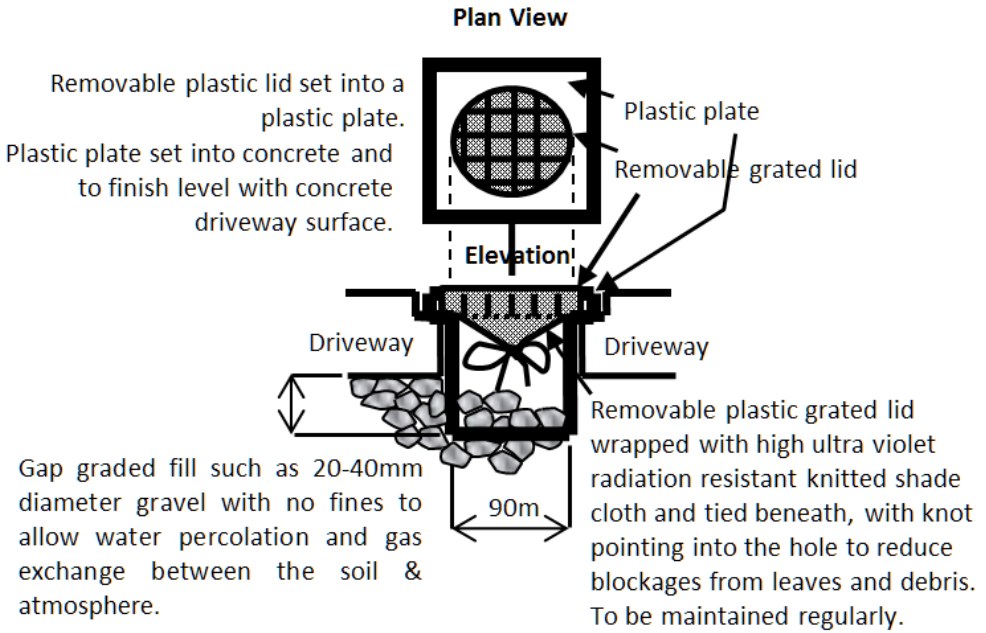
1.4.1.3 Alternatively a footpath or driveway may be constructed at ground level without any excavation, removing turf by raking, having sprayed with herbicide first if time permits. Here the path or driveway section is to extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the footpath, or driveway.

1.4.1.4 Watering / Gaseous exchange vents are to be installed in the area of the dri ***one*** area a concealed with the finished level beside the path equivalent to the top of the path by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate.

1.4.2 **Root Protection where a Driveway close to a Tree is to be Demolished and a New Driveway Constructed in a Similar Location to a Previous Driveway.**

After demolition of an existing driveway as per 1.3.2, the level of the base for the new driveway should be located at the same existing level as that of the base of the previous driveway, and should extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the driveway. To prevent excavation from damaging the existing roots which may be located at, near or above the surface of the soil beneath the base of the previous driveway, the new driveway may need to be raised by constructing it on pier or bridge footings between or over them (see 1.4.2 for minimum clearances), or based on a gap graded fill and the driveway constructed with any exposed edges concealed to the top of the driveway by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. Where roots have grown to occupy the soil between the concrete strips of a concrete, stone or brick strip driveway, they and the soil may be excavated to the level of the base of the concrete strips, but where such roots have a diameter of 20 mm or greater, a Consulting Arboriculturist should be contacted prior to such works being undertaken. Where roots are to be severed, they are to be cut cleanly with a final cut to undamaged woody tissue.

Irrigation / Gaseous Exchange Vent



NOTE: Such vents can be installed in a grid pattern at 1 per 1 m^2 and their planning and construction utilised in consultation with an appropriate structural or civil engineer.

1.4.3 **Root Protection where a Footpath is to be Constructed close to a Tree.**

1.4.3.1 A footpath may be constructed at ground level without any excavation, by first killing with herbicide the plants to be removed from the pathway area, and then removing that plant material by cutting the trunks of woody shrubs to ground level and by raking all other plant material to expose the top soil surface without organic matter. This will remove the need for physically disturbing the soil and the roots of the tree. The path section is to extend for a distance past each tree equivalent to the lateral spread of the crown of that tree where it extends alongside the footpath.

1.4.3.2 To prevent excavation from damaging the existing roots which may be located at, near, or above the surface of the soil, a gap graded fill as a fill material of a media as appropriate, to a depth of 100 mm above the soil surface, or above the top of the root of any tree to be retained, or above the soil surface may be utilised as a base treatment to construct the foot path. Any exposed edges to be concealed to the top of the edges of the footpath and tapering back to the base of the trunk of each tree by minimal filling at each trunk of no greater than 100 mm with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation with ground covers, or other landscape treatments as appropriate. A Consultant Arboriculturist should be contacted prior to such works being undertaken or if any structural roots are considered appropriate to be severed being those roots of 20 mm diameter or greater.

1.4.4 **Structural Soil to Accommodate Load Bearing Conditions**

A structural soil should only be considered as a new media into which the trees could be planted if the planting was into a new area where the area surrounding was to be load bearing such as a footpath, driveway or road.

1.4.5 **Gap Graded Fill to Accommodate Compacted Sub Grade and Root Growth**

To further protect woody roots with a diameter of 20 mm or greater, a gap graded fill with no fines such as gravel 40 mm diameter should only be considered as a fill media above existing grade when soil levels are to be increased near existing trees and the roots can utilise the new media to develop on-going and future root growth and provide for gaseous exchange between the soil and the atmosphere.

Appendix 10: Glossary

Please refer to *Dictionary for Managing Trees in Urban Environments,* Institute of Australian Consulting Arboriculturists (IACA) 2009. (Draper & Richards)

Appendix 11: SULE

SULE (an acronym for **Safe** & **Useful Life Expectancy**). There are a number of SULE categories that indicate the safe useful life anticipated for each tree. Factors such as the location, age, condition and health of the tree are significant to determining this rating. Other influences such as the tree's effect on better specimens and the economics of managing the tree successfully in its location are also relevant to SULE (Barrell 1993, 1995).

SULE Categories and Subgroups

1 = Long SULE OF > 40 years

A Structurally sound in suitable location	**B** Suitable to retain with some remedial care	**C** Significant status – requires special care to preserve

2 = Medium SULE of 15-40 years

A Lifespan limit	**B** Eventual removal for safety or nuisance	**C** Remove for adjacent trees or replanting	**D** Requires extensive remedial care

3 = Short SULE of 5-15 years

A Lifespan limit	**B** Eventual removal for safety or nuisance	**C** Remove for adjacent trees or replanting	**D** Requires extensive remedial care

4 = Remove tree within 5 years

A Dead, dying or disease	**B** Unstable or exposed by new clearing	**C** Structurally defective	**D** Damaged and unsafe	**E** Remove for adjacent trees or replanting	**F** Damaging existing structures	**G** Clearing will affect stability

5 = Trees suitable to transplant

A Less than 5m high	**B** Young trees over 5m high	**C** Height/width contained by pruning

The SULE rating given to any tree in this report assumes that reasonable maintenance will be provided by a qualified Arboriculturist (AQF 3) using the correct and acknowledged techniques. Retained trees are to be protected from root damage. Incorrect tree work practices can significantly accelerate tree decline and increase hazard potential.

Appendix 12: Curriculum Vitae

U W S (Hawkesbury)	Graduate Diploma in Horticulture
	Diploma in Horticulture
Hortus Australia	Diploma of Horticulture (Arboriculture) (RTF50203-6522-6/12/2005) Qualified AQF5
Ryde School of Horticulture	Tree Surgery
	Arboriculture Techniques
Central Coast Community College	Excel Module 1 and 2
	Excel – Advanced
Workcover	OHS General Induction for Construction Work in NSW (CGI00871464SEQ1)
	St Johns Ambulance First Aid Certificate

CONFERENCE ATTENDANCE & TRAINING

2015	Quantified Tree Risk Assessment System A Practitioners Guide to Visual Tree Assessment
2011	Institute of Australian Consulting Arboriculturists (IACA) AS4970 Forum
2011	Ecological Consultants Association of NSW - Impacts of Invasive Species
2010	Root Barrier Field Day
2009	Matheny & Clark: Arboriculture
2007	Quantified Tree Risk Assessment System A Practitioners Guide to Visual Tree Assessment
2006	Barrell Tree A-Z 2 Day Workshop
	IML Resistograph F500S Training Course
2005	Urban Tree Forum – Sydney City Council
	Urban Tree Risk Management – Treelogic
	DA Workshop Preparing Development Applications for Local Council –AIH
	Urban Forest – The New Imperative – Parks and Leisure Australia
2004	Visual Tree Assessment Workshop – Professor Doctor Claus Mattheck
2003	Urban Trees - Our Urban Urgency – Parks and Leisure Australia
1999	Tree Hazard Assessment – Parramatta Park – NAAA
1990	Aero Advanced Climbers Seminar NSW

BUSINESS ACHIEVEMENT

Finalist in Central Coast Advocate Community Business Awards 2005 for Specialised Business category.

Appendix 5

2016 Nursery Stock List for Randwick City Council Community Nursery

Appendix 5
2016 Nursery Stock List for Randwick City Council Community Nursery

Local indigenous species

Species	Common Name
Groundcover and climbers	
Billardiera scandens	Apple Berry
Carpobrotus glaucescens	Pigface
Eustrephus latifolius	Wombat Berry
Glycine clandestina	Love Creeper
Hibbertia scandens	Guinea Flower
Kennedia rubicunda	Dusky Coral Pea
Oxylobium cordifolium	Heart-leaf Shaggy Pea
Pelargonium australe	Wild Geranium
Rulingia hermannifolia	Wrinkled Kerrawang
Viola hederacea	Native Violet
Clumping Plants	
Austrodanthonia setacea	Wallaby Grass
Dianella congesta	Coastal Flax Lily
Dichelachne crinita	Plume Grass
Ficinia nodosa	Knobby Club Rush
Juncus pallidus	Pale Rush
Lomandra longifolia	Mat Rush
Microlaena stipoides	Weeping Rice Grass
Xanthorrhoea resinosa	Grass Tree
Shrubs (1m)	
Acacia myrtifolia	Myrtle Wattle
Baeckea imbricata	Heath Baeckea
Calytrix tetragona	Fringe Myrtle
Correa alba	White Correa
Darwinia fasicularis	-
Gompholobium glabratum	-
Grevillea speciosa	Red Spider Grevillea
Lomatia silaifolia	Parsley Bush
Melaleuca thymifolia	Thyme Honey Myrtle
Micromyrtus ciliata	Fringe Heath Myrtle
Shrubs (1-5m)	
Acacia longifolia var. sophorae	Sydney Coast Wattle
Acacia suaveolens	Sweet-Scented Wattle
Allocasuarina distyla	Scrub She Oak
Banksia ericifolia	Heath Banksia
Banksia oblongifolia	Rusty Banksia
Banksia robur	Swamp Banksia
Banksia spinulosa	Hair Pin Banksia
Bauera rubioides	River Rose
Correa reflexa	Native Fuchsia
Dodonaea triquetra	Hop Bush
Grevillea sericea	Pink Spider Flower
Hakea gibbosa	Needle Bush
Hakea teretifolia	Dagger Hakea

Species	Common Name
Kunzea ambigua	Tick Bush
Leptospermum juniperum	Prickly Tea Tree
Leptospermum squarrosum	Pink Tea Tree
Leptospermum trinervium	Paperbark Tea Tree
Melanthera biflora	Sea Daisy
Monotoca elliptica	Tree Broom Heath
Pultenaea daphnoides	-
Westringia fruticosa	Coastal Rosemary
Trees (4-7m)	
Eucalyptus obstans	Port Jackson Mallee
Leptospermum laevigatum	Coast Tea Tree
Trees (7m+)	
Acmena smithii	Lillypilly
Angophora costata	Sydney Red Gum
Banksia integrifolia	Coast Banskia
Banksia serrata	Old Man Banksia
Corymbia gummifera	Red Bloodwood
Eucalyptus haemastoma	Scribbly Gum
Eucalyptus robusta	Swamp Mahogany
Glochidion ferdinandi	Cheese Tree

Appendix 6

Baseline monitoring point photographs (from Monitoring Point 1) in Thomas Hogan Reserve

Appendix 6
Baseline monitoring point photographs in Thomas Hogan Reserve (for Monitoring Point 1 taken on 26 August 2015)

Monitoring point 1: 26/8/2015: Panorama 1a, standing in the central flat area of gully, facing in a south-easterly direction, with a view upslope of Transect 3

Monitoring point 1: 26/8/2015: Panorama 1b, facing in a southerly direction, with a view of the stairway

Monitoring point 1: 26/8/2015: Panorama 1c, facing in a south westerly direction

Monitoring point 1: 26/8/2015: Panorama 1d, facing in a west south westerly direction, view of Transect 2

Monitoring point 1: 26/8/2015: Panorama 1e, facing in a westerly direction

Monitoring point 1: 26/8/2015: Panorama 1f, facing in a west north westerly direction

Monitoring point 1: 26/8/2015: Panorama 1g, facing in a north westerly direction

Monitoring point 1: 26/8/2015: Panorama 1h, facing in a northerly direction

Monitoring point 1: 26/8/2015: Panorama 1i, facing in a north east northerly direction

Monitoring point 1: 26/8/2015: Panorama 1j, facing in a north easterly direction