Arboricultural Assessment at Former Sydenham North School Mapp

Prepared for: Department of Early Education and Childhood Development

Prepared by: David Phillips
1. Client Brief

Department of Education and Early Childhood Development contracted Tree Logic to undertake an assessment of trees associated with rezoning and potential development of the former Sydenham North School Mapp at 18 – 24 Robertsons Road, Sydenham.

The arboricultural consultancy was required to:

- Describe assessment methods.
- Provide detailed tree assessment including species, dimensions, condition and arboricultural rating.
- Guidelines for tree protection.
- A plan (aerial image) that locates and identifies (unique identifier - Tree No.) the assessed trees.
- Additional information included
- Recommendations on any tree pruning works required to successfully retain suitable trees.

2. Summary of Findings

One tree group comprising of twenty one (21) trees was assessed within the tree study area. The inspection identified a group of over – mature Monterey Cypress Pines that were of No arboricultural value in poor health and structurally declining. The condition of the tree group is irreversible and it is recommended to remove all the trees.

3. Method

3.1. The site was inspected on Friday December 6, 2013.

3.2. The trees were inspected from the ground and observations made of the growing environment and the surrounding area. The trees were not climbed and no samples of the vegetation or site soil were taken for further analysis.

3.3. The assessment was undertaken with regard to modern arboricultural principles and practices, and consisted of a visual inspection of observable external and aboveground tree parts. The assessment does not generally involve any exploratory assessment of below ground or internal tree parts.

3.4. Observations were made of the trees to determine age and condition, with measurements taken to establish crown height (measured with a clinometer), crown width (paced) and trunk diameter (measured 1.4m above the existing grade unless stated otherwise).

3.5. Arboricultural assessment method;

3.5.1. The health and structural characteristics of each tree were assessed and each tree was attributed an ‘Arboricultural Rating’. The arboricultural rating correlates the combination of tree condition factors (health,
structure & form) with tree amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics within a built environment. The arboricultural rating in combination with other factors can assist the project team and planners in nominating trees suitable for retention. The four arboricultural ratings used by Tree Logic include:

3.5.2. **High**: Trees of high quality in good to fair condition. Retention of such trees is highly desirable.

3.5.3. **Moderate**: Trees with a Moderate arboricultural rating were generally suitable for retention and design should attempt to incorporate these trees and provide adequate clearances during development stages where reasonable design intent is not unduly hampered.

3.5.4. **Low**: Trees with a Low arboricultural rating generally had low retention values. They were either fair specimens of relatively small size or displayed general health or structural deficiencies. Retention of Low rated trees may be considered in some instances if not requiring a disproportionate expenditure of resources to successfully incorporate into the design or manage ongoing condition.

3.5.5. **None**: Trees attributed an arboricultural rating of None have health or structural characteristics that were beyond arboricultural maintenance or are environmental weed species.

Full tree descriptors are attached as Appendix 2.

3.6. **Establishing Tree Protection Zones (TPZ);**

3.6.1. To successfully retain suitable trees within or around a development site, consideration must be given to protecting the trunk, crown and roots of each specimen. Tree protection zones (TPZ’s) are used to provide adequate space for the preservation of sufficient roots to maintain tree health (particularly important for mature trees) whilst providing a buffer zone between construction activity and the tree trunk and crown.

3.6.2. The method for determining tree protection zones adopted in this report is the ‘Australian Standard for Protection of trees on development sites’ (AS4970-2009). The TPZ area is based on the trunk diameter measurement measured in metres at 1.4m and multiplied by 12 and is a guide for planning purposes. The trunk of the tree is used as the centre point for the measurement. TPZ measurements are included in Section 5, Table 1.

3.6.3. Additional measurements can be calculated to determine the allowable encroachment on one side of the TPZ (Reduced TPZ) and the Structural Root Zone (SRZ) which is the absolute minimum required to maintain tree stability without consideration to ongoing health. Details of tree protection zone establishment, permissible encroachment and management guidelines are outlined in Appendix 3.
4. Documents & Literature

I have viewed and reviewed the following documents:

4.1. Planning Property Reports and City of Brimbank planning zones and overlays. The site is zoned Public Use – Education Zone 2 (PUZ2).

4.2. No planning overlays that specifically relate to tree controls apply to the site.

- Clause 52.17 of the Victorian Planning Provisions of the Planning and Environment Act, 1987 (Vic) applies to the site because the allotment is greater than 4,000 m² in area.
  
  Under clause 52.17 it is necessary to demonstrate what steps have been taken

  - To avoid the removal of (Victorian) native vegetation.
  - To minimise the removal of native vegetation.
  - To appropriately offset the loss of native vegetation.

- Clause 52.17 applies only to vegetation native to Victoria. Vegetation planted for purposes of ‘shelter belts, woodlots, street trees, gardens or the like’ are exempt under 52.17-6 unless planted with assistance from public funding.

5. Observations

5.1. The tree study area is the former site of Sydenham North School Mapp on the east side of Robertsons Road in Sydenham. It is a rather flat allotment of approximately 7.2 Ha with no creeks or natural drainage lines within the site. Residential housing abuts the site to the north, east and south-east.

5.2. The site was a vacant allotment with trees planted as a rectangular feature group primarily as a windrow in the centre of the site. See Appendix 1 for tree group location.

5.3. The attributes of the tree group is shown in Table 1.
5.4. Table 1 details of the trees identified in this report.

<table>
<thead>
<tr>
<th>Table 1: Tree details</th>
<th>Tree Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Name and Species</td>
<td>Monterey Cypress <em>Hesperocyparis macrocarpa</em> (syn. <em>Cupressus macrocarpa</em>)</td>
</tr>
<tr>
<td>Tree Type</td>
<td>Exotic Conifer</td>
</tr>
<tr>
<td>Age</td>
<td>Over - mature</td>
</tr>
<tr>
<td>Height (m)</td>
<td>Average 14</td>
</tr>
<tr>
<td>Width (m)</td>
<td>Average 12</td>
</tr>
<tr>
<td>DBH (cm)</td>
<td>70 – 135 @ 0.1m</td>
</tr>
<tr>
<td>Health</td>
<td>Poor</td>
</tr>
<tr>
<td>Structure</td>
<td>Very Poor-</td>
</tr>
<tr>
<td>Form</td>
<td>Symmetric</td>
</tr>
<tr>
<td>TPZ (radial m)</td>
<td>15.0</td>
</tr>
<tr>
<td>Reduced TPZ (metres)</td>
<td>10.5</td>
</tr>
<tr>
<td>Retention Value</td>
<td>None</td>
</tr>
<tr>
<td>Comments</td>
<td>Crown dieback, over mature, several trees have failed, structurally declining planted as windrow in centre of allotment. 21 x Stems</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Remove tree group.</td>
</tr>
</tbody>
</table>

5.5. Tree health:

5.6.1. The health rating was assessed based on foliage colour, size and density as well as shoot initiation and elongation.

5.6.2. The trees displayed Poor health displaying crown dieback, dead and dying branches.

5.6. Tree structure:

5.7.1. The structure of the trees was assessed for structural defects and deficiencies, likelihood of failures and presence of targets.

5.7.2. The structural condition of the tree group was very poor and in decline. Several trees on the northern side of the stand had completely failed and further decline is expected with continued limb failure and whole tree failure. The condition of the tree group is irreversible and removal of the tree group is recommended.
6. Permit Requirement

6.1. Clause 52.17 of the Victorian Planning Provisions of the Planning and Environment Act, 1987 (Vic) applies only to Victorian native vegetation and therefore Clause 52.17 does not apply to the tree group as it is an exotic conifer species.

7. Photographs

Photo 1: Shows the northern side of the tree group. Several trees had died and completely failed. It is expected that further tree decline will occur as the group becomes increasingly exposed and fragmented. Due to this reason it is recommended to remove all the trees in the group.

Photo 2: Shows the southern side of the tree group. Crown dieback is occurring as indicated by the brown foliage and dead branches.
8. Conclusions & Recommendations

8.1. A site assessment was undertaken of one tree group located within the former Sydenham North School map at 18 – 24 Robertsons Road in Sydenham.

8.2. The assessment found one tree group comprising of twenty one (21) trees to be in poor health and structurally declining. Refer to Page 5 Table 1 for tree details, Appendix 1 for tree locations and Appendix 2 for tree descriptors.

8.3. It is recommended to remove the tree group as further limb and whole tree failure will continue as tree condition is irreversible.

8.4. No permit is required to remove the trees.

8.5. Any pruning recommendations must be undertaken by a suitably qualified and experienced arborist and comply with Australian Standard AS 4373-2007 – ‘Pruning of Amenity trees’.
Under no circumstance shall this report be reproduced unless in full.

I am available to answer any questions in relation to the content put forward in this report.

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References

Australian Standard AS4970-2009 ‘Protection of trees on development sites’.
Appendix 1: Tree Location

Refer to following page
Appendix 1: Tree location: former Sydenham North School Mapp (Tree Logic, 2014).
Appendix 2: Arboricultural Descriptors (August 2013)

Note that not all of the described tree descriptors may be used in a tree assessment and report. The assessment is undertaken with regard to contemporary arboricultural practices and consists of a visual inspection of external and above-ground tree parts.

2. Tree Condition

The assessment of tree condition evaluates factors of health and structure. The descriptors of health and structure attributed to a tree evaluate the individual specimen to what could be considered typical for that species growing in its location. For example, some species can display inherently poor branching architecture, such as multiple acute branch attachments with included bark. Whilst these structural defects may technically be considered arboriculturally poor, they are typical for the species and may not constitute an increased risk of failure. These trees may be assigned a structural rating of fair-poor (rather than poor) at the discretion of the author.

Diagram 1, provides an indicative distribution curve for tree condition to illustrate that within a normal tree population the majority of specimens are centrally located within the condition range (normal distribution curve). Furthermore, that those individual trees with an assessed condition approaching the outer ends of the spectrum occur less often.

3. Tree Name

Provides botanical name, (genus, species, variety and cultivar) according to accepted international code of taxonomic classification, and common name.

4. Tree Type

Describes the general geographic origin of the species and its type e.g. deciduous or evergreen.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous</td>
<td>Occurs naturally in the area or region of the subject site</td>
</tr>
<tr>
<td>Victorian native</td>
<td>Occurs naturally within some part of the State of Victoria (not exclusively) but is not indigenous</td>
</tr>
<tr>
<td>Australian native</td>
<td>Occurs naturally within Australia but is not a Victorian native or indigenous</td>
</tr>
<tr>
<td>Exotic deciduous</td>
<td>Occurs outside of Australia and typically sheds its leaves during winter</td>
</tr>
<tr>
<td>Exotic evergreen</td>
<td>Occurs outside of Australia and typically holds its leaves all year round</td>
</tr>
<tr>
<td>Exotic conifer</td>
<td>Occurs outside of Australia and is classified as a gymnosperm</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Native conifer</td>
<td>Occurs naturally within Australia and is classified as a gymnosperm</td>
</tr>
<tr>
<td>Native Palm</td>
<td>Occurs naturally within Australia. Woody monocotyledon</td>
</tr>
<tr>
<td>Exotic Palm</td>
<td>Occurs outside of Australia. Woody monocotyledon</td>
</tr>
</tbody>
</table>

5. Height and Width

Indicates height and width of the individual tree; dimensions are expressed in metres. Crown heights are measured with a height meter where possible. Due to the topography of some sites and/or the density of vegetation it may not be possible to do this for every tree. Tree heights may be estimated in line with previous height meter readings in conjunction with author’s experience. Crown widths are generally paced (estimated) at the widest axis or can be measured on two axes and averaged. In some instances the crown width can be measured on the four cardinal direction points (North, South, East and West).

6. Trunk diameters

The position where trunk diameters are captured may vary dependent on the requirements of the specific assessment. DBH is the typical trunk diameter captured as it relates to the allocation of tree protection distances. The basal trunk diameter assists in the allocation of a structural root zone. Some municipalities require trunk diameters be captured at different heights, with 1.0 m above grade being a common requirement. The specific planning schemes will be checked to ascertain requirements.

**Diameter at Breast Height (DBH)**

Indicates the trunk diameter (expressed in centimetres) of an individual tree measured at 1.4m above the existing ground level or where otherwise indicated, multiple leaders are measured individually. Plants with multiple leader habit may be measured at the base. The range of methods to suit particular trunk shapes, configurations and site conditions can be seen in Appendix A of Australian Standard AS 4970-2009 Protection of trees on development sites. Measurements undertaken with foresters∅ tape or builders tape.

**Basal trunk diameter**

The basal dimension is the trunk diameter measured at the base of the trunk or main stem(s) immediately above the root buttress.

7. Health

Assesses various attributes to describe the overall health and vigour of the tree.

<table>
<thead>
<tr>
<th>Category</th>
<th>Vigour/Extension growth</th>
<th>Decline symptoms/Deadwood/Dieback</th>
<th>Foliage density, colour, size, intactness</th>
<th>Pests and disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Above typical</td>
<td>Negligible</td>
<td>Better than typical</td>
<td>Negligible</td>
</tr>
<tr>
<td>Category</td>
<td>Vigour/Extension growth</td>
<td>Decline symptoms/Deadwood/Dieback</td>
<td>Foliage density, colour, size, intactness</td>
<td>Pests and or disease</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------</td>
<td>-----------------------------------</td>
<td>-------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Fair</td>
<td>Typical</td>
<td>Minor or expected</td>
<td>Typical</td>
<td>Minor, within damage thresholds</td>
</tr>
<tr>
<td>Fair to Poor</td>
<td>Below typical</td>
<td>More than typical</td>
<td>Exhibiting deficiencies</td>
<td>Exceeds damage thresholds</td>
</tr>
<tr>
<td>Poor</td>
<td>Minimal</td>
<td>Excessive, large and/or prominent amount/size</td>
<td>Exhibiting severe deficiencies</td>
<td>Extreme and contributing to decline</td>
</tr>
<tr>
<td>Dead</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**8. Structure**

Assesses principal components of tree structure (Diagram 2).

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Zone 1 - Root plate &amp; lower stem</th>
<th>Zone 2 - Trunk</th>
<th>Zone 3 - Primary branch support</th>
<th>Zone 4 - Outer crown and roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>No obvious damage, disease or decay; obvious basal flare / stable in ground</td>
<td>No obvious damage, disease or decay; well tapered</td>
<td>Well formed, attached, spaced and tapered</td>
<td>No obvious damage, disease, decay or structural defect</td>
</tr>
<tr>
<td>Fair</td>
<td>Minor damage or decay. Basal flare present.</td>
<td>Minor damage or decay</td>
<td>Typically formed, attached, spaced and tapered</td>
<td>Minor damage, disease or decay; minor branch end-weight or over-extension</td>
</tr>
<tr>
<td>Fair to Poor</td>
<td>Moderate damage or decay; minimal basal flare</td>
<td>Moderate damage or decay; approaching recognised thresholds</td>
<td>Weak, decayed or with acute branch attachments; previous branch failure evidence</td>
<td>Moderate damage, disease or decay; moderate branch end-weight or over-extension</td>
</tr>
<tr>
<td>Poor</td>
<td>Major damage, disease or decay; fungal fruiting bodies present. Excessive lean placing pressure on root plate</td>
<td>Major damage, disease or decay; exceeds recognised thresholds; fungal fruiting bodies present. Acute lean. Stump resprout</td>
<td>Decayed, cavities or has acute branch attachments with included bark; excessive compression flaring; failure likely</td>
<td>Major damage, disease or decay; fungal fruiting bodies present; major branch end-weight or over-extension</td>
</tr>
<tr>
<td>Very Poor</td>
<td>Excessive damage, disease or decay; unstable / loose in ground; altered exposure; failure probable</td>
<td>Excessive damage, disease or decay; cavities. Excessive lean. Stump resprout</td>
<td>Decayed, cavities or branch attachments with active split; failure imminent</td>
<td>Excessive damage, disease or decay; excessive branch end-weight or over-extension</td>
</tr>
</tbody>
</table>

**Diagram 2:** Tree structure zones

2. Root plate & lower stem
3. Trunk
4. Primary branch support
5. Outer crown & roots

Adapted from Coder (1996)
Structure ratings will also take into account general branching architecture, stem taper, live crown ratio, crown symmetry (bias or lean) and crown position such as tree being suppressed amongst more dominant trees.

The lowest or worst descriptor assigned to the tree in any column could generally be the overall rating assigned to the tree. The assessment for structure is limited to observations of external and above ground tree parts. It does not include any exploratory assessment of underground or internal tree parts unless this is requested as part of the investigation. Trees are assessed and given a rating for a point in time. Generally, trees with a poor or very poor structure are beyond the benefit of practical arboricultural treatments.

The management of trees in the urban environment requires appropriate arboricultural input and consideration of risk. Risk potential will take into account the combination of likelihood of failure and impact, including the perceived importance of the target(s).

9. Life Stage

Relates to the physiological stage of the tree's life cycle.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>Sapling tree and/or recently planted. Approximately 5 or less years in location.</td>
</tr>
<tr>
<td>Semi-mature</td>
<td>Tree increasing in size and yet to achieve expected size in situation. Primary developmental stage.</td>
</tr>
<tr>
<td>Maturing</td>
<td>Specimen approaching expected size in situation, with reduced incremental growth</td>
</tr>
<tr>
<td>Over-mature</td>
<td>Tree is senescent and in decline. Significant decay generally present</td>
</tr>
</tbody>
</table>

10. Arboricultural Rating

Relates to the combination of tree condition factors, including health and structure (arboricultural merit), and also conveys an amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics (Hitchmough 1994) within an urban landscape context.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Tree of high quality in good to fair condition. Generally a prominent arboricultural feature.</td>
</tr>
<tr>
<td></td>
<td>These trees have the potential to be a medium- to long-term component of the landscape if managed appropriately. Retention of these trees is highly desirable.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Tree of moderate quality, in fair or better condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment.</td>
</tr>
<tr>
<td></td>
<td>These trees have the potential to be a medium- to long-term component of the landscape if managed appropriately. Retention of these trees is generally desirable.</td>
</tr>
</tbody>
</table>
**Low**  
Tree of low quality and/or little amenity value. Tree in poor health and/or with poor structure.  
Tree is not significant because of its size and/or age. These trees are easily replaceable.  
Tree (species) is functionally inappropriate to specific location and would be expected to be problematic if retained.  
Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.

**None**  
Tree has a severe structural defect and/or health problem that cannot be sustained with practical arboricultural techniques and the loss of tree would be expected in the short term.  
Tree whose retention would not be viable after the removal of adjacent trees (includes trees that have developed in close spaced groups and would not be expected to acclimatise to severe alterations to surrounding environment – removal of adjacent shelter trees).  
Tree has a detrimental effect on the environment, for example, the tree is a woody weed with potential to spread into waterways or natural areas.

Trees have many values, not all of which are considered when an arboricultural assessment is undertaken. However, individual trees or tree group features may be considered important community resources because of unique or noteworthy characteristics or values other than their age, dimensions, health or structural condition. Recognition of one or more of the following criterion is designed to highlight other considerations that may influence the future management of such trees.

<table>
<thead>
<tr>
<th>Significance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horticultural Value/ Rarity</td>
<td>Outstanding horticultural or genetic value; could be an important source of propagating stock, including specimens that are particularly resistant to disease or exposure. Any tree of a species or variety that is rare.</td>
</tr>
</tbody>
</table>
| Historic, Aboriginal Cultural or Heritage Value | Tree could have value as a remnant of a particular important historical period or a remnant of a site or activity no longer in action. Tree has a recognised association with historic aboriginal activities, including scar trees.  
Tree commemorates a particular occasion, including plantings by notable people, or having associations with an important event in local history. |
| Ecological Value                     | Tree could have value as habitat for indigenous wildlife, including providing breeding, foraging or roosting habitat, or is a component of a wildlife reserve.  
Remnant Indigenous vegetation that contribute to biological diversity |
Bibliography:
Coder, K D. (1996) Construction damage assessments: trees and sites, University of Georgia, USA
Hitchmough, J.D. (1994) Urban landscape management, Inkata Press, Australia
Appendix 3: Tree Protection Measures

1.0 Introduction

In order to sustain trees on a development site consideration must be given to the establishment of tree protection zones.

The physical dimensions of tree protection zones can sometimes be difficult to define. The projection of a tree’s crown can provide a guide but is by no means the definitive measure. The unpredictable nature of roots and their growth, differences between species and their tolerances, and observable and hidden changes to the trees growing environment, as a result of development, are variables that must be considered.

Most vigorous, broad canopied trees survive well if the area within the drip-line of the canopy is protected. Fine root density is usually greater beneath the canopy than beyond (Gilman, 1997). If few to no roots over 3cm in diameter are encountered and severed during excavation the tree will probably tolerate the impact and root loss. A healthy tree can sustain a loss of between 30% and 50% of absorbing roots (Harris, Clark, Matheny, 1999), however encroachment into the structural root system of a tree may be problematic.

The structural root system of a tree is responsible for ensuring the stability of the entire tree structure in the ground. A tree could not sustain loss of structural root system and be expected to survive let alone stand up to average annual wind loads upon the crown.

2.0 Allocation of tree protection zone (TPZ)

The method of allocating a TPZ to a particular tree will be influenced by site factors, the tree species, its age and developed form.

Once it has been established, through an arboricultural assessment, which trees and tree groups are to be retained, the next step will require careful management through the development process to minimise any impacts on the designated trees. The successful retention of trees on any particular site will require the commitment and understanding of all parties involved in the development process. The most important activity, after determining the trees that will be retained is the implementation of a TPZ.

The intention of tree protection zones is to:

- mitigate tree hazards;
- provide adequate root space to sustain the health and aesthetics of the tree into the future;
- minimise changes to the trees growing environment, which is particularly important for mature specimens;
- minimise physical damage to the root system, canopy and trunk; and
- define the physical alignment of the tree protection fencing

Tree protection

The most important consideration for the successful retention of trees is to allow appropriate above and below ground space for the trees to continue to grow. This requires the allocation of tree protection zones for retained trees.

The Australian Standard AS 4970-2009 Protection of trees on development sites has been used as a guide in the allocation of TPZs for the assessed trees. The TPZ for individual trees is calculated based on trunk (stem) diameter (DBH), measured at 1.4 metres up from ground level. The radius of
the TPZ is calculated by multiplying the trees DBH by 12. The method provides a TPZ that addresses both the stability and growing requirements of a tree. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. The minimum TPZ should be no less than 2m and the maximum no more than 15m radius. The TPZ of palms should be not less than 1.0m outside the crown projection.

Encroachment into the TPZ is permissible under certain circumstances though is dependent on both site conditions and tree characteristics. Minor encroachment, up to 10% of the TPZ, is generally permissible provided encroachment is compensated for by recruitment of an equal area contiguous with the TPZ. Examples are provided in Diagram 1. Encroachment greater than 10% is considered major encroachment under AS4970-2009 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable.

Diagram 1: Examples of minor encroachment into a TPZ. Extract from: AS4970-2009, Appendix D, p30 of 32

The 10% encroachment on one side equates to approximately ⅓ radial distance. Tree root growth is opportunistic and occurs where the essentials to life (primarily air and water) are present. Heterogeneous soil conditions, existing barriers, hard surfaces and buildings may have inhibited the development of a symmetrically radiating root system.

Existing infrastructure around some trees may be within the TPZ or root plate radius. The roots of some trees may have grown in response to the site conditions and therefore if existing hard surfaces and building alignments are utilised in new designs the impacts on the trees should be minimal. The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998). Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build.

The TPZ should also give consideration to the canopy and overall form of the tree. If the canopy requires severe pruning in order to accommodate a building and in the process the form of the tree is diminished it may be worthwhile considering altering the design or removing the tree.

General tree protection guidelines

The most important factors are:

• Prior to construction works the trees nominated for tree works should be pruned to remove larger dead wood. Pruning works may also identify other tree hazards that require remedial works.

• Installation of tree protection fencing. Once the tree protection zones have been determined the next step is to mulch the zone with woodchip and erect tree protection fencing. This
must be completed prior to any materials being brought on-site, erection of temporary site facilities or demolition/earth works. The protection fencing must be sturdy and withstand winds and construction impacts. The protection fence should only be moved with approval of the site supervisor. Other root zone protection methods can be incorporated if the TPZ area needs to be traversed.

- Appropriate signage is to be fixed to the fencing to alert people as to importance of the tree protection zone.
- The importance of tree preservation must be communicated to all relevant parties involved with the site.
- Inspection of trees during excavation works.

Exploratory excavation

The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998).

Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build. This also allows management decisions to be made and allows time for redesign works if required.

Any exploratory excavation within the allocated TPZ is to be undertaken with due care of the roots. Minor exploration is possible with hand tools. More extensive exploration may require the use of high pressure water or air excavation techniques. Either hydraulic or pneumatic excavation techniques will safely expose tree roots; both have specific benefits dependent on the situation and soil type. An arborist is to be consulted on which system is best suited for the site conditions.

Substantial roots are to be exposed and left intact.

Once roots are exposed decisions can be made regarding the management of the tree. Decisions will be dependent on the tree species, its condition, its age, its relative tolerance to root loss, and the amount of root system exposed and requiring pruning.

Other alternative measures to encroaching the TPZ may include boring or tunnelling.

Construction Guidelines

The following are guidelines that must be implemented to minimise the impact of the proposed construction works on the retained trees.

- The Tree Protection Zone (TPZ) is fenced and clearly marked at all times. The actual fence specifications should be a minimum of 1.2 - 1.5 metres of chain mesh or like fence with 1.8 meter posts (e.g. treated pine or star pickets) or like support every 3-4 metres and a top line of high visibility plastic hazard tape. The posts should be strong enough to sustain knocks from on site excavation equipment. This fence will deter the placement of building materials, entry of heavy equipment and vehicles and also the entry of workers and/or the public into the TPZ. Note: There are many different variations on the construction type and material used for TPZ fences, suffice to say that the fence should satisfy the responsible authority.

- Contractors and site workers should receive written and verbal instruction as to the importance of tree protection and preservation within the site. Successful tree preservation occurs when there is a commitment from all relevant parties involved in designing, constructing and managing a development project. Members of the project team need to interact with each other to minimise the impacts to the trees, either through design decisions or construction practices. The importance of tree preservation must be communicated to all relevant parties involved with the site.

- The consultant arborist is on-site to supervise excavation works around the existing trees where the TPZ will be encroached.
• A layer of organic mulch (woodchips) to a depth of no more than 100mm should be placed over the root systems within the TPZ of trees, which are to be retained so as to assist with moisture retention and to reduce the impact of compaction.

• No persons, vehicles or machinery to enter the TPZ without the consent of the consulting arborist or site manager.

• Where machinery is required to operate inside the TPZ it must be a small skid drive machine (i.e Dingo or similar) operating only forwards and backwards in a radial direction facing the tree trunk and not altering direction whilst inside the TPZ to avoid damaging, compacting or scuffing the roots.

• Any underground service installations within the allocated TPZ should be bored and utility authorities should common trench where possible.

• No fuel, oil dumps or chemicals shall be allowed in or stored on the TPZ and the servicing and re-fuelling of equipment and vehicles should be carried out away from the root zones.

• No storage of material, equipment or temporary building should take place over the root zone of any tree.

• Nothing whatsoever should be attached to any tree including temporary services wires, nails, screws or any other fixing device.

• Supplementary watering should be provided to all trees through any dry periods during and after the construction process. Proper watering is the most important maintenance task in terms of successfully retaining the designated trees. The areas under the canopy drip lines should be mulched with woodchip to a depth of no more than 100mm. The mulch will help maintain soil moisture levels. Testing with a soil probe in a number of locations around the tree will help ascertain soil moisture levels and requirements to irrigate. Water needs to be applied slowly to avoid runoff. A daily watering with 5 litres of water for every 30 mm of trunk calliper may provide the most even soil moisture level for roots (Watson & Himelick, 1997), however light frequent irrigations should be avoided. Irrigation should wet the entire root zone and be allowed to dry out prior to another application. Watering should continue from October until April.

References
Mattheck C. 2002. Tree Mechanics, Forschungszentrum Karlsruhe GMBH
Tree Logic Pty. Ltd.
Unit 4, 21 Eugene Terrace,
Ringwood. VIC. 3134.

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