Tree Protection Procedures

for

Hume City Council

Development of Tree Protection Specifications

17 January 2013

Contents

1. Introduction

This document describes the importance of trees in the landscape, their structure and the impact of construction activities, tree protection measures and a recommended certification process. The tree protection measures are based on the Australian Standard AS 4970 'Protection of trees on development sites'.

Council considers trees as important community assets that should be considered on any site analysis and the following principles should apply.

- AVOID the tree and its root system in the first place.
- MINIMISE damage via consultation with Parks & Open Space department if the tree root zone and construction zone overlap or are in close proximity with each other.
- OFFSET the loss of tree as a last resort if approval has been given. In regards to tree replacement, parity of vegetation in the landscape is essential.

Trees which are classed as remnant in accordance with Clause 52.17 of the Hume Planning Scheme require additional planning and protection measures. Whenever staff or contractors are in doubt if the planning scheme provisions apply, they are to contact Council's Environmental Planner.

2. Key Objectives

- Describe the importance of trees in the landscape.
- Describe how trees can be adversely impacted by construction works.
- Outline tree protection measures and a process to ensure these are implemented from the planning to post-construction phases of projects.

3. Introduction to trees and their root systems

An understanding of the biology of trees by planning, design and construction staff is important to ensure their protection in the landscape. All components of a tree (canopy, trunk and roots) are interlinked and play an important role in tree survival.

A tree's energy source (sugar in the form of glucose) is produced in the leaves. Roots absorb oxygen, water and nutrients from the soil and provide anchorage. The trunk contains cells that transport sugar from the leaves to the roots and other cells that transport water in the opposite direction. Construction impact on roots, leaves, branches and the trunk must be avoided to maintain tree vitality.

Trees can be directly or indirectly damaged during construction. Direct damage includes mechanical injury to the trunk or canopy, the severing of roots, or alterations to the soil environment in the immediate vicinity of tree roots such as compaction.

Indirect effects of site development are usually related to soil hydrology that includes alterations to soil moisture content, changes in the level of the water table and drainage patterns. The addition of fill over the root zone affects aeration levels and is likely to impact tree health.

Root damage is the most common form of damage to trees on development sites. This is in part due to a common misconception that trees have large, deep root systems (Figure 1). In fact most tree roots grow in a horizontal direction, close to the soil surface (Figure 2). Tree root systems are wide spreading with the majority of roots usually found in the surface 500-1000mm. Conditions tend to be more favourable for root growth at the soil surface with higher oxygen and nutrient availability and less compaction.

Soil compaction in the root zone is detrimental to trees. It reduces the amount of oxygen present in the soil for roots to absorb and the soil is denser making root growth more difficult

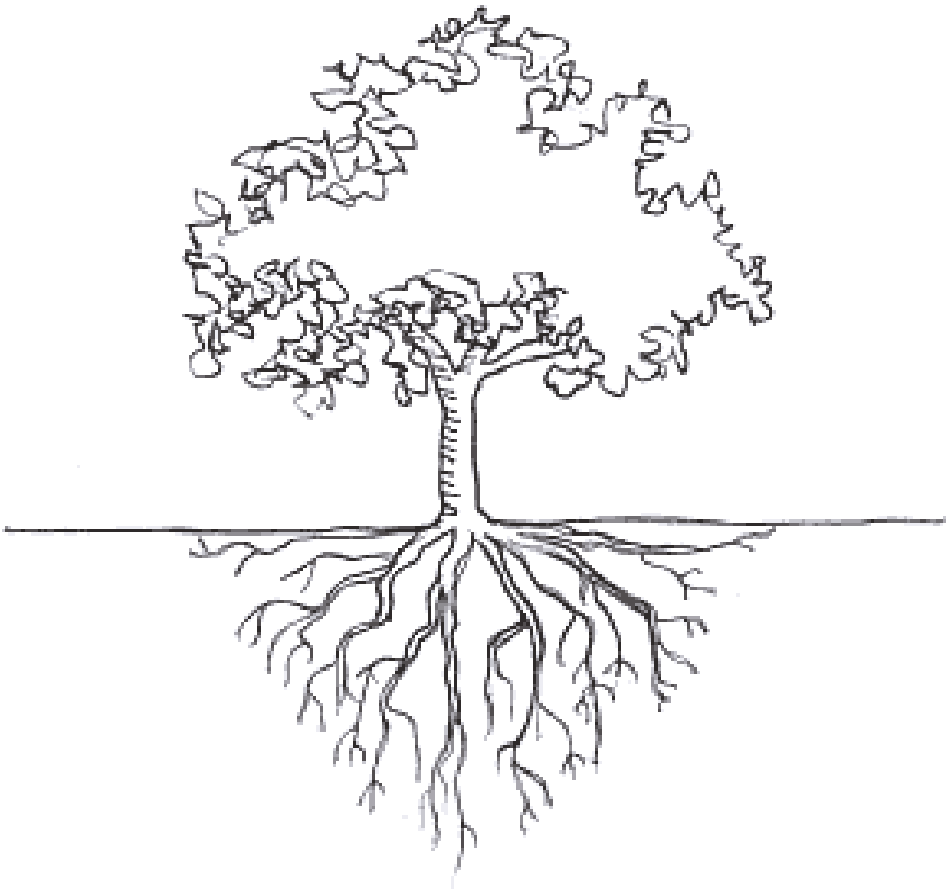


Figure 1: An historical and inaccurate depiction of tree root systems
(Harris, Clark and Matheny 1991)

Figure 2: A modern and accurate depiction of tree root systems
(Biddle 1998)

4. Importance of retaining trees in the landscape

Trees in urban areas provide many benefits to the local community, such as:

- shade and shelter to street and park users
- cooling that may assist with the mitigation of the urban heat island effect
- visual softening of the built landscape
- contribute to stormwater management
- add to the sense of local character.
- improved air quality
- aesthetic qualities and landscape contribution
- natural heritage values
- human health and wellbeing

Many existing trees in areas of new housing developments are large, remnant Eucalypt specimens. Protection of these trees during construction is particularly important as:

- many similar trees have already been removed during land clearing
- they provide food sources and provide nesting sites (hollows) for local fauna
- mature trees are more susceptible to root damage than young specimens
- they offer significant biodiversity value
- provide planning and legislative requirements

5. Ideal tree protection workflow

To ensure the protection of trees in the landscape, arborist involvement is required during development from planning through to post construction. The following table is adapted from AS 4970-2009 *Protection of Trees on Development Sites*.

Table 1: Indicative stages in development and the tree management process.

Stage in development	Tree management process	
	Matters for consideration	**Arborist actions and certification**
Planning		
Site acquisition	Legal constraints	
Detail surveys	Council plans and policies Planning instruments and controls Heritage Threatened species	Existing trees accurately plotted on survey plan (this is a critical requirement that sets the foundation for the whole process)
Preliminary tree assessment	Hazard/risks Tree retention value	Evaluate trees suitable for retention and mark on plan Provide preliminary arboricultural report and indicative TPZs to guide development layout
Preliminary development design	Condition of trees Proximity to buildings Location of services Roads Level changes Building operations space Long-term management	Planning selection of trees for retention Design review by proponent Design modifications to minimize impact to trees
Development submission	Identify trees for retention through comprehensive arboricultural impact assessment of proposed construction. Determine tree protection measures Landscape design	Provide arboricultural impact assessment including tree protection plan (drawing) and specification
Development approval	Development controls Conditions of consent	Review consent conditions relating to trees
Pre-construction		
Initial site preparation	State based OHS requirements for tree work Approved retention/removal Refer to AS 4373-2007 for the requirements on the pruning of amenity trees Specifications for tree protection measures	Compliance with conditions of consent Tree removal/tree retention/transplanting Tree pruning Certification of tree removal and pruning Establish/delineate TPZ Install protective measures **Certification of tree protection measures**
Construction		
Site establishment	Temporary infrastructure Demolition, bulk earthworks, hydrology	Locate temporary infrastructure to minimize impact on retained trees Maintain protective measures **Certification of tree protection measures**
Construction work	Liaison with site manager, compliance Deviation from approved plan	Maintain or amend protective measures Supervision and monitoring
Implement hard and soft landscape works	Installation of irrigation services Control of compaction work Installation of pavement and retaining walls	Remove selected protective measures as necessary Remedial tree works Supervision and monitoring
Practical completion	Tree vigour and structure	Remove all remaining tree protection measures **Certification of tree protection**

Stage in development	Tree management process	
	Matters for consideration	**Arborist actions and certification**
Post construction		
Defects liability/ maintenance period	Tree vigour and structure	Maintenance and monitoring Final remedial tree works **Final certification of tree condition**

NOTES:

1. Owing to variations in planning legislation this table is a general indication of the process only.
2. Certification of tree protection and condition should be carried out by the project arborist.

6. Method of Protection

The most common method of protecting trees during construction is by setting up a Tree Protection Zone (TPZ). The TPZ acts as a physical barrier of protective fencing that is erected around retained specimens (at the edge of the TPZ) before site works commence.

The following procedures are required in setting up and maintaining most TPZs (adapted from AS 4970-2009):

- construct TPZ fencing to prevent pedestrian and machinery access into the protected area.
- erect warning signs at regular intervals along the entire length of any protective TPZ fencing (Figure 3)
- mulch the TPZ area with organic woodchips to a depth of 100mm
- irrigate TPZs periodically, as determined by the consulting arborist.

When dealing with remnant trees protection is afforded under a Native Vegetation Precinct Plan or Offset Management Plan. These remnant trees need to be additionally protected.

The following procedures are required in setting up and maintaining:

- zone to twice canopy width
- no maximum width for this calculation
- Again, whenever staff or contractors are in doubt if the planning scheme provisions apply, they are to contact Council's Environmental Planner.

Figure 3: Example of a TPZ warning sign clearly displayed on TPZ fencing

6.1 Tree Protection Zone (TPZ) calculations

For most trees, the radius of the TPZ is calculated as 12 times the trunk diameter at 1.4m above ground level, referred to as the diameter at breast height (DBH) (Figure 4). The TPZ radius should not be less than 2m or greater than 15m, unless this maximum dimension is inadequate for protection the crown (AS 4970). This method does not apply for palms, cycads and tree ferns. For these fibrous rooted species the TPZ is calculated as the crown plus at least 1m.

TPZ radius = 12 x DBH

where DBH = trunk diameter (m), measured at 1.4m above ground level

minimum TPZ =2m, maximum TPZ = 15m

TPZ radius (for palms, cycads and trees ferns) = edge of crown + 1m

Figure 4: TPZ fencing is erected around retained trees prior to site works.

6.2 Appropriate TPZ fencing

TPZ fencing needs to be secure and remain in place for the duration of demolition and construction. The fencing must:

- be 1.8m high
- secured to prevent access
- be constructed from a sturdy material, such as chain wire mesh or wooden paling
- be supported with fencing feet if it is a temporary fence (Figure 5)

Flagging and bunting are not appropriate for TPZ fencing.

Figure 5: Fencing feet

6.3 Restricted activities

To maintain the health and longevity of retained tree specimens the exclusion of the following from the TPZ is required (adapted from AS 4970-2009):

- built structures or hard landscape features (i.e. paving, retaining walls)
- materials storage (i.e. equipment, fuel, building waste or rubble)
- soil disturbance (i.e. stripping, grade changes, placement of fill)
- excavation works including soil cultivation (specifically surface-dug trenches for underground utilities)
- lighting of fires
- preparation of chemicals, including cement products and cleaning of any vehicles or plant
- vehicular or pedestrian access (i.e. pathways or parking of vehicles or plant).

6.4 Encroachment into the TPZ

A level of encroachment into the TPZ may be unavoidable in some circumstances. Minor encroachment must be offset by an equivalent sized area adjacent to the TPZ (Table 2). Major encroachment requires assessment by an arborist to demonstrate that the tree will remain viable (Table 2). The vigour of the tree, number and size of roots in the area, tolerance of the species to root damage, previous encroachment within the TPZ are important considerations in determining if the tree with remain viable. Root sensitive construction methods such as pier and beam, suspended slabs, cantilevered building sections, screw piles and contiguous piling should be investigated to minimise the extent of encroachment.

Table 2. Minor and major encroachment within the TPZ (AS 4970)

Level of encroachment	Definition	Requirement
Minor	Less than 10% of the TPZ area Outside the SRZ	Area compensated for by an offset area adjoining the TPZ
Major	Greater than 10% of the TPZ area Within the SRZ	Arborist must demonstrate that the tree will remain viable Non-destructive root investigation may be required

6.5 Structural Root Zone (SRZ) calculations and implications

The structural root zone (SRZ) is the area of roots and soil required to keep the tree stable. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated if encroachment of greater than 10% into a TPZ is proposed. The minimum SRZ radius for trees is 0.15m (AS 4970). If the SRZ is breached the chances of the tree falling over is substantially increased.

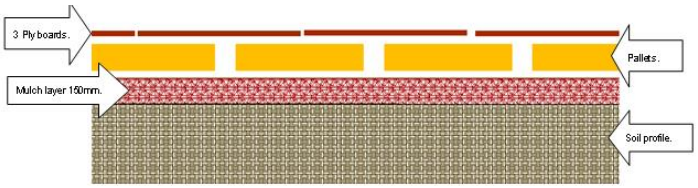
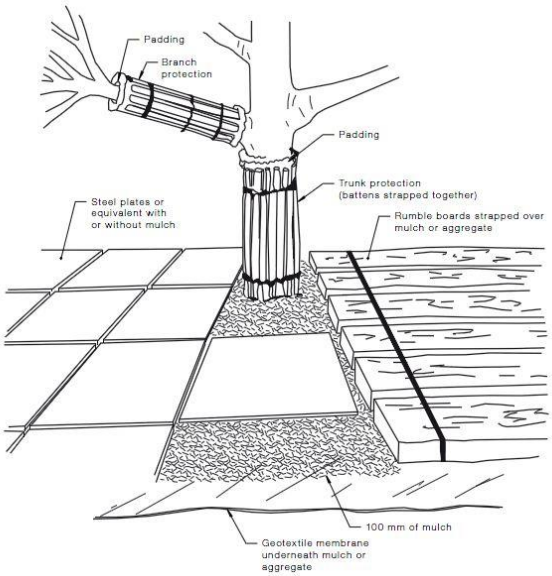
SRZ radius = $(D \times 50)^{0.42} \times 0.64$

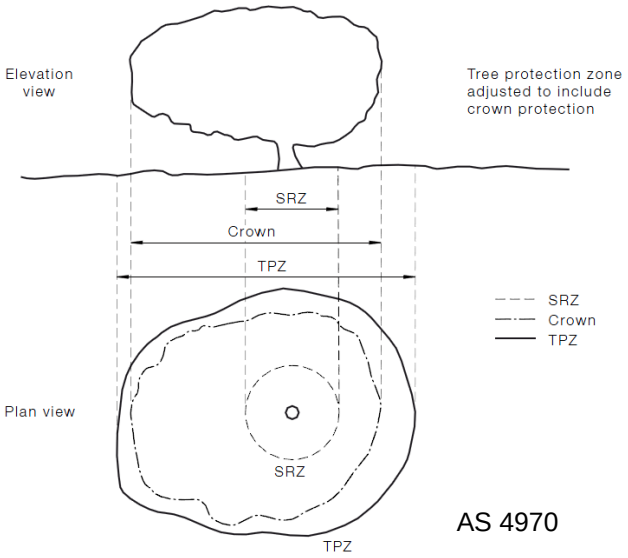
where D = trunk diameter (m), measured above the root buttress.

6.6 Modified protection measures for the ground, trunk, branches and canopy

Temporary access within the TPZ may be necessary due to construction. Additional tree protection measures may be required to avoid damaging the ground or above-ground sections of tree (Table 3).

Table 3. Canopy, ground, branch and trunk protection requirements is access is permitted within the TPZ

Aim of protection	Description of protection method	Examples
Ground protection – prevent root damage and soil compaction	1. Permeable membrane, such as geofabric, placed on the soil surface. 2. mulch or crushed rock (150mm deep) 3. rumble boards strapped together or pallets and ply boards This layered ground protection spreads the load of pedestrians, vehicles or plant and is easy to remove afterwards.	
Trunk and branches – prevent physical damage of the bark that may provide a potential entry point for pathogens	Strap padding and then wooden battens around the tree trunk or branch Do not screw or nail the padding in place as this will wound the tree. Materials should be fixed in place using strapping. Minimum height of 2m above the ground is recommended in AS 4970	 AS 4970

Aim of protection	Description of protection method	Examples
Canopy – prevent physical damage to the canopy	Extend the TPZ so that the TPZ fencing provides physical protection to the canopy. Canopy protection is only required when the canopy is wider than the standard TPZ	

7. Maintenance of TPZ during construction

During construction the TPZ should be maintained so that:

- Fencing is secure and located at the edge of the TPZ
- Mulch layer is 50-100mm deep
- Soil moisture levels are adequate for tree health
- It is free of weeds larger than 150mm wide or tall. Weeds should be removed by hand without soil disturbance or by the appropriate use of herbicide

Inspections of the TPZ by an arborist should be undertaken to ensure that the TPZ is compliant. The frequency of these inspections will vary according to the significance of the trees being protected.

8. Recommended monitoring and certification process

There are many stages in the development process where the project arborist may be required to monitor or certify tree protection. Table 2 summarizes the process and indicates the stages that may require certification.

Table 4. Recommended monitoring and certifying of works by an arborist (adapted from AS 4970)

Tree protection activity	Purpose	Arborist to certify or monitor	Comment
Tree Protection Plan	Identifies key stages where monitoring and certification will be required	Certify plan	The arborist to meet with site manager and contractors to discuss Tree Protection Plan TPZs should be shown on all relevant construction plans
Tree removal and pruning		Confirm correct trees are marked for removal. Certify the works on completion	Undertaken prior to TPZ fencing being erected Engage qualified practical arborists. Tree pruning as per AS 4373.
TPZ fencing installation and inspections	Provide physical protection to the trees	Certify the TPZ fencing and other protection measures	Install protection measures as per Tree Protection Plan
Site establishment and construction		Monitor any demolition, earthworks or construction within the TPZ	Discuss construction management plan with project arborist. Notify project arborist prior to works
Landscaping		Monitor any hard landscaping works within the TPZ	
Practical completion		Assess tree condition and certify practical completion	
Post construction		Assess tree condition	

9. Conclusion

Existing trees, particularly remnant specimens, are valuable in areas that are to be developed and they require protection if they are to be retained. The roots, root zone soil, trunk and canopy must be protected from damage during construction. Tree root systems can easily be damaged during construction as they are not visible to workers and are wide spreading and mainly in the surface 500mm of the soil. Setting up a TPZ, with a 1.8m sturdy fence around the perimeter, is the recommended method for protecting trees. Arborists should be involved from the planning to post-construction phase to ensure trees are protected.

10. Bibliography

AS 4373, 2007, *Australian Standard, Pruning Amenity Trees*, 2nd Edition, Standards Australia.

AS 4970, 2009, *Australian Standard, Protection of Trees on Development Sites*, Standards Australia.

Biddle, P.G., 1998, *Tree root damage to buildings, Causes, Diagnosis and Remedy,* Willowmead Publishing Ltd., Wantage, UK.

Coder, K. D., 1995, 'Tree quality BMPs for developing wooded areas and protecting residual trees', in *Trees and Building Sites, Proceedings of an International Workshop on Trees and Buildings,* Edited by G. W. Watson and D. Neely, International Society of Arboriculture, Champaign, Illinois.

Harris, R.W., Clark, J.R. & Matheny, N.P., 1999, *Arboriculture; Integrated management of landscape trees, shrubs, and vines,* Prentice Hall, Upper Saddle River, New Jersey.

Hitchmough, J., 1994, *Urban Landscape Management*, Inkata Press, Sydney.

McPherson, E.G. & Rowntree, R.A., 1993, 'Energy conservation potential of urban tree planting' *Journal of Arboriculture* 19(6): pp. 321-331.

McPherson, E. G., Simpson, J.R., Peper, P.J., Shelley, L.G., Vargas, K.E., Maco S.E. & Xiao, Q., 2006, *Midwest Community Tree Guide: Benefits, Costs and Strategic Planning,* Davis, CA, USDA Forest Service, Pacific Southwest Research Station.

Nowak, D. J., Crane, D.E. & Stevens, J.C., 2006, 'Air pollution removal by urban trees and shrubs in the United States' *Urban Forestry and Urban Greening* (4): pp. 115-123.

Perry, T. O., 1982, 'The ecology of tree roots and the practical significance thereof.' *Journal of Arboriculture,* 8(8), pp. 197-211.

Sydnor, T. D., Gamstetter, D., Nichols, J., Bishop, B., Favorite, J., Blazer, C & Turpin, L., 2000, 'Trees are not the root of all sidewalk problems', *Journal of Arboriculture*, 26, pp. 20-26.

Watson, G. W., 1995, 'Tree root damage from utility trenching', In *Trees and Building Sites,* Paper presented to *Proceedings of an International Workshop on Trees and Buildings*, Edited by G. W. Watson and D. Neely, International Society of Arboriculture, Illinois, pp. 33 – 41.

Wolf, K. L., 2007, 'City trees and property values', *Arborist News* (August): pp. 34-36.

Xiao, Q., McPherson, E.G., Simpson, J.R. and Ustin, S.L., 1998, 'Rainfall interception by Sacramento's urban forest', *Journal of Arboriculture,* 24(4), pp. 235-244.