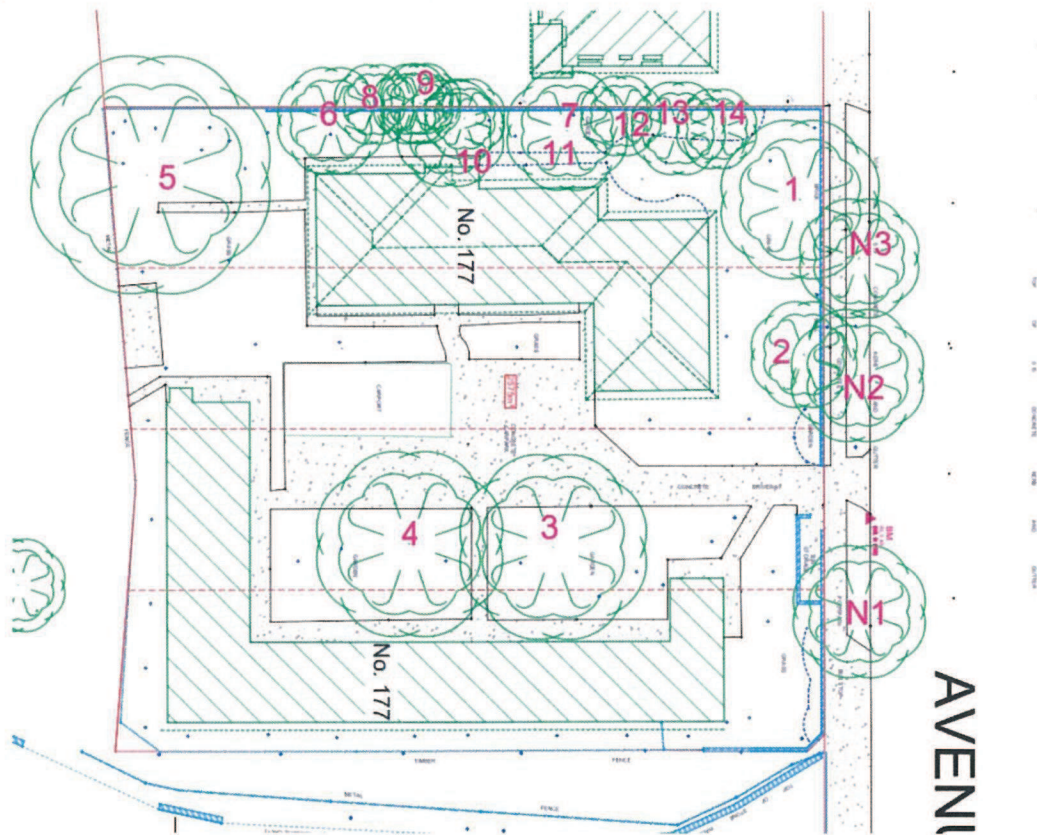
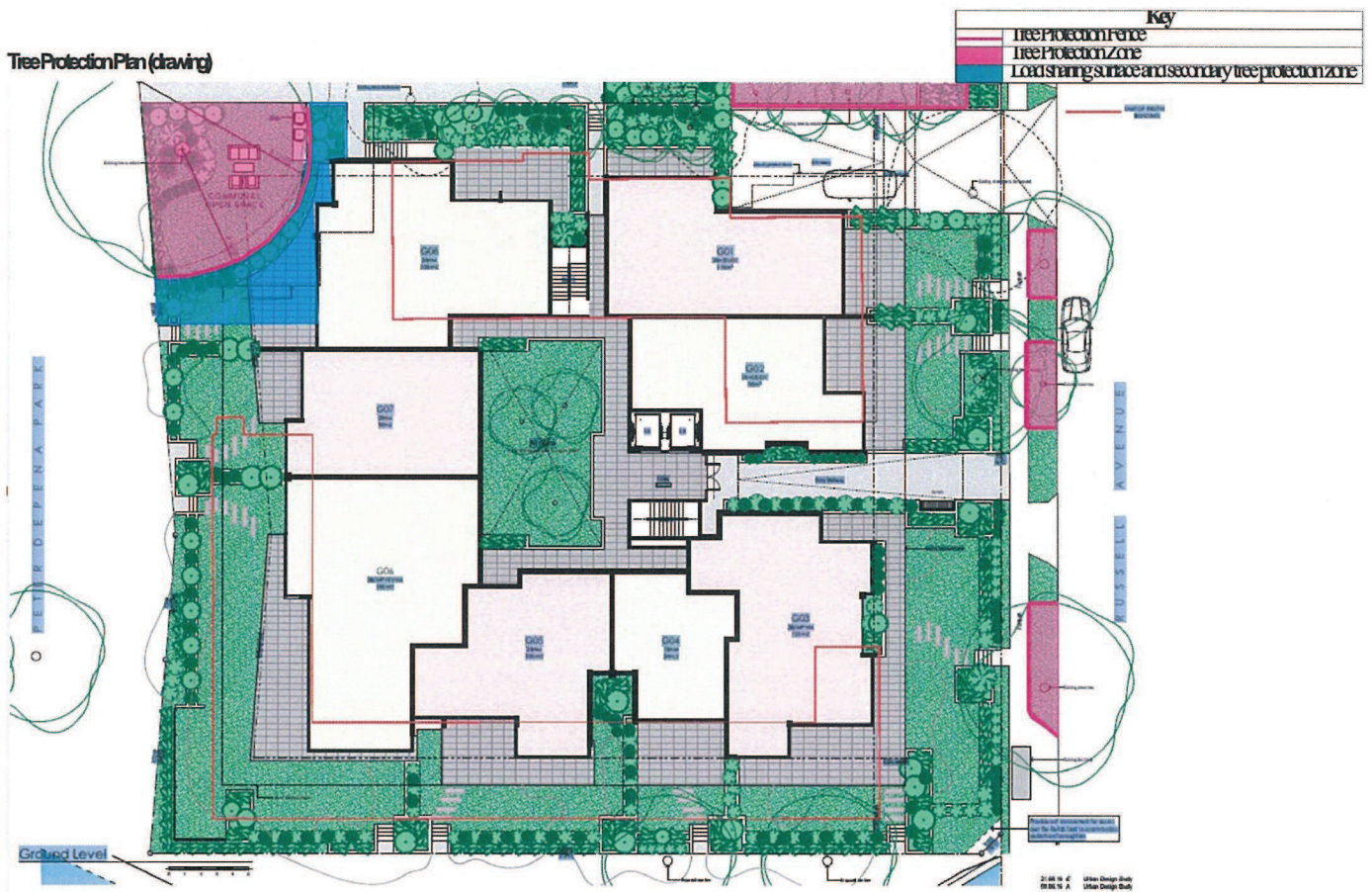

Appendix 2:

Plans

Tree Location Plan



Tree Protection Plan (drawing)



Appendix 3:

Determining the tree protection area

A simple solution

Over the last two decades, there has been an increasing awareness of the need to protect appropriately and care for trees on development sites. There have been conferences, workshops as well as some publications written. Most notably these include British Standard BS 5837: 2005, "Trees and Development" by Matheny N & Clark J and "Protection of Trees on Construction Site" by Hartley M. These publications all focus on minimising damage to the root system of the tree by establishing appropriate Tree Protection Zones (TPZ).

The British Standard provides Matheny and Clark as the source of the formula for calculating the radius of the tree protection zone. Interestingly Matheny and Clark site the British Standard as the source of the formula. Such a circular argument is of concern, particularly when the Matheny and Clark include many examples of their successful encroachment of their Tree Protection Zone in their text.

Matheny said, *"It is not that common that we get that much space."* and *"With tolerant species, we can squeeze that down by half or two-thirds"*. (ISA Annual Conference 2007) Mathematically that suggests that the Tree Protection Zone could potentially contain as little as 12% of the root volume provided for using either formula.

Calculations and tables in the first two publications aim at providing a Tree Protection Zone sufficiently large enough to ensure that the health of the tree is not adversely impacted and achieves this without the need for arboricultural input other than ensuring the maintenance of the protection zones. The British Standards on Trees and Development are ideal documents to be applied by anybody regardless of their understanding of plant physiology.

Matheny rightly states, *"Because the tree is an individual the table is not enough. You need to consider all the factors."* (ISA Annual Conference 2007) If we are to find benefit in the TPZ given in either the British Standard or Trees and Development, it is that this is a TPZ that can be determined by any person and without any arboricultural input since it is a simple formula. Anyone able to measure the trunk diameter and follow the formula can calculate the TPZ.

A suitably experienced consulting arborist is often able to support a smaller TPZ when combined with appropriate arboricultural care, and some provision is given in the British standard for this to take place. This makes no sense unless the formula for calculating the TPZ in the British Standard is prefaced with a note saying that this is the point at which arboricultural input is required. Regrettably the Standard does not say this and as a result, it becomes overly prescriptive.

An arboricultural solution

Land and development costs along with the environmental impact of urban sprawl make it undesirably burdensome to sterilise vast areas of land to enclose an optimum **TPZ**. It is often far more cost effective to provide even the highest level of Arboricultural care possible to a tree to ensure that it thrives and prospers in the long term than to establish a **TPZ** that is unnecessarily large.

It makes logical sense to adopt a **Minimum Tree Protection Zone** that is based on the size of a root plate required to transplant the same tree. Transplanting of large and even very old trees has been carried out with enough frequency and over such a long period that we have a good understanding how transplanted trees respond to root loss. A success rate of 97% can be expected when a transplant is properly undertaken with appropriate ongoing care.

Perhaps the 3% failure rate could be considered as unacceptable, but it is likely that a percentage of these would have died within a few years in any case. Matheny again points out *“Transplanting is a far greater impact – if we are going to transplant it we might as well keep it where it is and squeeze the protection zone.”* (ISA Annual Conference 2007) A transplanted tree will undoubtedly undergo a greater degree of stress than a tree that is retained with an identically sized root plate that is appropriately protected and cared for.

The site constraints, more often than not, are likely to benefit from a **TPZ** that is smaller than that specified by the British Standard and Trees and Development. Using a smaller **TPZ** means that there will be a requirement for appropriate levels of arboricultural care. This approach may give rise to the question “What is the minimum area required by the tree?” There is, unfortunately, no absolute answer to this question but there are some important benchmarks to be considered.

- The protection should be sufficient to allow the maintenance of the tree, with appropriate arboricultural input. In the past, this was called the **Critical Root Zone (CRZ)** and frequently relates to the size of the root plate that would be required to transplant the tree successfully. In most instances is an area with a radius of 5 times the trunk diameter. This document refers to this at the **Minimum Tree Protection Zone (MTPZ)**.
- Depending on the trees response to root damage, it is possible to come even closer to the tree particularly when construction impact is going to be limited to one side or better still to one quadrant of the Critical Root Zone and with the provision of additional distance around the remaining area of the root zone.
- The extent of any excavation should not result in the structural instability of the tree. A number of formula and test exist to determine the size of the **Structural Root Zone (SRZ)**. There is however generally no need to consider the issue of structural stability if work is performed outside the **MTPZ**. In most circumstances, it is undesirable and often unwise to cut roots located in the Structural Root Zone.

There must be sufficient soil volume to allow the tree to grow to maturity with appropriate ongoing care. If the goal is to have little ongoing care, this will undoubtedly take a greater soil volume than a tree that will be extensively maintained (such as a tree growing in a rooftop planting).

The approach of AS 4970-2009

In August 2009, Standards Australia released AS 4970-2009 Protection of Trees on Development Sites. In its preface, this document acknowledges its reliance on the British Standard and Matheny and Clark. This standard requires a **TPZ** with a radius 12 times trunk diameter. As already discussed, there is no question that this will provide adequate protection of the tree in almost all conceivable situations. It achieves this by enclosing and sterilising an enormous area.

The standard does acknowledge that it may be possible to encroach on this **TPZ** if the project arborist can demonstrate that the “trees will remain viable.” As already stated, we can successfully transplant most trees in good health and vigour, so the use of a reduced sized root plate remains demonstrated by several hundred years of successful tree transplanting. (Mathematically the standard sized root plate for a transplant has less than 20% of the root area of the **TPZ** specified in the AS 4970-2009.)

Of equal concern is the impact of the insistence of a **TPZ** with a radius of 12 times trunk diameter may have on tree retention and urban sprawl. Where there is a conflict between development and tree retention a decision will need to be made to refuse the development (potentially increasing urban sprawl) or to reduce the size of the **TPZ**.

If the development is acceptable then we need to answer the question “should we be removing trees that cannot be given a **TPZ** of the size recommended in AS 4970-2009?” The answer should be “No!” whenever there is adequate potential for retention the tree with appropriate arboricultural input. Unfortunately, this standard leaves us guessing on this issue.

Given that the standard has some significant issues and seeks to be “informative”, it is hard to give it the credence that it deserves. The standard does outline some important process namely, considering tree retention as a design consideration, seeking sound arboricultural advice and ensuring appropriate monitoring of the trees. As far as practical this document forms an important part of that process.

This report adopts the terms and nomenclature provided in the Australian Standard AS 4970-2009. This may be particularly true of the terms Tree Protection Plan (the recommendations and processes required to protect the trees and the Tree Protection Plan (drawing), which is a drawing or plan that may or may not include sections of the Tree Protection Plan

Appendix 4:

Generic Tree Protection Guidelines

1. Pre-Construction:

- 1.1. Prior to the commencement of construction, the consulting Arborist will issue a report outlining the following:
 - 1.1.1. The trees that have been protected, the maintenance activities (if any) for each tree that have already been performed, that the protective fence or fences have been installed in accordance with the Arborist's Report.
 - 1.1.2. A statement that the physical protection (items 7 and 8 of the POTOCS standards) of the trees has been performed, to the above standards or if not, any non-conformances and why. e.g. the fence around trees is incomplete because of boundary fences.
 - 1.1.3. All trees to be removed are to be marked with a single white line around the trunk. No tree shall be so marked until council consent for its removal has been given.
 - 1.1.4. Confirm a tree is to be removed by marking the tree with a single horizontal yellow or orange line. Only a Surveyor, Landscape Architect, Arborist, or Tree Preservation Officer, should do this.

2. Tree Protection Zones:

- 2.1. The trees are to be protected by a 1.8-metre-high fence to be constructed within 500mm of any construction activity and to include as much of the Primary Root Zone as possible.
- 2.2. Where the Tree Protection Zone occurs in part on the adjacent property, the fence will stop at the boundary lines.
- 2.3. Provision will be made to these protection zones for pedestrian access only.

3. Maintenance activities:

The following maintenance activities will be required for this site:

- Irrigation – by hand to comply with current specifications
- Soil Amelioration
- Mulching
- Crown cleaning in accordance with AS 4373-2007
- Pruning of Amenity Trees, removal of trees by sectional felling and stump grinding.

Tree Removal

Timing: Maintenance activities are to be at the commencement of the construction process by qualified Arborists and then as required during the construction period.

3.1. Irrigation

- 3.1.1. Soil moisture during construction shall be maintained at not less than 60% of field capacity.
- 3.1.2. Irrigation is to be applied by hand. No construction activities are to take place within the Primary Root Zone until irrigation has been initiated and soil moisture reaches 70% of field capacity at a depth of 300mm.