Arboricultural Impact Assessment Report

Site Address: Hornsby Ku-ring-gai Hospital
1 Derby Road
HORNSBY NSW 2077

Prepared For: **Health Infrastructure**
C/- TSA Management
Level 16, 207 Kent Street
Sydney NSW

Prepared On: **15th June 2011**

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Executive Summary

The proposed development involves demolition of the existing building and construction of a new building. A total of nineteen (19) trees were inspected and assessed in preparation of this report. Of these only thirteen (13) were indicated on the supplied plans (605_001.PRO Sheets 1, 2 and 3). The remaining six (6) trees were identified on site. Trees 23 and 24 are Brush Box (*Lophostemon confertus*) trees, located within the road reserve of Palmerston Avenue and are Council owned assets. The remaining trees are all located within the subject property.

Four (4) trees, identified as Trees 30, 31, 39 and 40 have been identified as being essential for retention from an arboricultural perspective. These trees are significant specimens to both the site and the local environment. They are in a condition whereby they can be retained for extended periods of time and their size and/or species makes them particularly appropriate for retention. Trees 23, 24, 35, 37 and 41 have been identified as having a high priority for retention and protection during any proposed redevelopment of the subject site. The remaining trees have been identified as having either low or nil retention value.

Recommendations based on the arboricultural assessment of all trees have been included in this report. As part of these recommendations, alterations to the design and form of the proposed building have been suggested to insure retention of highly significant trees on the site. A Tree Protection Plan, including suggested Conditions of Development Consent has also been included within this report.

Brief

I have been asked to-

- Visit the site
- Identify the trees
- Determine the health and condition of the trees
- Examine the proposed plans
- Consider the impact of the proposed works on trees located within 10 metres of those works.
- Develop a Tree Protection Plan
- Prepare an Arboricultural Impact Assessment Report for inclusion as a part of the DA Documentation

Information Provided

The following plans and documents were reference in preparation of this report.

- Landscape Code for Development Applications, prepared by Hornsby Shire Council, dated 11 May 2005.
- Plan Showing Relative Height and Features Over Part Hornsby Hospital, Drawing No: 605_001.PRO, Sheets 1, 2 and 3, prepared by S P Setout Pty Ltd, dated 15 December 2010,
- Ground Floor Plan, Drawing No.: (5044) SK10b-B, prepared by Hames Sharley, dated 3 June 2011,
- First Floor Plan, Drawing No.: (5044) SK11-B, prepared by Hames Sharley, dated 3 June 2011,
- Plant Floor Plan, Drawing No.: (5044) SK11b-1, prepared by Hames Sharley, dated 3 June 2011,
- Site Plan, Drawing No.: (5044) SK12-B, prepared by Hames Sharley, dated 3 June 2011,
- Elevations 01, Drawing No.: (5044) SK13a-B, prepared by Hames Sharley, dated 3 June 2011,
- Elevations 02, Drawing No.: (5044) SK13b-B, prepared by Hames Sharley, dated 3 June 2011,
- Landscape Concept Plan, Drawing No.: (5044) SK18-B, prepared by Hames Sharley, dated 3 June 2011,
- Courtyard Concept Plan, Drawing No.: (5044) SK19-B, prepared by Hames Sharley, dated 3 June 2011.

Limits

Inspection date:

The site inspection was carried out on the 12/06/2011 and the site related observations contained in this report arise from the inspection on that date.

Definition of a Tree:
This report considerers trees that are covered by the Tree Preservation Order and relies on the definition and exemptions contained with the Tree Preservation Order in determining what a tree is and which trees are exempt. This report also considers all trees on the neighbouring properties that are likely to be impacted by the proposed development regardless of the definition contained in the Tree Preservation Order

Method:

All trees were inspected from the ground and involved inspection of the external features only. Inspection of trees on the neighbouring property was from the property and or the public footpath. The inspection included the performance of a **V**isual **T**ree **A**ssessment (**VTA**)[1]. The inspection did not include any invasive, diagnostic or laboratory testing.

Identification:

Broad features visible at the time of inspection were used to identity the trees. Identification was not based upon a full taxonomical identification or comparison against a herbarium specimen. Wherever possible the selection of genus and probable species is provided.

Plans:

This report adopts the terms and nomenclature provided in the Australian Standard AS 4970-2009. To avoid confusion that this can cause, the term Tree Protection Plan refers to the recommendations and processes required to protect the trees. This document is presented in a written format. The Tree Protection Plan (drawing), is a diagrammatic plan that may or may not, have on it all information contained within the Tree Protection Plan.

The trees that were not located on the survey plans provided are shown with their approximate centres marked on the Tree Location Plan (drawing) (See Appendix 2).

Only the plans referred to above have been used in assessing the impact of the proposed DA on the trees. Where recommendations are made in this report including those recommendations contained in the Tree Protection Guidelines it is essential that these recommendations be able to be implemented. Any additional drawings, details or redesign that impact on the ability to do so may negate the conclusions made in this report

Observations

See Tree Schedule attached as Appendix 1.

Discussion

Roots on Development Sites

The critical issue when constructing adjacent to trees is the impact of construction activities on the roots. To understand this impact, it is important that we understand that there are two substantially different components to the root system.

[1] **VTA** – Visual Tree Assessment is a systematic inspection of a tree for indicators of structural defects that may pose a risk of failure. This is made from ground level, unless otherwise stated. Dr Clause Mattheck describes the method in *The Body Language of Trees*. It is the recognised assessment process and is supported by the International Society of Arboriculture as the standard visual assessment process. Invasive and other diagnostic fault detection procedures are generally only recommended when visual indicators of potential concern are observed.

- The structural roots are essentially underground branches. They are long lived. They provide physical support for the tree and act as the connection between the absorbing roots and the rest of the tree. These roots can be a little under a millimetre in diameter and can grow to be hundreds of millimetres in diameter over time. Their thick bark prevents them from drying out but as a result, they are not effective at absorbing water and nutrients from the soil.

- Absorbing roots are very small and the absorbing components usually microscopic. The absorbing roots are responsible for nearly the entire uptake of water and nutrients. They are highly ephemeral (come and go quickly), often lasting only two or three months but sometimes, in association with beneficial fungi, they can last a year or more.

  Absorbing roots are readily stimulated by water, soluble nutrients and soil temperatures over 16 degrees. (We can generally assume that soluble nutrients are always present in most soils at satisfactory levels particularly when organic material is present. This is one of the reasons that we encourage the use of mulch.)

The majority of roots occur in the first 600mm of soil depth. This is primarily because all plant tissue respires (burns oxygen) in order to function. Oxygen levels and root density deplete as soil depth increases. Absorbing roots and absorbing root organs are always at their highest density close to the surface. This zone is richer in oxygen, nutrients and beneficial micro- and macro-organisms.

The cutting of a structural root with a diameter of 25mm could conceivably result in the death of many thousands or even millions of root hairs, depending on the amount of root division.
The most important structural roots are those that grow directly from the trunk (first order lateral roots) and those roots that branch near the trunk and get rapidly thinner (zone of rapid taper). Damage to these roots is extremely undesirable.

In the construction process the most common risk of root severance occurs with excavation for the footings and or the slab, trenching for services and through grade changes (bulk earth works)

Because many roots are close to the surface, construction activity can indirectly impact on the health of roots through soil compaction. Even regular pedestrian activity has an affect on the roots close to the surface. By far the easiest and most efficient way of limiting construction damage is to limit activity in the area where roots are and to stimulate absorbing roots in the same area.

The Existing Trees

A total of nineteen (19) trees were inspected and assessed in preparation of this report. Of these only thirteen (13) were indicated on the supplied plans (605_001.PRO Sheets 1, 2 and 3). The remaining six (6) trees were identified on site. Trees 23 and 24 are Brush Box (*Lophostemon confertus*) trees, located within the road reserve of Palmerston Avenue and are Council owned assets. The remaining trees are all located within the subject property.

Four (4) trees, identified as Trees 30, 31, 39 and 40 have been identified as being essential for retention from an arboricultural perspective. These trees are significant specimens to both the site and the local environment. They are in a condition whereby they can be retained for extended periods of time and their size and/or species makes them particularly appropriate for retention.

Tree 30 is a Sydney Blue Gum (*Eucalyptus saligna*) which is a locally indigenous species. Additionally, it is a species indicative of Blue Gum High Forest, an endangered ecological community under both Federal and State legislation. Whilst it is not suggested that this isolated specimen indicates the presence of such an ecological community, its interaction with the tree population of the local area is considered an important ecological benefit and one which is deserved of consideration. Further, the tree is a healthy specimen with no significant visible structural issues. As a semi-mature specimen, this condition suggests that the tree could live for an extended period of time providing positive amenity to both the site and the local environment.

Tree 31 has been identified as an English Oak (*Quercus robur*). This tree is a mature specimen of good health, form and structure. It is of a considerable size and, based on this size, would appear to be quite old for this country. Even at this time, this tree is a significant specimen within the property and, given its substantial size and good condition, should be retained.

Trees 39 and 40 are a pair of Smooth-barked Apples (*Angophora costata*) located on the Lowe Road frontage of the property. They are within an existing garden bed to the west of a vehicle entry way. Smooth-barked Apple (*Angophora costata*) is an indicative species of both Blue Gum High Forest and the often adjacent Sydney Sandstone Ridge Top Woodland, another endangered ecological community under Federal and State legislation. As for Tree 30, the presence of these trees does not in and of itself indicate the presence of the community however, their interaction with larger tree population of the local area is an important function. With no arboricultural reason to remove these specimens, and the obvious importance of their species, retention and protection of these two (2) trees is recommended.

Trees 23, 24, 35, 37 and 41 have been identified as having a high priority for retention and protection during any proposed redevelopment of the subject site. Tress 23 and 24 have been identified within this category as they are Council owned assets and not under ownership of the subject site. Tree 37 Tallowwood (*Eucalyptus microcorys*) and Tree 41 Lemon Scented Gum (*Corymbia citriodora*), whilst not being locally indigenous species, are native and provide support to the local fauna. As both have been assessed as being in good arboricultural conditions, with no notable health, structural or formative issues, there is no arboricultural grounds which would warrant their removal.

Tree 35 Liquidambar (*Liquidambar styraciflua*) is an exceptional specimen of this species. It is a large tree with no observable health, structural or formative issues. Whilst the species is considered by some to be an environmental weed, the combination of this trees deciduous habit, location on the northern side of the property and its considerable size give it the ability to be able to provide a very high level of positive amenity to the property. The combination of these factors allows the tree to modify solar impact on any building located to its south, as the existing building is. This capacity would increase the energy efficiency of any building constructed in a similar location to the existing one. Given the ever increasing running costs

associated with public and private buildings, utilization of all energy cost minimising options requires consideration. The combination of this, and the trees good arboricultural condition, make it an excellent candidate for protection and retention within the site.

Trees considered as having a moderate importance for protection and retention have been identified as Trees 25 and 29. A Turpentine (*Syncarpia glomulifera*) and a Chinese Tallow (*Sapium sebiferum*) respectively, these trees are fair examples of their species. The Turpentine (*Syncarpia glomulifera*) is a species associated with Turpentine-Ironbark Forest, another ecological community considered endangered by both Federal and State legislation. This forest type is often found adjoining Blue Gum High Forest and so there is a strong connection between the predominant species. Once again, the presence of this one specimen does not in itself indicate the existence of the ecological community however, in connection to surrounding trees and vegetation it does contribute in some way to the existing, locally indigenous ecological community. As quite a young and small specimen, this impact is considered less than that of, for example Tree 30. For this reason, this particular tree is seen as being less critical to retain on the site than some previously discussed examples.

The Chinese Tallow (*Sapium sebiferum*) is a mature specimen located on the northern boundary of the site. The tree is in fair condition, a status which is possibly the best that can be expected given that environmental conditions within the Sydney region are not particularly conducive to this species. Retention of this tree is considered desirable provided that the impact of doing so is not too great on the subject site.

The remaining trees have been identified as having either low or nil retention value. This assessment is based on their species, health, structure and/or a combination of these factors. The four (4) Bottlebrush (*Callistemon spp*.) identified as having nil retention received this catagorization as they have structural issues, are evidently in generally poor health and have been heavily pruned reducing both their visual and environmental significance. Tree 28 Jacaranda (*Jacaranda mimosifolia*) has been catagorised as a low retention value due to its poor structure and form. Continuous lopping of the specimen has resulted in high levels of epicormic growth throughout the canopy. The main stem junction of this tree is included, a structural form noted to be defective and a likely point of failure. Given the increased end weighting of the scaffold branches, resulting from the inappropriate pruning which has been carried out over an extended period of time, there is an increased risk of failure at the main junction.

Tree 33 Common Alder (*Alnus glutinosa*), whilst arboriculturally a good specimen and one with a high visual amenity value to the property due to its location, is also considered by many as an environmental weed. Its self seeding habit is considered unsuitable for sites adjoining or close to bushland environments. Removal and replacement with a more suitable species during redevelopment of this site could result in a generally more beneficial result both in the short and long term of the site.

The overall health, structure and form of Tree 36 Desert Ash (*Fraxinus angustifolia*) is considered to range from poor to very poor. This tree has been excessively pruned to provide clearances to the existing building which surrounds it on two (2) sides. With the only canopy remaining being that which is above the roof line of the existing building, this tree has reached critical canopy level. This is the level at which removal of any further foliage will have

significant negative impacts on the health of the subject tree. It is apparent from the location of this tree and the resulting treatment, that it was initially planted in an inappropriate location. With no arboricultural means available to rectify the issues facing this tree, its removal is recommended.

Located on the northern boundary of the site, immediately below Tree 37, Tree 38 Kaffir Plum (*Harpephyllum caffrum*), was found to be a poor specimen. It displayed a high level of chlorotic leaves indicating some significant health issues. Being located so close to Tree 37, there is significant competition between the trees for available moisture and nutrients, a competition which, based on the evidence of the trees foliage, Tree 38 is loosing. With Tree 37 being the larger, healthier and more environmentally beneficial of the two (2) trees, removal of Tree 38 is recommended.

Impacts of the Proposed Redevelopment

The existing building will be demolished a new building is constructed, including associated landscaping. The plans provided lack some details that impact upon the assessment of the possible impacts associated with the proposed works in relation to trees on the site. Such things as the location points not being shown on the plans for all of the existing trees being, the need to assume finished levels and a lack of sections to indicate proposed level variations within the site and inclusion of only selective trees in existence on the site in all plans. Based on available information however, the following construction impacts are noted.

1. Trees to be Removed

The supplied plans indicated that Trees 25, 26, 27, 31, 32 and 36 are required for removal in order to facilitate construction of the proposed building. Of these trees, Tree 31 English Oak (*Quercus robur*) has been assessed an essential retention value (please refer to previous discussion). The remaining trees have retention values ranging from moderate to nil. For these reasons, the removal of Trees 25, 26, 27 and 32 are not seen as presenting an impediment to the proposal. Removal of Tree 31 cannot however be arboriculturally supported and alterations to the proposed design are recommended in order to protect and retain this tree.

2. Trees Impacted by Proposed Excavation

Information within the supplied plans indicates that Trees 29, 30, 35, 37, 39 and 40 will be negatively impacted by excavation within their identified Tree Protection Zones. Whilst some encroachment into the Tree Protection Zone (TPZ) is conditionally permissible, the levels indicate in the instance of Trees 29, 30, 35, 39 and 40 is considered arboriculturally unacceptable. Encroachment to the levels indicated by the supplied plans will have a negative impact on both the structural stability of the subject trees and on their health and vitality. Excavations at the distances indicated on the supplied plans from the noted trees would result ultimately in the requirement to remove these trees due to structural instability and/or their death. Significant alterations need to be made to the proposal if these trees are to actually be retained as indicated by the plans.

In the instance of Trees 35, 39 and 40 works are proposed to occur, not only within their TPZ but also within their Structural Root Zone (SRZ). The SRZ is the area of roots calculated to

provide the majority of structural support to a tree and into which, under the provisions of Australian Standard 4970 Protection of trees on development sites - 2009, no encroachment is permissible.

As previously discussed, Trees 39 and 40 are a pair of Smooth-barked Apples (*Angophora costata*). This species is identified as having a low tolerance to root plate disturbance. Whilst and existing vehicle entry way is located to their west, it is noted that the supplied plans show a proposal to construct two (2) parking spaces immediately below these trees. Finished levels for these parking spaces have not been provided however, it is reasonable to assume that the existing surface treatments would be required to be removed. Additionally, levelling to provide appropriate vehicle access would also be undertaken and excavation to install the final surface treatments. Due to the topography of the site, these works would all be occurring on the up slope side of these trees. As a botanical fact, when growing on inclining sites, the roots which provide the majority of structural support for this species are located on the up hill/slope side of the tree. This is exactly the area being proposed for construction work within the plans. Such works will result in significant root damage, potentially resulting in either or both trees becoming unstable.

In addition, the effect of compaction on the root plate of the subject trees must also be considered. In order to carry out the proposed construction, heavy machinery will be used within both the SRZ and TPZ of the subject trees. Use of this machinery will result in compaction of the soil and a reduction in the permeability of air and moisture to the root plates of the trees. The resulting reduction of effective catchment area to the trees will have a significant negative impact on their health and vigour and is likely to result in their death. Alteration of the proposed design to relocate all construction outside of the Structural Root Zone, and to minimise its encroachment into the Tree Protection Zone of these trees is recommended.

Tree 35 is indicated on the plans as being retained. Given that excavation to facilitate construction of the proposed building is located within 5 metres of the tree on the western side and 2.6 metres on the southern side, retention of this tree, is if the proposal is approved in its current format is impossible. Both of these excavations are well within the 12.24 metre Tree Protection Zone calculated for this tree and significantly within the SRZ of the tree on the southern side. As this tree has been assessed as having a high retention value, it is recommended that the proposed design be amended to permit reasonable and arboriculturally acceptable setbacks from the base of this tree.

3. Pruning Required to Facilitate Construction

In addition to considerations given to the impact of the proposed development on the root systems of the subject trees, it is also necessary to assess the impact on the canopy of each tree. As few details regarding finished levels etc were included within the supplied plans, calculations contained within this section have used information gleaned by cross referencing the following documents;

- Plan Showing Relative Height and Features Over Part Hornsby Hospital, Drawing No: 605_001.PRO, Sheets 1, 2 and 3, prepared by S P Setout Pty Ltd, dated 15 December 2010,

- Elevations 01, Drawing No.: (5044) SK13a-B, prepared by Hames Sharley, dated 3 June 2011 and
- Elevations 02, Drawing No.: (5044) SK13b-B, prepared by Hames Sharley, dated 3 June 2011.

The provisions of the Australian Standard 4373, Pruning of amenity trees, 2007 state that pruning should be carried out to the minimum necessary to achieve the aim of the pruning and that the tree should not be adversely affected by the works. Arboricultural best practice has interpreted this as generally allowing a maximum of 10% of the live foliage of a tree to be removed over the course of any one single year of growth. Ethical and responsible Arborists abide by this provision.

Calculations for the subject trees indicate that Tree 35 is the only tree which would be required to be pruned in excess of the acceptable 10% limitation. In this instance however, construction at the proposed distance from the subject tree would require removal of approximately 46% of the total canopy. This would not only be injurious to the health and vigour of the tree but would compromise its aesthetics irreparably. Additionally, if the tree were to survive removal of this level of canopy, ongoing maintenance pruning would be required to maintain clearances between the building and the tree. Due to the growth habits of this species, and regardless of the negative implications to its health and vigour, such maintenance pruning would be laborious and costly. Given the function of the site and the apparent level of arboricultural expertise currently engaged there a pruning regime such as this is not only financially inappropriate but practically not applicable. Taking into consideration the implications of the required pruning, retention of this tree as indicated on the supplied plans is not only unlikely but impossible should the project be approved in its current format. It is recommended that the building be redesigned within the constraints presented by this tree and allow for its retention and protection.

Methods of Tree Protection

It is important that we understand the processes and methods of tree protection. For that reason, a number of images have been included in Appendix 4 along with the information in this section to assist in ensuring that appropriate implementation of the tree protection.

The following Tree Protection Measures can only be applied to those trees which have been shown by assessment to be viable for retention. Where significant issues exist between the proposed treatment of the tree, as indicated by the cited plans and the arboricultural findings of this report, Tree Protection Guidelines have not been provided. Once the appropriate consent authority has provided a determination on the form of the proposed redevelopment and the treatment of the subject tree, an appropriate Tree Protection Plan can be prepared.

Protect the roots

As already explained the purpose of establishing a Tree Protection Zone is more than concerned with protecting the trunk of the tree. A tree protections Zone's primary function is the protection of the roots of the tree.

The most appropriate method of protecting a tree is to establish an exclusion zone using some form of rigid temporary fence (a Tree Protection Zone or TPZ). Whilst it may seem easier to use flexible fabric barrier fence these products tend to fail over time and is easily pushed out of the way or damaged. In comparison, damaging rigid fence requires more of a hit, can damage machinery and involves the cost of repair or replacement of the damaged fence.

Sometimes however, it may become necessary to work within or to gain access through a Tree Protection Zone. To do this we need to develop a method to stop soil compaction and prevent direct physical damage to roots. A simple action such as walking on the same spot half a dozen times or more can lead to soil compaction. Pushing a full wheelbarrow will cause compaction on the first instance. It does not take long for that damage to accumulate and harm the roots of a tree.

There are a number of ways to protect roots against compaction and physical damage. We can divide these into two simple groups

- Systems that share the load and
- Systems that are fully load bearing.

Load-sharing surfaces are temporary and usually lightweight systems. Load-sharing surfaces sometimes can be as simple as mulch beneath plywood or planks or the use of scaffolding, to heavier duty systems such as the use of plastic or metal road plates or even rail decking. Photographs in appendix 4 show that these can be enough to protect a delicate egg from breaking.

Fully load-bearing structures include finished structures such as the slab of a building, a driveway or a pathway. Obviously each of these has a limit to the weight that it can bear and if this is exceeded the structure and things beneath it can be damaged. Load bearing systems can also include scaffolding and temporary bridging structures.

Protect the trunk

In most instances, enclosing of the Tree Protection Zone ensures that the trunk of a tree cannot be damaged. Sometimes however work needs to take place within the Tree Protection Zone and as a result, there is a risk of impact to the trunk. Damage to the trunk is extremely undesirable. Where it is possible to treat the wound, treatment is time critical and is very expensive. When treatment is not possible or is ineffective a trunk injury can lead to long-term structural and physiological problems.

Where possible operating machinery or performing activities that may result in impact to the trunk of the tree should avoided. Where this is not possible, it is important to protect the trunk. Strapping pieces of timber to the trunk of the tree has been the traditional method for achieving this task.

As any high school science student will recall Conservation of Momentum (as demonstrated by Newtons cradle) tells us that this force is basically transferred through the pieces of timber to the trunk of the tree often providing little to no protection and in some circumstances actually resulting in increased damage.

In response to the failure of timber to absorb impact, hessian or carpet underlay were used and whilst these improved the situation the timber still lacked the ability to absorb any of the energy. The use of fabric wraps also carried new problems; in particular, they often held moisture and this moist material was in constant contact with the trunk.

A more appropriate system needs a hard but flexible outer surface bonded to a soft impact absorbing material that has a low water holding capacity. This system is better at absorbing the energy of an impact … just think about a bicycle helmet. Just as with a bicycle helmet, if impact damages a board, it needs replacing and at the same time, the trunk of the tree needs inspecting.

Lastly, prevention is the best process. When machinery is operating in close proximity to the trunk of a tree, using an observer can greatly reduce the likelihood of impact. To be effective the observer should maintain direct visual contact with the tree and the machine and should have direct audio contact with the operator. (Two-way earmuff systems are useful for this task).

Protection of the canopy

The canopy of the tree is often the part of the tree that is least harmed in the construction process. Even so, there are two ways that the construction process can harm the canopy. The first is by direct impact between equipment and the branches of the tree and the second is from incorrect or excessive tree pruning.

Avoiding impact between machinery and branches simply requires care. When machinery needs to operate near branches an independent observer should be used. The observer should maintain direct visual contact with machine and the branches of the tree and should have direct audio contact with the operator.

All pruning work should be performed in accordance with the Australian Standard AS 4373-2007 “Pruning of Amenity Trees.” Any person who does not fully understand this standard or who has not had proper training to perform pruning should not attempt this work. The site arborist may provide instructions to workers on the site on making temporary cuts for later rectification by an arborist. These instructions should be carefully followed.

Recommendations and Tree Protection Plan

Design Issues

#	Recommendation	Reason
1	The proposal be redesigned to allow the retention and protection, in accordance with the clearances detailed within this report, of Trees 23 Brush Box (*Lophostemon confertus*), 24 Brush Box (*Lophostemon confertus*), 29 Chinese Tallow (*Sapium sebiferum*), 30 Sydney Blue Gum (*Eucalyptus saligna*), 31 English Oak (*Quercus robur*), 35 Liquidambar (*Liquidambar styraciflua*), 37 Tallowwood (*Eucalyptus microcorys*), 39 Smooth-barked Apple (*Angophora costata*), 40 Smooth-barked Apple (*Angophora costata*) and 41 Lemon Scented Gum (*Corymbia citriodora*).	To allow for retention of the most arboriculturally appropriate and significant trees within the area of the site.
2	Trees 25 Turpentine (*Syncarpia glomulifera*), 26 Bottlebrush (*Callistemon spp.*), 27 Bottlebrush (*Callistemon spp.*), 32 Bottlebrush (*Callistemon spp.*) and 38 Kaffir Plum (*Harpephyllum caffrum*) be approved for removal.	To allow for removal of the most arboriculturally appropriate trees.
3	Tree 28 Jacaranda (*Jacaranda mimosifolia*) be considered for removal.	To allow for removal of a structurally defective tree and provide potentially greater flexibility to the use of the area.
4	Soil levels at the base of any tree to be retained should not be altered.	To minimise damage to the root plate of trees to be retained.
5	Establish a 'tree protection' policy document for inclusion as a part of the site induction process for all staff and contractors to undertake before commencing on site. Including a Tree Protection Plan (Drawing)	Ensuring all site staff and contractors understand the value and importance of protecting the tree reduces the likelihood of accidental damage.
6	All copies of the plans must include a copy of the Tree Protection Plan (Drawing) and a reference must be made on each and every plan or drawing to "check the Tree Protection Plan (drawing)"	Trades people often read plans rather than notes, including the Tree Management Plan (drawing) in the plan set will help the awareness of all trades people

Pre construction

7	In accordance with AS 4970-2009 (5.2) a copy of the Tree Protection Plan including the Tree Protection Plan (drawing) **must** be on site prior to any work commencing on the site.	To ensure that documentation is present and available as a reference for all site personnel.
8	TrunkGuard™ or a similar system of 100mm wide boards with thick polystyrene foam bonded to one side is to be installed around the entire trunk of each tree to be retained. This protection should extend as close as practicable to the first branching of the tree.	To provide protection for the trunk during adjacent demolition and construction works.
9	TrunkGuard™ or a similar system of 100mm wide boards with thick polystyrene foam bonded to one side is to be installed on lower level branches of each tree to be retained and in accordance with instruction from the Site Arborist.	To provide protection for the lower branches during adjacent demolition and construction works.
10	Correct and complete installation of Tree "Protection measures **are** to be certified by the project Arborist" to the Principal Certifying Authority (PCA) AS 4970-2009 (5.3.2).	This is to ensure the tree protection is correct and completed in accordance with the Tree Protection Plan
11	An AQF Level 3 Arborist **must** perform the canopy pruning with all final cuts made in accordance with AS4373-2007. The Arborist must **not** use climbing spikes.	To ensure the arborist makes correct cuts and that the tree is not unnecessarily damaged. It is preferable to use an AQF Level 5 arborist for this work.

During site works

12	In accordance with AS 4970-2009, (5.4.1) the project Arborist **should** perform regular site inspections. Monthly inspections are appropriate.	To ensure a suitably qualified person has confirmed that the tree is in good health and the recommendations are being followed.
13	If at any stage an inspection reveals the Tree Protection Plan has not been complied with the project Arborist **must** specify any required remedial works and the timeframe in which these works must be completed.	To ensure that all problems are appropriately rectified and that any remedial works required are carried out in a timely manner.
14	If at any stage an inspection reveals the Tree Protection Plan (recommendations) has not been complied with the project Arborist, site inspections thereafter **must** be carried out weekly	This is to provide additional supervision in order to avoid repeat problems and to ensure the correct and timely performance of remedial works.

15	If at any stage an inspection reveals the Tree Protection Plan (recommendations) has not been complied with the project Arborist is required to notify the Principle Certifying Authority who will immediately take appropriate action for failure to comply with the issued Conditions of Development Consent unless the non-conformity has been rectified to the Site Arborists satisfaction. .	To ensure non-conformance is followed up and rectified by those responsible for activities on the subject site.
16	Maintain natural ground level within the Tree Protection Zone. Do not trench, stockpile materials or change grades within this zone.	To prevent unnecessary or unauthorised damage to the trunk, roots and branches of the tree
17	The Tree Protection Zones **must** remain in force until construction work is completed.	To ensure that the tree is protected for the duration of the works that may impact on the tree.
18	Machinery access **is not** be permitted in the Tree Protection Zone to perform landscaping works	To avoid damage caused by machinery as a part of landscaping activities.
19	Should the need arise to modify the Tree Protection Zone, the project Arborist **must** prepare an amended Tree Protection Plan and submit it to the Council's Tree Preservation Officer or the appropriate consent authority for approval **prior** to access or changes taking place.	To enable changes to occur if necessary but to ensure that those changes do not adversely affect the tree.
20	An independent observer **must** be present during the demolition of any structure within 3 metres of the Tree Protection Zone.	This is to reduce the likelihood of accidental impact to the tree. (Note: The use of the project arborist for this task is strongly recommended)
21	Prior to removing any exposed root, greater than 25mm in diameter, cleanly cut it to within 1 metre of the Tree Protection Zone.	This is to avoid tearing of roots.
22	Keep the cut ends of any root, cut as a part of condition 16, moist using a root oasis, a temporary hoarding or a root curtain.	To ensure that cut roots do not dry out.
23	The project Arborist **must** be present for any open excavation on the boundary line adjacent to the Tree Protection Zone.	This is to ensure that site personnel follow items 16 and 17 correctly.

Post Construction

24	At practical completion, the project Arborist **should** "assess tree condition and provide certification", to the PCA that the tree protection works have been in accordance with the Tree Protection Plan.	This is to provide a completion to the document trail for the certifier and or the certifying authority.
25	"Certification **should** include a statement on the condition of the retained trees, details of the deviations from the approved tree protection measures and their impacts on [the] trees" and provide specifications for any remedial or rectification works required.	This is to comply with AS 4970-2009 (5.5.2). It provides a documented record of the final condition of the tree. It audits and certifies the correction of any problems.
26	The project Arborist **should** continue to perform quarterly inspects, maintenance and reporting for whichever is greater: • For 12 months after completion of construction activities or • For 12 month after achieving stable growth of the tree	To ensure the long tem recovery of the tree is certain.

Additional conditions

27	Irrigation of the Tree Protection Zone **must / should** be performed as follows • Less than 20mm of rain has fallen in the previous week from October to March or • Less than 10mm of rain has fallen in the previous week from April to September. Apply irrigation at 1 litre / square metre for every 2mm shortfall in the rainfall during the previous week.	This is to ensure healthy root growth and to ensure higher levels of readily available water to minimise stress. (Note: It may be easier to install a temporary irrigation system prior to installing any load sharing surface.)
28	An irrigation log **must / should** be maintained and kept on site and must record the weekly rainfall and the date and duration of any manual irrigation event.	To ensure appropriate records are available for monitoring and reporting.
29	Within 24 hours of observing a non-conformance, the Arborist **must** provide a written non-conformance report to the construction manager. The report must include what rectification and remedial action is required.	To ensure all relevant personnel are made aware of non-conformance and given the opportunity to rectify said.
30	Within 7 days of observing a non-conformance, the Site Arborist **must** supply a copy of any non-conformance report to the Council and the Principal Certifying Authority.	To ensure non-conformance is followed up and rectified by those responsible for activities on the subject site.

31	Within 7 days of receiving a report of non-conformance, the Principle Certifying Authority must take appropriate action for a breach of the Conditions of Development Consent unless the non-conformity has been rectified to the Site Arborists satisfaction.	To ensure non-conformance is followed up and rectified by those responsible for activities on the subject site.
32	All holes for piers, fencing, and planting within the Tree Protection Zone **must** be potholed using an Air Knife, Air Laser or similar compressed air device.	To prevent excessive damage to the root plate of trees to be retained and minimise instances of trees being made unstable by inappropriate root severance.
33	Do not cut or damage any root greater than 25mm in diameter for the installation of a fence post, planting hole or pit. If a root of 25mm or greater is encountered the hole **must** be moved to allow for its retention	To prevent excessive damage to the root plate of trees to be retained and minimise instances of trees being made unstable by inappropriate root severance.
34	The Tree Protection Fences **must** remain in place until landscape works are to take place within the Tree Protection Zone.	To minimise damage to trees to be retained.
35	Provide notification to the Site Arborist, the Council and the PCA not less than 7 days before removing the Tree Protection Fences.	This allows a check to be undertaken to see whether trades remaining on site or landscaping works are likely to adversely impact on the trees

Should you require any further information, do not hesitate to call our office for assistance.

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Appendix 1

Tree

Schedule

Tree Schedule

Client Name: Health Infrastructure **Site Address:** Hornsby Ku-ring-gai Hospital, 1 Derby Road, Hornsby (NSW) 2077

No	Common/Botanical Name	Health / Structure / Form	Height (m)	Spread (m)	DBH (m)	SRZ (m)	TPZ (m)	Retention Value	Comments	Recommendation
23	Brush Box *(Lophostemon confertus)*	Fair / Fair / Poor	8	10 x 8	0.5	2.46	5.94	High	• Dual @ 1.6m. Included main junction. • Lopped for service line clearances. • 20% semi-mature & mature epicormic growth.	Retain & Protect.
24	Brush Box *(Lophostemon confertus)*	Fair / Fair / Poor	8	9 x 6	0.33	2.06	3.90	High	• Lopped for service line clearances. • Asymmetrical canopy. • End weighted scaffold branch to east. • 20% semi-mature & mature epicormic growth.	Retain & Protect.
25	Turpentine *(Syncarpia glomulifera)*	Fair / Poor / Fair	7	6 x 8	0.27	1.91	3.24	Moderate	• Inclusions in canopy. • Adjacent existing driveway.	Remove to facilitate proposed development.
26	Bottlebrush *(Callistemon spp.)*	Fair / Poor / Fair	6	3 x 5	0.205 / 0.11	1.79	2.79	Nil	• Included junctions throughout canopy.	Remove to facilitate proposed development.
27	Bottlebrush *(Callistemon spp.)*	Fair / Poor / Fair	6	5 x 4	0.16 / 0.14	1.73	2.55	Nil	• Dual @ 1.0m. Included main junction.	Remove to facilitate proposed development.
28	Jacaranda *(Jacaranda mimosifolia)*	Fair / Poor / Poor	7	11 x 10	0.25 / 0.21	2.07	3.92	Low	• Dual @ 0.6m. Included main junction. • Lopped & pruned for clearance to car park. • 40% semi-mature epiormic growth.	Retain & Protect.
29	Chinese Tallow *(Sapium sebiferum)*	Good / Fair / Fair	7	12 x 10	0.435	2.33	5.22	Moderate	• Lopped & pruned for clearances. • Minor storm damage to canopy.	Retain & Protect.
30	Sydney Blue Gum *(Eucalyptus saligna)*	Good / Good / Good	22	14 x 12	0.645	2.75	7.74	Essential	• Semi-mature specimen. • Has been crown lifted for clearances. • <10% deadwood.	Retain & Protect.
31	English Oak *(Quercus robur)*	Good / Good / Good	12	14 x 17	0.75	2.93	9.00	Essential	• Large Ø prune wound on east side. Almost totally callused over. • Surface roots – damaged. • Exceptional specimen.	Retain & Protect.

32	Bottlebrush *(Callistemon spp.)*	Poor / Poor / Poor	5	4 x 4	0.13	1.4	2.00	Nil		Remove to facilitate proposed development.
33	Common Alder *(Alnus glutinosa)*	Good / Good / Good	9	9 x 9	0.29	1.97	3.48	Low	• 10^{o} phototropic lean to east.	Retain & Protect.
34	Bottlebrush *(Callistemon spp.)*	Poor / Poor / Poor	5	6 x 5	0.155	1.51	2.00	Nil	• Dual @ 1.8m. Included main junction. • Crown lifted for clearances. • Chlorotic foliage.	Remove to facilitate proposed development.
35	Liquidambar *(Liquidambar styraciflua)*	Good / Good / Good	14	18 x 16	1.02	3.34	12.24	High	• Some pruning within canopy. Most callusing. • Surface roots – minor damage. • Excellent specimen.	Retain & Protect.
36	Desert Ash *(Fraxinus angustifolia)*	Poor / Fair / Very Poor	15	14 x 8	0.39	2.23	4.68	Low	• Has been under pruned to provide clearances. • Scaffold branch emerging from base has been removed.	Retain & Protect.
37	Tallowwood *(Eucalyptus microcorys)*	Good / Good / Good	16	16 x 12	0.485	2.44	5.82	High	• Chlorotic foliage. • Multiple leaders @ 0.2m. • Lopped.	Retain & Protect.
38	Kaffir Plum *(Harpephyllum caffrum)*	Poor / Fair / Poor	9	8 x 8	0.50	2.55	6.48	Low	• Located in corner of building. Has been heavily lopped & pruned to clear buildings. • Epicormic shoots immerging from base.	Remove to facilitate proposed development.
39	Smooth-barked Apple *(Angophora costata)*	Fair / Fair / Poor	20	8 x 7	0.455	2.38	5.46	Essential	• Asymmetrical canopy due to proximity of T40. • 10% deadwood. • Lopped for clearance of service lines. • 15% semi-mature epicormic growth, most as a result of the lopping.	Retain & Protect.
40	Smooth-barked Apple *(Angophora costata)*	Good / Good / Fair	20	18 x 14	0.58	3.24	11.38	Essential	• Dual @ 1m. Occluded junction. • Lopped for service line clearances. • 15% semi-mature & mature epicormic growth within canopy. Most as a result of the lopping.	Retain & Protect.
41	Lemon Scented Gum *(Corymbia citriodora)*	Good / Good / Good	24	16 x 12	0.41	2.28	4.92	High	• 10^{o} phototropic lean to east due to proximity of T21. • Main leader appears to have been lost when tree was very young. Apical dominance re-established by alternate branch.	Retain & Protect.

Notes on Tree Schedule

Number (No)	N – Neighbours tree within proximity of the development
Scientific Name	Identification was performed using visual features visible from ground level at the time of inspection.
Health	**Good** – In good health with no significant faults or defects **Fair** – Some faults or health problems, not likely to cause short-term problems, generally able to be managed **Poor** – Significant health or structural defects with management likely to be inadequate or inappropriate
Height (m)*	Palm heights given for trunk only and does not include the height of the fronds.
Spread (m)*	The average diameter of the canopy unless the asymmetry of the canopy is noted or is critical to the design process.
DBH (cm)*	Trunk diameter - measured or approximated at 1.4m above ground as outlined in "Appendix A" AS 4970 – 2009
TPZ	The **T**ree **P**rotection **Z**one radius without requiring input from an arborist, as specified by AS 4970 – 2009
TPZM	The suggested minimum Tree Protection Zone radius determined following the process for reducing the TPZ outlined in AS 4970 – 2009. The TPZM usually requires moderate to extensive arboricultural input along with ongoing maintenance
Retention Value	**E = Essential** - Site suitability 40 plus years, good condition. **H = High** - Site suitability 40 plus years fair condition or better. **M = Moderate** - Site suitability 20 - 40 years. **L = Low** - Site suitability less than 20 years. **N = Nil** - Site suitability less than 5 years. **Note:** Site suitability considers health, life expectancy, risk of harm, desirability of species and impacts on current land use.
Recommendations	Unless otherwise stated trees are to be retained

* All dimensions are approximate.

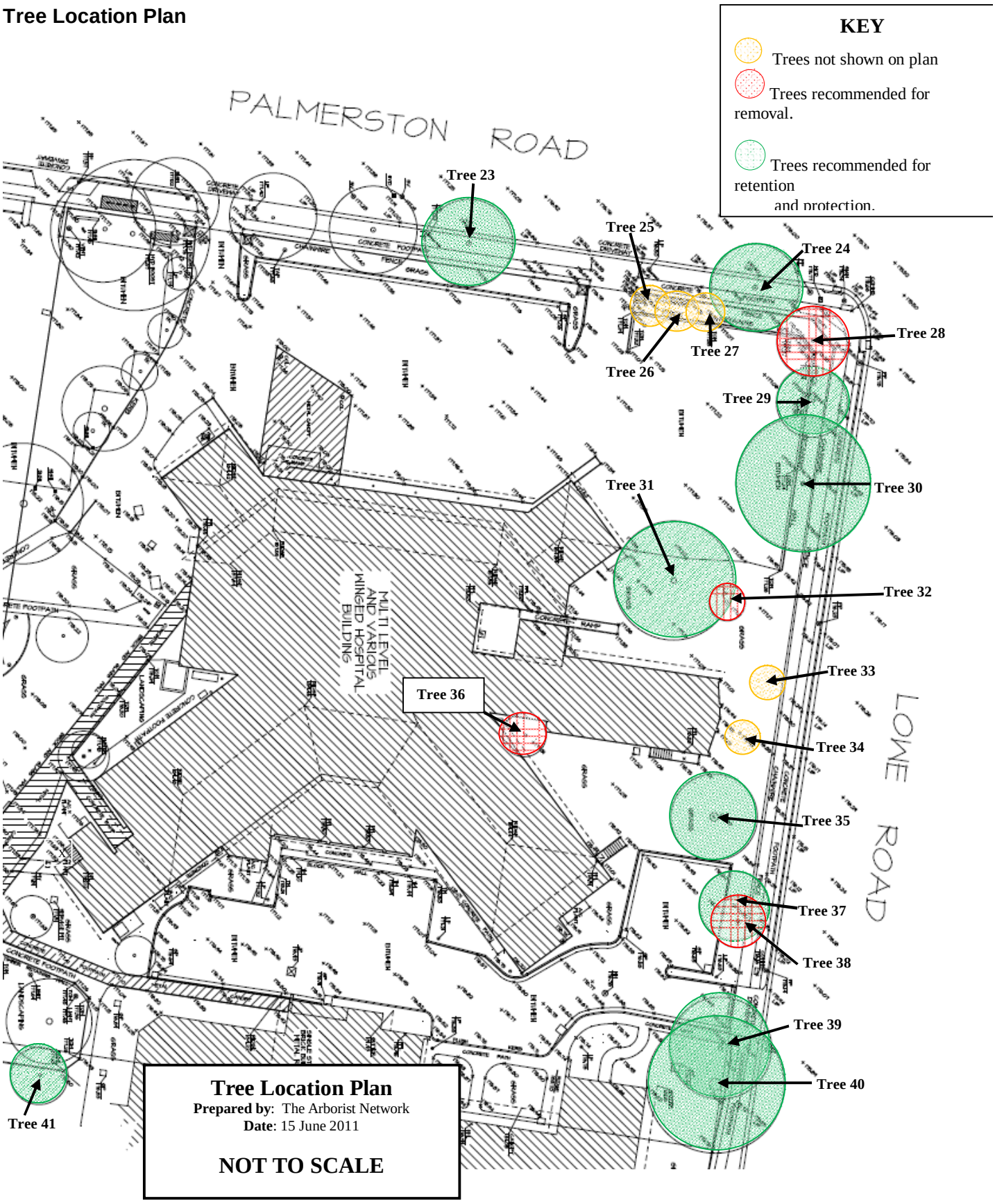
Appendix 2

Tree

Location

Plan

Tree Location Plan



Appendix 3

Generic

Tree

Protection

Guidelines

Generic Tree Protection Guildelines

1.0 Pre Construction:

1.1 Prior to the commencement of construction, the consulting Arborist will issue a report outlining the following:

1.2 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.

1.3 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.

1.4 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.

1.5 Prior to removal one of the following will confirm the tree is to be removed by marking the tree with a single horizontal yellow or orange line. One of the following persons, Surveyor, Landscape Architect, Arborist, Project Manager, and Tree Preservation Officer, should do this.

2.0 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 impart 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.

3.0 Maintenance activities:

3.01 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 4373-1996 - Pruning of Amenity Trees, removal of trees by sectional felling and stump grinding.
- Tree Removal

3.02 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

3.11 Soil moisture during construction shall be maintained at not less than 60% of field capacity.

3.12 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.

3.13 On each visit, the consulting arborist shall check the soil moisture and manually check the irrigation system, when installed.

3.14 Soil moisture levels should be checked by physical touch or with a tensiometer.

3.2 Soil amelioration

3.21 An application of rooting hormones, humic acids, soil microflora and mycorrhizae may be applied by an arborist in accordance with the manufacturer's instructions.

3.22 Chemical fertilizers are to be used only after representative soil testing and based on the soil scientist's recommendations.

3.3 Mulching

3.31 The fenced area should be mulched with seed free mulch to a depth of at least 50mm.

3.4 Weed Control

3.41 Weed control shall be by hand pulling, wiping or spraying with a glyphosate based herbicide. Material likely to be root grafted to trees to be retained shall be removed manually.

3.42 Weed control shall not be performed by mechanical cultivation or by scraping or back burning.

3.5 Crown cleaning

3.51 Crown cleaning (AS4373-1996, Pruning of Amenity Trees) shall be performed in accordance with the standard, by an arborist and in compliance with the appropriate occupational health and safety regulations. All branches down to 50mm in size shall be inspected and appropriately treated.

3.52 Any concerns about health or safety that are observed by the arborist on the site will be reported in writing within 7 days to the superintendent/principal/client and/or head contractor.

3.53 The use of spurs on live trees and internodal cutting is strictly prohibited.

3.6 Tree Removal and Stump Grinding

3.61 Remove trees in a controlled or sectional felling to avoid any damage to the trees to be retained.

3.62 All shrubs, under-scrub and woody weeds that are to be removed shall be removed by hand as per 3.4 above.

3.63 No tree shall be removed unless it has been marked with a horizontal white and yellow/orange line around the trunk.

4.0 Fences:

4.1 The fencing of the Tree Protection zone as defined in section 8.0 of the POTOCS standards should be commenced prior to the commencement of ANY work, including demolition and land clearing by earth moving machinery but may be erected after tree maintenance activities.

4.2 The fence surrounding the Tree Protection Zone must be a rigid fence not less than 1.8m high.

5.0 Signs:

5.1 At least every 25 metres attached to all tree protection fence there shall be a sign, a minimum of 600mm x 600mm, bearing the following phrase in red letters on white background at least 50mm in height:

"TREE PROTECTION ZONE - KEEP OUT"

5.2 On the same sign above or on a separate sign attached adjacent, in red lettering on white background not less than 25mm in height is to be the following:

"PROHIBITED ACTIVITIES"

Followed by the list below in black letters not less than 15mm in height.

a) Entry of machinery or people.
b) Storage of building materials.
c) Parking of any kind.
d) Erection or placement of site facilities.
e) Removal or stockpiling of soil or site debris.
f) Disposal of liquid waste including paint and concrete wash.
g) Excavation or trenching of any kind (including irrigation or electrical connections).
h) Attaching any signs or any other objects to the tree.
i) Placing of waste disposal or skip bins.
j) Pruning and removal of branches, except by a qualified Arborist.

5.22 In letters not less than 25mm in height on the above sign should be the name of the supervising Arborist or arboricultural company or other appropriate contact and a contact phone number.

6.0 Root Cutting

6.1 All roots greater than 50mm in diameter that are required to be removed shall be cleanly cut and kept moist at all times and shall not be left exposed to the air for more than 10 to 15 minutes.

7.0 Maintenance Reports:

7.1 Weekly inspections and monthly reports should be made until the end of construction.
7.2 A consulting Arborist should be on site during any excavation work within the Critical Root Zone and will report on that work in the monthly report.
7.3 A site log shall be maintained and include the date of each inspection, the person who performed the inspection, the items inspected or tested, the maintenance activities performed, any repairs undertaken or required to be undertaken, and any substantial breaches or non-conformances.
7.4 The arborist performing the inspection should sign the entries in the logbook
7.5 The log shall be maintained on site or alternatively copies of the log entries for the month shall be submitted each month with the monthly report.
7.6 All maintenance shall continue for the 3 months after completion of construction

8.0 Non-Conformance Reports:

8.1 The following are non-conformances that need to be managed when they occur.
8.11 The removal or relocation closer to the tree of all or part of any protective fence prior to landscaping.
8.12 The performing of any activity noted as prohibited on protection zone signage
8.13 The failure to maintain adequate soil moisture or the failure in the operation of the irrigation system.
8.14 Mechanical damage to the trunk, stems, branches or retained roots.
8.15 The sudden and abnormal or premature shedding or decline of the tree.
8.2 Substantial breaches and non-conformances:
8.21 Any breach or non-conformance of the tree protection zone, by any party, shall be notified in writing within 2 working days of it being first observed.
8.22 Notification of any non-conformance should be made in writing to the site foreman, the consent authority and any independent certifier.

Appendix 4

Protection of Trees on Construction Sites

Establishing a Tree Protection Zone

Good Work	Poor Work
	
The fence should be rigid and hard to move.	Too easily damaged and collapses when hit
	
The TPZ is mulched where appropriate and weed free.	Put the fence where it should be! The TPZ is not for storage.
	
The purpose of the fence is to isolate the tree from the works and to protect the roots	Woven fencing seldom work particularly when it is used close to the work or when space is scarce

Load –Sharing Surfaces and root protection

Good Work	Poor Work
	
Like an egg tree roots are delicate	A single movement of a truck will cause irreparable damage
	
Load sharing should be appropriately designed for the load that it is to carry.	Without protection soil is compacted and roots are broken and damaged
	
The goal is to ensure that impact on the roots that are to remain is minimal.	This shows no regard for tree roots

Trunk protection using TrunkGuard

Good Work	Poor Work
	
Designed to absorb impact just like a bicycle helmet.	Trunk damage is usually irreparable and often causes long-term damage!
	
Flexible to fit the trunk	Even installation of a poorly designed system can injure tree!
	
Able withstand moderate construction impact (not that this should happen but unfortunately it does).	Serves little purpose at all!