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# Sydney Children's Hospital Stage 1 / Children's Comprehensive Cancer Centre (CCCC) Arboricultural Impact Assessment

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## Health Infrastructure

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## DOCUMENT TRACKING

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Template 2.8.1

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## Abbreviations

Abbreviation	Description
AQF	Australian Qualifications Framework
AS	Australian Standards
CCCC	Children's Comprehensive Cancer Centre
DBH	Diameter at Breast Height
ELA	Eco Logical Australia
IASB	Integrated Acute Services Building
m	Metre
mm	Millimetre
NDE	Non-Destructive Excavation
NO	Number
NSW	New South Wales
REF	Review of Environmental Factors
RHIP	Randwick Health and Innovation Precinct
RHW	Royal Hospital for Women
SCH	Sydney Children's Hospital
SP	Species
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment

## 1. Background

The purpose of this report is to accompany the State Significant Development Application (SSDA) for the Sydney Children's Hospital Stage 1 (SCH-1) / Children's Comprehensive Cancer Centre. The Randwick Health and Innovation Precinct (RHIP) is one of the most comprehensive health innovation districts in Australia. While health care at RHIP has been evolving for over 160 years, the last five years has seen a strengthening of collaboration amongst a wide range of organisations in the precinct, including with government, universities and community.

The project seeks to strengthen the precinct as a world-class centre for health, research and education, driving cutting edge, compassionate and holistic healthcare and wellness programs for the local community and other residents of NSW. The project will deliver brand new, state-of-the-art paediatric health, medical research and education facilities and will assist to transform paediatric services and a key step in realising the vision for the RHIP.

The project is located on the corner of High Street and Hospital Road, Randwick as outlined in Figure 1 and the address of the subject site is in Table 1.

Trees affected by the Hospital Road and utilities upgrade are assessed in a Review of Environmental Factors under a separate approval pathway (Development Application to Randwick City Council to be submitted January 2021).

The purpose of this report is to:

- identify the trees within the site that are likely to be affected by the proposed works
- undertake a visual tree assessment of the subject trees
- assess the current overall health and condition of the subject trees
- evaluate the retention value of the subject trees
- identify trees to be removed, retained or transplanted
- determine the likely impacts on trees to be retained
- recommend tree protection measures to minimise adverse impacts.

Features of the subject site are tabulated below.

**Table 1: Development site**

Criteria	Description
Street address	High Street & Hospital Road, Randwick NSW 2031
Local Government Area	Randwick City Council
General land use	Road, hospital land and residential

The description of the proposed activity in Table 2 is based on information available at the time of preparing this report.

**Table 2: Proposed activity**

Activities that can impact trees	Description of proposed activities
Clearing vegetation	No – no trees will be impacted
Pruning vegetation	No
Earthworks including regrading, excavation and trenching <ul style="list-style-type: none"> <li>For building</li> <li>For services</li> </ul>	Yes – construction of a 9-storey building, 2 basement levels, podium over Hospital Rd to join both Hospitals and a plant room to provide: <ul style="list-style-type: none"> <li>A new Emergency Department</li> <li>A new Intensive Care Unit</li> <li>Short Stay Unit</li> <li>Day and Inpatient CCCC oncology units</li> <li>Children's Comprehensive Cancer Centre</li> <li>Ambulance access, parking, back of house and loading dock services accessed via the lowered Hospital Road</li> <li>Integration with the Prince of Wales Acute Services Building and Integrated Acute Services Building, both currently under construction</li> <li>Integration with the proposed Health Translation Hub (HTH) which is a facility being developed by UNSW for education, training and research</li> <li>Public domain and associated landscaping</li> <li>Tree removal</li> <li>Utilities services and amplification works</li> <li>Site preparation and Civil works</li> </ul>
Compaction <ul style="list-style-type: none"> <li>Storage of materials</li> <li>Installation of structures</li> <li>Stockpiling fill or materials</li> <li>Parking</li> </ul>	Yes
Refuelling and chemical use (e.g. herbicides)	Yes
Erection of scaffolding	Yes
Vehicle movements	Yes
Changes to stormwater management	No
Landscaping	No

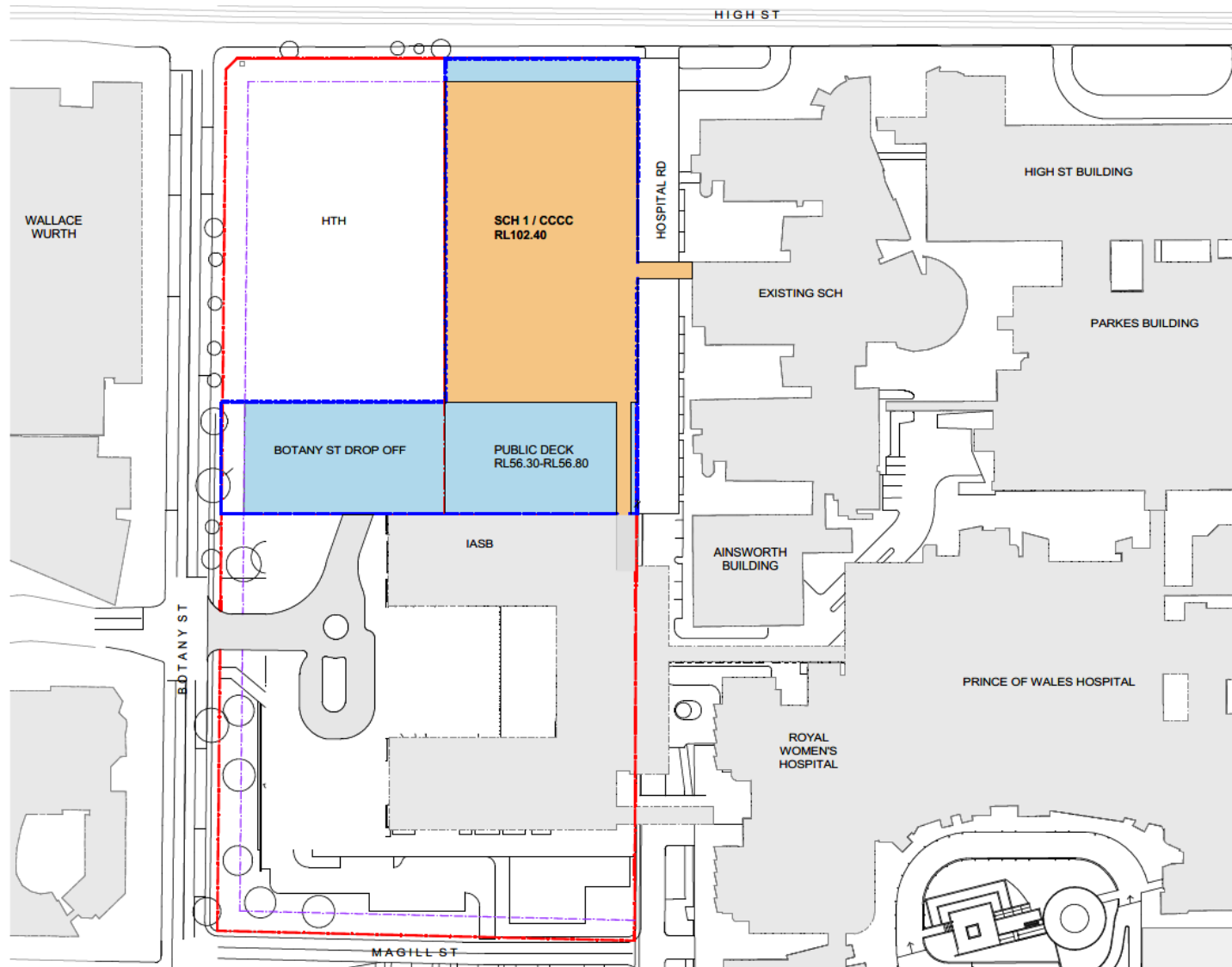


Figure 1: Project site plan as provided by the client



## 2. Method

### 2.1 Definition of a tree

A tree is defined under the Australian Standard, AS 4970-2009, *Protection of Trees on Development Sites* as a long lived woody perennial plant greater than (or usually greater than) 3 m in height with one or relatively few main stems or trunks.

Randwick City Council defines a tree as having a:

*'height equal to or exceeding 6 m; a canopy width equal to or exceeding 4 m; for a single trunk tree species, a trunk circumference equal to or exceeding 1 m at a height of 1 m above ground level; or for a multi-trunk tree species, a combined trunk circumference (measured around the outer girth of the group of trunks) equal to or exceeding 1 m at a height of 1 m above ground level'* (Randwick City Council 2013).

### 2.2 Visual tree assessment

The subject trees were assessed in accordance with a stage one visual tree assessment (VTA) as formulated by Mattheck and Breloer (1994) and practices consistent with modern arboriculture.

A total of 9 subject trees were inspected on 14 August 2020 by AQF Level 5 Consulting Arborist, Sophie Diller.

The following limitations apply to this methodology:

- Trees were inspected from ground level, without the use of any invasive or diagnostic tools and testing.
- Trees were inspected within limits of site access.
- No aerial inspections or root mapping was undertaken.
- Tree heights, canopy spread and diameter at breast height (DBH) were estimated, unless otherwise stated.
- Tree identification was based on broad taxonomical features present and visible from ground level at the time of inspection.
- Trees 1, 2, 3, 4 and 9 are proposed for removal under a separate planning approval pathway and therefore not considered as part of this AIA or development application.

### 2.3 Retention value

The retention value or importance of a tree or group of trees, is determined in accordance with the Institute of Australian Consulting Arborists (IACA) Significance of a Tree Assessment Rating System (STARS®), which is summarised in Appendix A. The method considers the Useful Life Expectancy (ULE) and landscape significance of a tree. Trees are provided one of the following ratings:

- High - priority for retention. These trees are considered important and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by Australian Standard AS 4970–2009 Protection of trees on development sites.

- Medium - consider for retention. These trees are moderately important for retention. Their removal should only be considered if adversely affected by the proposed works and all other alternatives have been considered and exhausted.
- Low - consider for removal. These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
- Priority for removal: These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

## 2.4 Protection zones

### 2.4.1 Tree protection zone (TPZ)

The TPZ is a specific area above and below ground and at a distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by the development. The TPZ (as defined by AS 4970-2009) requires restriction of access during the development process. Groups of trees with overlapping TPZs may be included within a single protection area. Tree sensitive measures must be implemented if works are to proceed within the TPZ.

### 2.4.2 Structural root zone (SRZ)

The SRZ is the area of the root system (as defined by AS 4970-2009) used for stability, mechanical support and anchorage of the tree. It is critical for the support and stability of trees. Severance of roots within the SRZ is not recommended as it may lead to the destabilisation and/or decline of the tree.

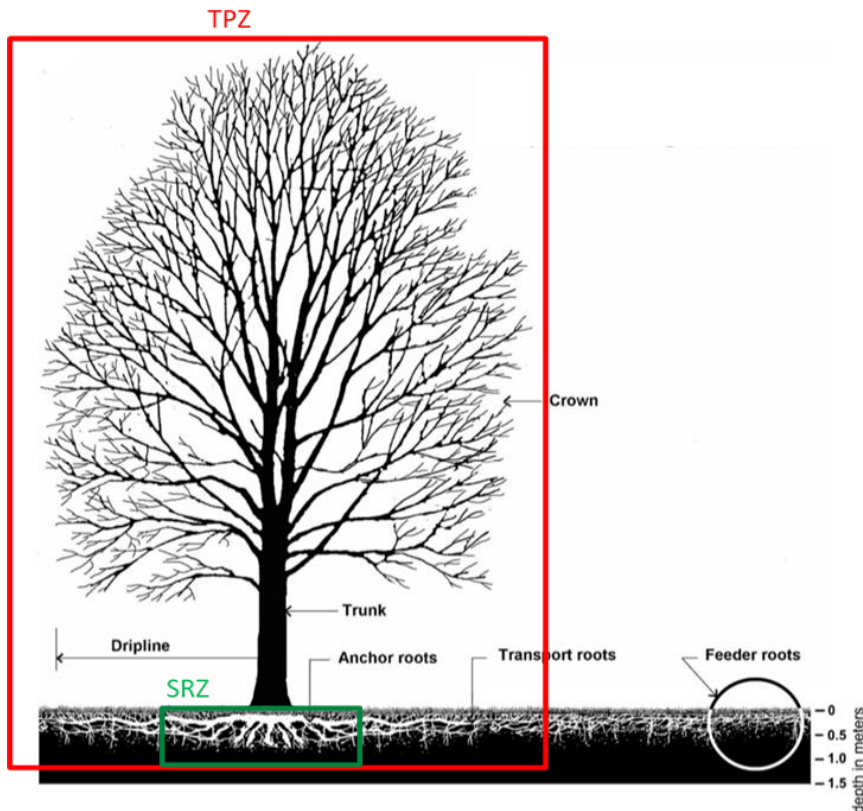


Figure 2: Representative tree structure and indicative TPZ and SRZ

## 2.5 Potential impacts

Trees may be impacted by physical or chemical damage to roots or above tree parts. Examples include impacts associated with site grading, soil compaction, excavation, stock piling within TPZ as well as changes in site hydrology, changes in soil level and site contamination. The extent of encroachment to the TPZ and SRZ determines the level of potential impact. AS 4970-2009 defines types of encroachment as follows and as illustrated in Appendix B:

- **Major encroachment** - If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ, the project arborist must demonstrate that the tree(s) would remain viable. The location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), Air Spade or manual extraction. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ.
- **Minor encroachment** – If the proposed encroachment is less than 10% of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ.

For the purposes of this Arboricultural Impact Assessment, impacts are defined as follows:

- **High impact:** The SRZ is directly affected or the proposed encroachment is greater than 20% of the TPZ. Trees may not remain viable if they are subject to high impact. These trees cannot be retained unless the proposal is changed.
- **Medium impact:** If the proposed encroachment is greater than 10% of the TPZ (but less than 20% of the TPZ) and outside of the SRZ, the project arborist may require detailed root investigation to demonstrate that the tree(s) would remain viable. These trees may be retained subject to further investigation and mitigation measures.
- **Low impact:** If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. These trees can be retained.
- **No impact:** No likely or foreseeable encroachment within the TPZ. These trees can be retained.

Impacts are calculated using geographic information systems techniques.

## 2.6 Proposed action

The proposed actions to either retain or remove each tree are determined by the impact from the proposed design footprint, conversations of intent with the client and corresponding mitigation measures. The following are the definition of these actions:

- **Remove:** Trees that are to be impacted by the proposed development to the extent whereby retention is not suitable and / or incompatible if the current plans are approved. All tree removal must comply with guidelines specified in section 4 of this report and subject to regulatory approval.
- **Retain:** Trees that are suitable for retention granted they follow the specific mitigation measures discussed in section 3 and / or the tree protection measures outlined in section 4 and / or the tree protection guidelines outlined in Appendix E.

### 3. Results and discussion

No trees will be subject to impact from the proposed SSDA works.

Results of the arboricultural assessment are summarised in Table 3. Detailed results are included in Appendices C and D. Tree protection guidelines are provided in Appendix E and site photos are provided in Appendix F.

A total of four medium retention value trees (Trees 5, 6, 7 and 8) are proposed to be retained as they are subject to no impact (0% TPZ encroachment) from the proposed building and road developments.

Refer to section 4 for the tree protection plan and section 5 for the hold points, inspection and certification.

## 4. Tree protection plan

- Permission must be granted from the relevant consent authority prior to removing or pruning of any of the subject trees. Approved tree works should not be carried out before the installation of tree protection measures.
- All tree pruning and removal is to be carried out by an arborist with a minimum AQF Level 3 qualification in Arboriculture.
- All tree work must be in accordance with Australian Standard *AS 4373-2007, Pruning of Amenity Trees* and the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).
- Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist and must comply with *AS 4970-2009 - Protection of trees on development sites*.

Tree protection measures are summarised in Table 3 and further information is in Appendix E.

**Table 3: Summary of tree protection measures**

Type	More details	Comment
Stockpiling	-	No-stockpiling of materials or contamination is to be within the TPZ or SRZ of subject trees to be retained.
Signage	Appendix E1	Prominently sign posted with 300 mm x 450 mm boards stating, "NO ACCESS - TREE PROTECTION ZONE".
Tree protection fencing	Appendix E1	Protective cyclone chain wire link fence to be erected around the TPZ to protect and isolate retained trees from the construction works. Existing boundary fencing may be used.
Crown protection	Appendix E2	Where required, crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches. Consider some minimal pruning of overhanging branches in accordance with AS4373-2007 prior to using piling rig to avoid tearing tree branches during piling.
Trunk and branch protection	Appendix E3	When fencing is not practical or prior to any activities within the TPZ, trunk protection is required and consist of a layer geotextile fabric or similar followed by 1.8 m lengths of softwood timbers spaced evenly around the trunk and secured with a galvanised hoop strap.
Ground protection	Appendix E4	Install and maintain 100mm thick layer of mulch around tree in TPZ. For machine or vehicle access within TPZ geotextile fabric beneath crushed rock or rumble boards may be required.
Soil moisture		Soil moisture levels should be regularly monitored by the project arborist. Temporary irrigation or watering may be required within TPZ.
Root protection and investigation	Appendix E5	If incursions/excavation within the TPZ are unavoidable, root investigation may be needed to determine the extent and location of roots within the area of construction activity using non-destructive excavation (NDE) methods.
Underground services	Appendix E6	All underground services should be routed outside of the TPZ

## 5. Hold points, inspection and certification

An AQF Level 5 Consulting Arborist needs to be engaged to supervise work within the TPZ, provide advice regarding tree protection and monitor compliance. Once each stage is reached, the work will be inspected and certified by the project arborist and the next stage may commence. Alterations to this schedule may be required due to necessity, however, this shall be through consultation with the project arborist only.

A copy of this report must be available on-site prior to the commencement of works, and throughout the entirety of the project. Hold points have been specified in the schedule of works below to ensure trees are adequately protected during construction. It is the responsibility of the principal contractor to complete each of the tasks.

### **Pre-construction**

Indicate clearly (with spray paint on trunks) trees marked for removal. Installation of tree trunk protection on trees in accordance with *AS 4970-2009 - Protection of trees on development sites* and minimal pruning to be undertaken in accordance with *the Australian Standard AS 4373-2007, Pruning of Amenity Trees*.

### **During construction**

Monthly inspection of trees by the project arborist (or other timing as agreed with the project arborist). Notification to be given prior to the commencement of work within the TPZ, with supervision by the project arborist of any work undertaken in this zone. Non-destructive excavation techniques such as air spading or hydro-vacuuming is recommended to be undertaken within the TPZ of trees to be retained in order to minimise root disturbance support tree retention. Avoid the cutting or removal of tree roots larger than 25 mm in diameter two maintain tree health and stability. Retain roots and install electrical cabling underneath tree roots.

### **Post-construction**

Final inspection of trees by project arborist after all major construction has ceased and following the removal of tree protection measures.

## 6. References

### 6.1 General references

- Barrell, J. 2001. 'SULE: Its use and status into the new millennium', in *Management of mature trees, Proceedings of the 4th NAAA Tree Management Seminar*, NAAA, Sydney.
- Brooker M.I.H, Kleinig D.A. 2006. *Field Guide to Eucalypts*. Volume 1, South-eastern Australia, 3rd ed Bloomings Books, Melbourne
- Draper, B. and Richards, P., 2009. *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.
- Harris, R.W., Matheny, N.P., and Clark, J.R., 1999. *Arboriculture: integrated management of landscape trees, shrubs, and vines*, Prentice Hall, Upper Saddle River, New Jersey.
- Mattheck, C. and Breloer, H. 1994. 'Field Guide for Visual Tree Assessment' *Arboricultural Journal*, Vol 18 pp 1-23.
- Mattheck, C. 2007. *Updated Field Guide for Visual Tree Assessment*. Karlsruhe: Forschungszentrum Karlsruhe.
- IACA 2010. *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturalists, Australia, [www.iaca.org.au](http://www.iaca.org.au).
- Robinson L, 2003. *Field Guide to the Native Plants of Sydney*, 3rd ed, Kangaroo Press, East Roseville NSW
- Standards Australia 2003. *Composition, Soil and Mulches, AS 4454 (2003)*, Standards Australia, Sydney.
- Standards Australia 2007. *Australian Standard: Pruning of amenity trees, AS 4373 (2007)*, Standards Australia, Sydney.
- Standards Australia 2009. *Australian Standard: Protection of trees on development sites, AS 4970 (2009)*. Standards Australia, Sydney.

### 6.2 Project specific references

- Randwick City Council 2013. *B5 Preservation of Trees and Vegetation, Randwick Comprehensive Development Control Plan 2013*. Pg 3

## Appendix A Tree retention assessment method

### A1 Tree Significance Assessment Criteria - STARS©

The tree is to have a minimum of three criteria in a category to be classified in that group.

Low	Medium	High
<p>The tree is in fair-poor condition and good or low vigour.</p> <p>The tree has form atypical of the species</p> <p>The tree is not visible or is partly visible from the surrounding properties or obstructed by other vegetation or buildings</p> <p>The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area</p> <p>The tree is a young specimen which may or may not have reached dimensions to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen</p> <p>The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions</p> <p>The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms</p> <p>The tree has a wound or defect that has the potential to become structurally unsound.</p> <p><b>Environmental Pest / Noxious Weed</b></p> <p>The tree is an environmental pest species due to its invasiveness or poisonous/allergenic properties. The tree is a declared noxious weed by legislation.</p> <p><b>Hazardous /Irreversible Decline</b></p> <p>The tree is structurally unsound and / or unstable and is considered potentially dangerous.</p> <p>The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.</p>	<p>The tree is in fair to good condition and good or low vigour</p> <p>The tree has form typical or atypical of the species</p> <p>The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area</p> <p>The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street</p> <p>The tree provides a fair contribution to the visual character and amenity of the local area</p> <p>The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ</p>	<p>The tree is in good condition and good vigour</p> <p>The tree has a form typical for the species</p> <p>The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age.</p> <p>The tree is listed as a heritage item, threatened species or part of an endangered ecological community or listed on Council's significant tree register</p> <p>The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity.</p> <p>The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values.</p> <p>The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ – tree is appropriate to the site conditions.</p>

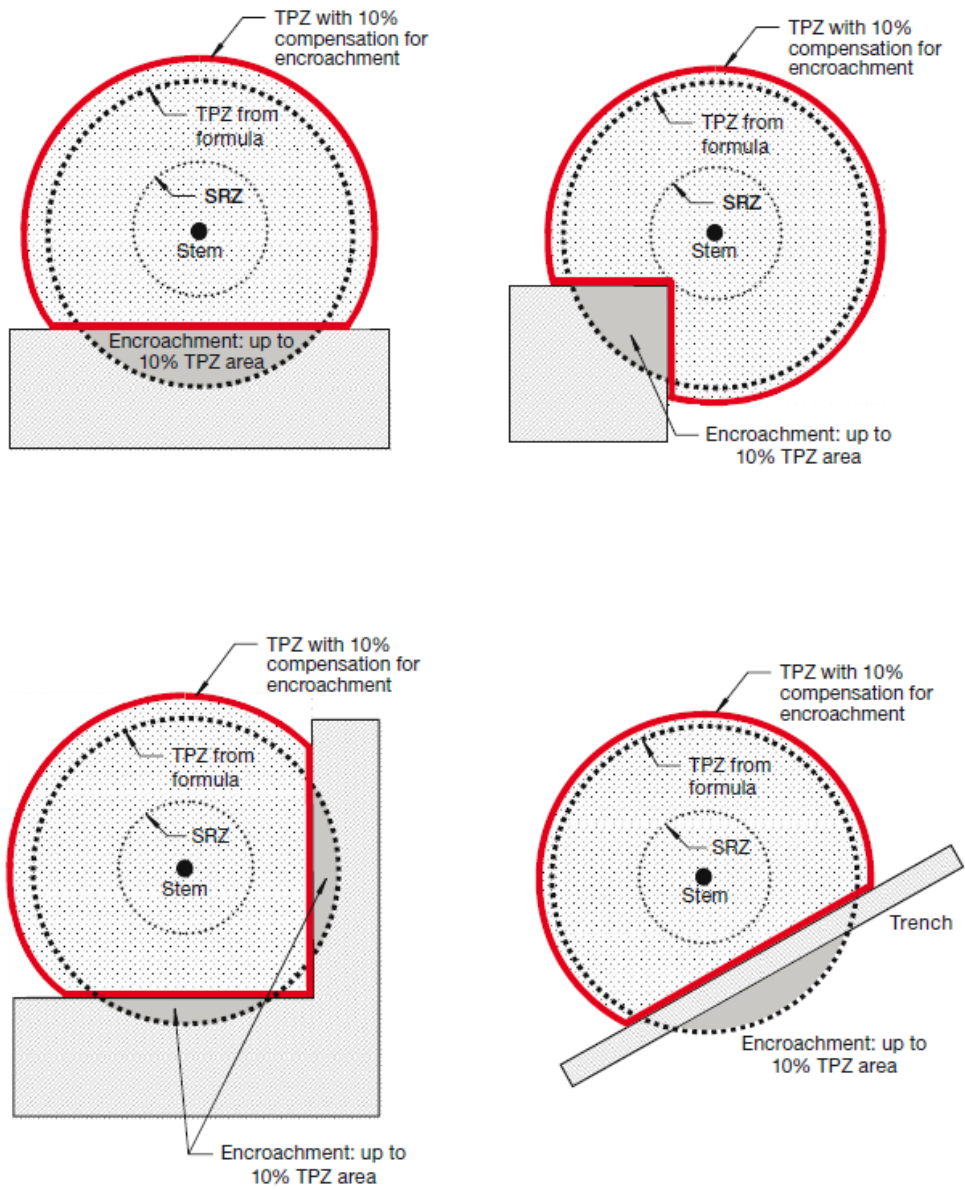


## A2 Matrix assessment - STARS©

		Tree significance				
		High	Medium	Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest/Noxious Weed Species	Hazardous/ Irreversible Decline
Useful Life Expectancy	Long >40 years					
	Medium 15-40 years					
	Short <1-15 years					
	Dead					

	<b>Priority for retention (High):</b> Tree considered important so should be retained and protected. Design modification or re-location of structure should be considered to accommodate the setbacks as prescribed by the <i>Australian Standard AS4970 Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented if works are to proceed within the Tree Protection Zone.
	<b>Consider for retention (Medium):</b> Tree considered less important; however, retention should remain priority. Removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	<b>Consider for removal (Low):</b> Tree not considered important for retention, nor requiring special works or design modification to be implemented for their retention.
	<b>Priority for removal:</b> These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

## Appendix B Encroachment into tree protection zones - AS 4970-2009





## Appendix C Maps

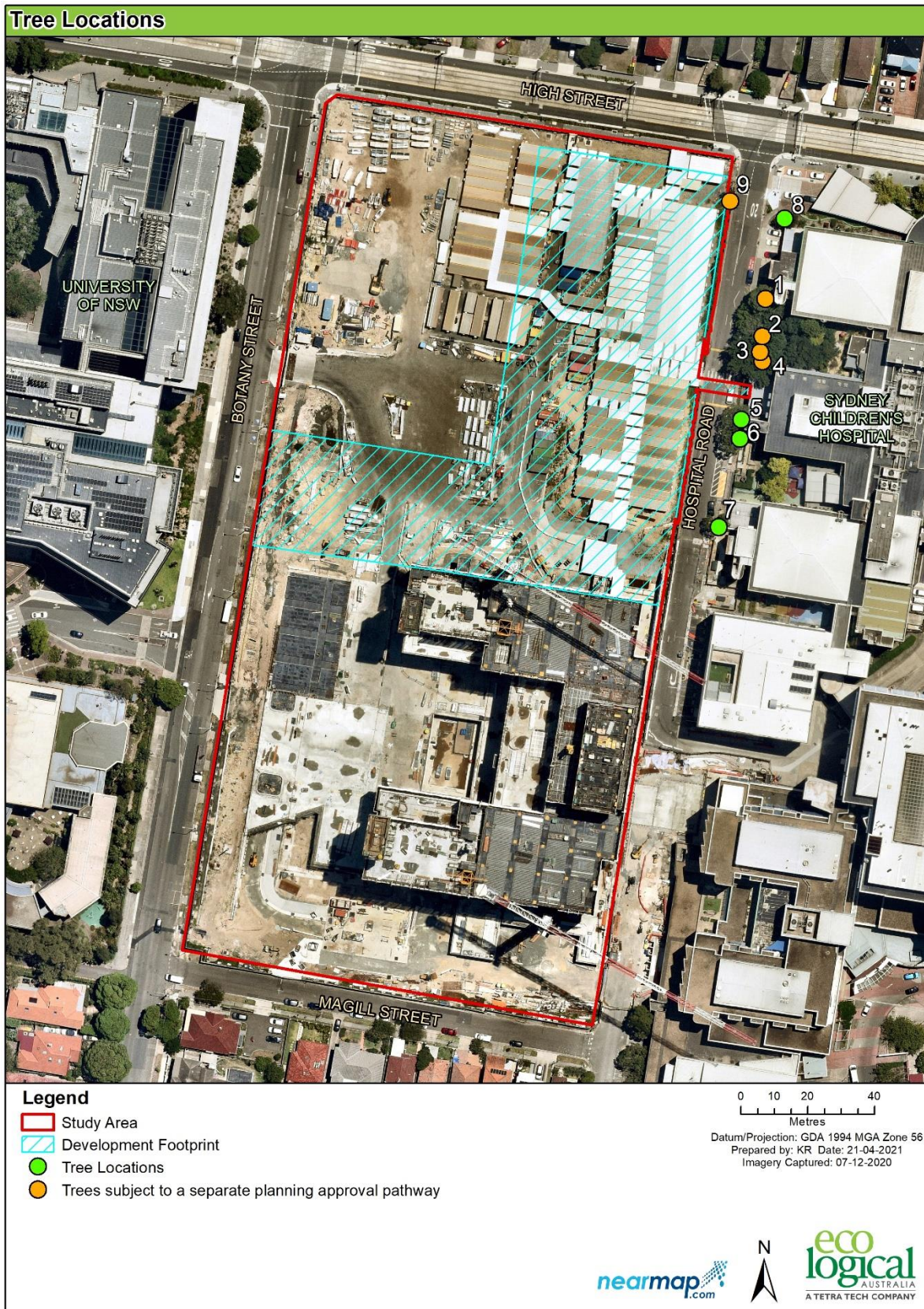


Figure 3: Tree locations



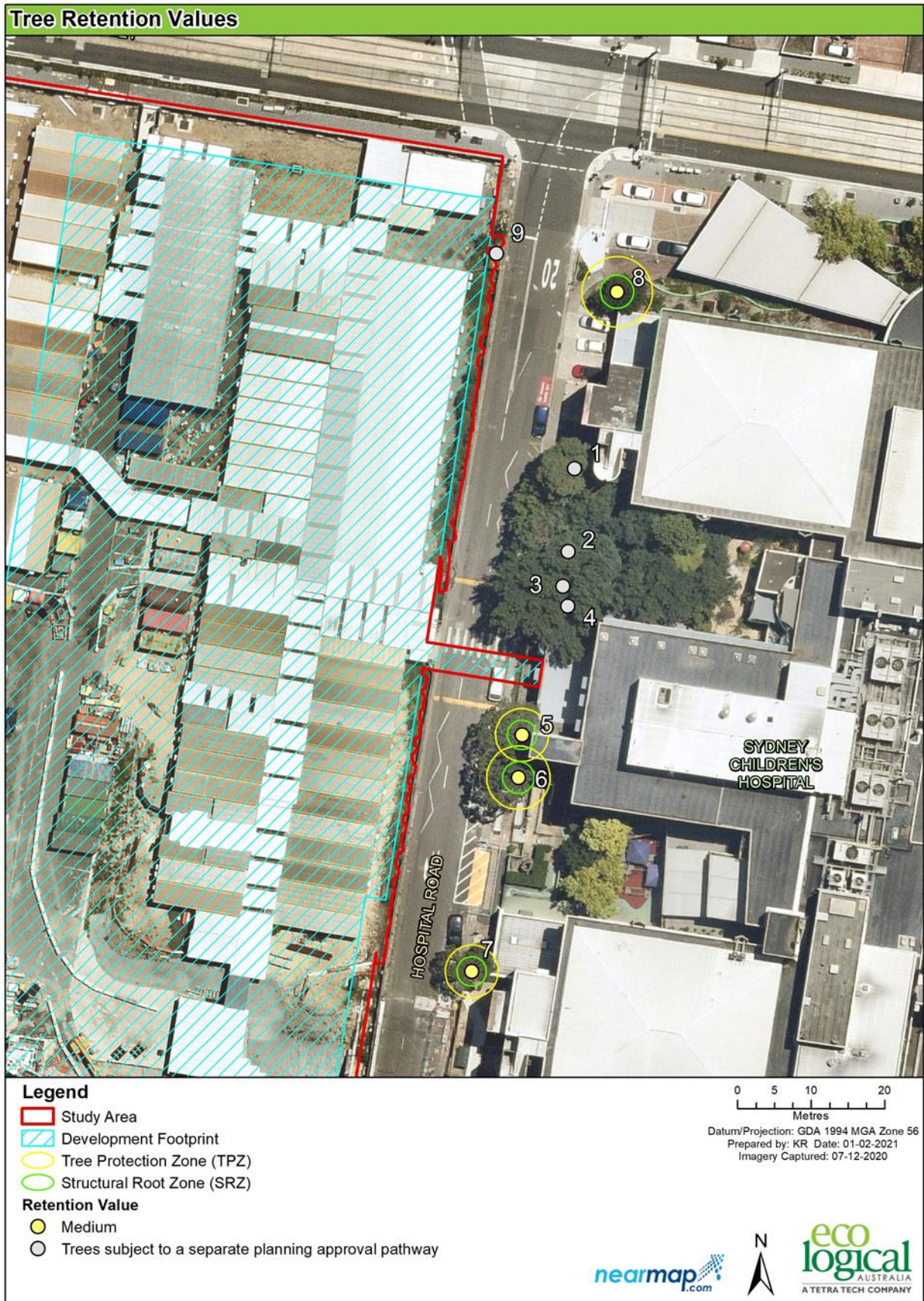


Figure 4: Retention value subject trees



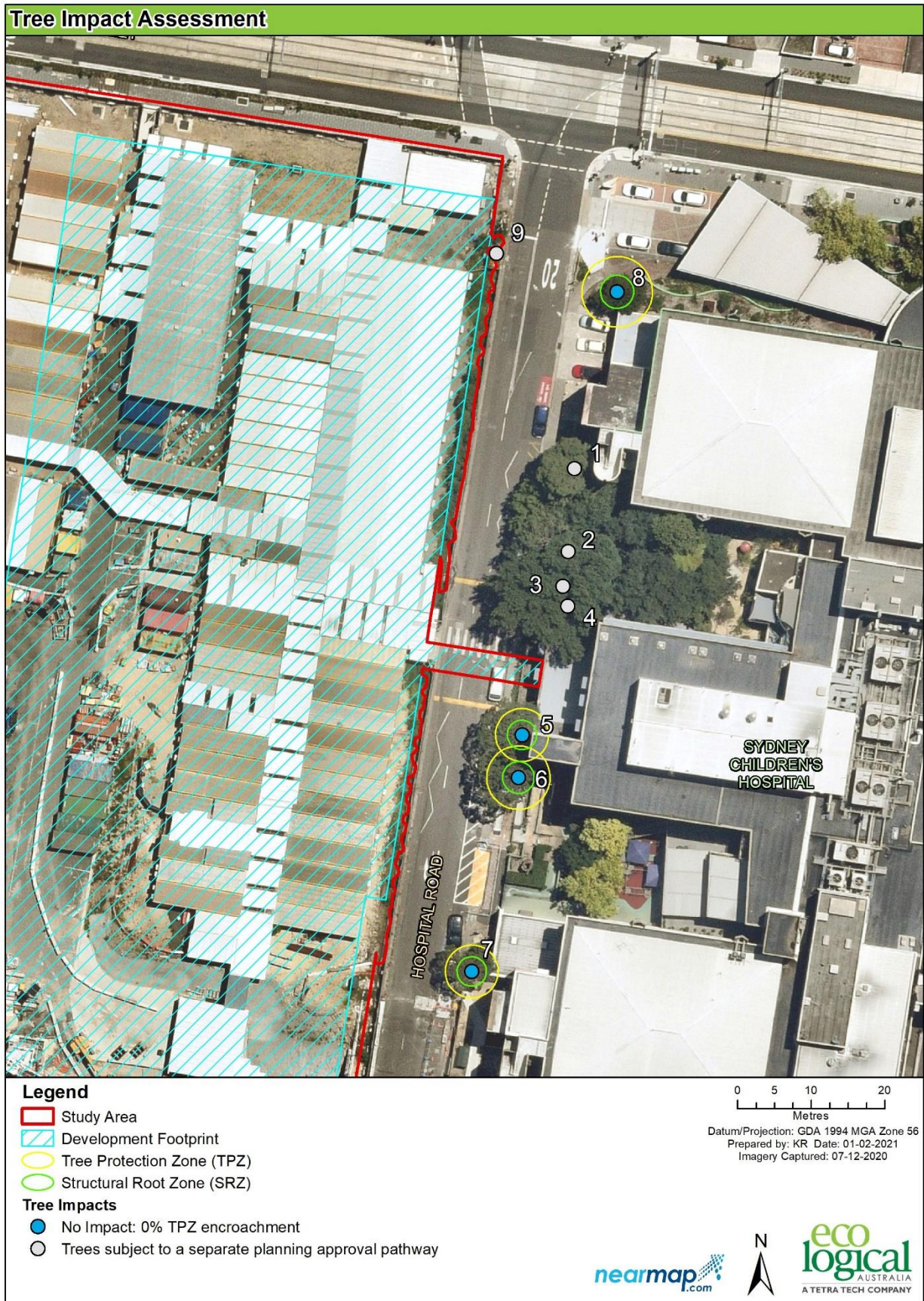


Figure 5: Arboricultural impact assessment

Appendix D Tabulated results of arboricultural assessment

Tree	Botanical name	Height (m)	Spread (m)	Health	Structure	ULE	Landscape Significance	DBH (mm)	TPZ (m)	SRZ (m)	Retention value	Impact	Proposed action	Notes
5	<i>Angophora costata</i>	13	7	Fair	Fair	Medium (15-40 years)	Medium	300	3.6	2.0	Medium	No Impact	Retain	Stockpiling occurring within TPZ, tree located in second garden bed
6	<i>Angophora costata</i>	13	6	Fair	Fair	Medium (15-40 years)	Medium	360	4.3	2.2	Medium	No Impact	Retain	Canker on trunk, tree located in second garden bed
7	<i>Angophora costata</i>	10	6	Fair	Good	Medium (15-40 years)	Medium	300	3.6	2.0	Medium	No Impact	Retain	Pruned, recent excavation near tree, tree located in third garden bed
8	<i>Syzygium australe</i>	6	4	Fair	Fair	Medium (15-40 years)	Medium	400	4.8	2.3	Medium	No Impact	Retain	Multi stemmed, one sided prune, located at the drive exit near entrance to SCH

## Appendix E Tree protection guidelines

The following tree protection guidelines must be implemented during the construction period if no tree-specific recommendations are detailed.

### E1 Tree protection fencing

The TPZ is a restricted area delineated by protective fencing or the use of an existing structure (such as a wall or fence).

Trees that are to be retained must have protective fencing erected around the TPZ (or as specified in the body of the report) to protect and isolate it from the construction works. Fencing must comply with the Australian Standard, AS 4687-2007, Temporary fencing and hoardings.

Tree protection fencing must be installed prior to site establishment and remain intact until completion of works. Once erected, protective fencing must not be removed or altered without the approval of the project arborist.

If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with AS 4970-2009, *Protection of Trees on Development Sites*.

Tree protection fencing shall be:

- Enclosed to the full extent of the TPZ (or as specified in the Recommendations and Tree Protection Plan).
- Cyclone chain wire link fence or similar, with lockable access gates.
- Certified and Inspected by the Project Arborist.
- Installed prior to any machinery or material are brought to site and before the commencement of works.
- Prominently sign posted with 300 mm x 450 mm boards stating, "NO ACCESS - TREE PROTECTION ZONE".

### E2 Crown protection

Tree crowns/canopy may be injured or damaged by machinery such as; excavators, drilling rigs, trucks, cranes, plant and vehicles. Where crown protection is required, it will usually be located at least one meter outside the perimeter of the crown.

Crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches.

### E3 Trunk protection

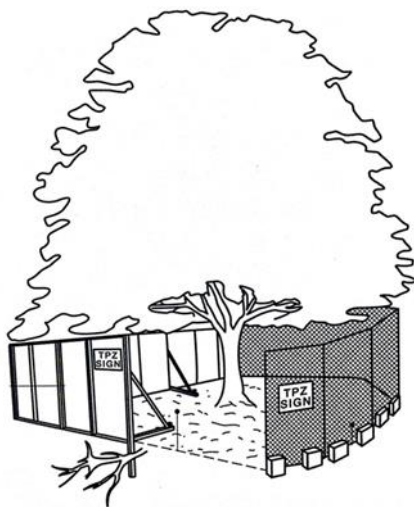
Where provision of tree protection fencing is impractical or must be temporarily removed, trunk protection shall be installed for the nominated trees to avoid accidental mechanical damage.



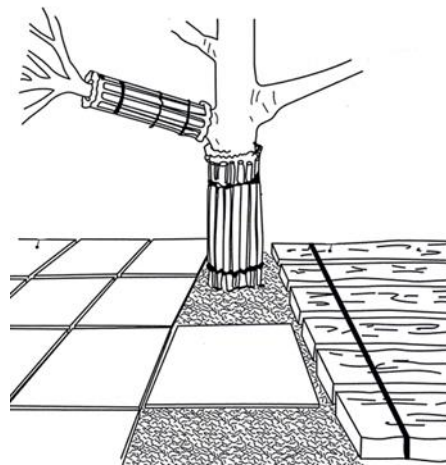
The removal of bark or branches allows the potential ingress of micro-organisms which may cause decay. Furthermore, the removal of bark restricts the trees' ability to distribute water, mineral ions (solutes), and glucose.

Trunk protection shall consist of a layer of either carpet underfelt, geotextile fabric or similar wrapped around the trunk, followed by 1.8 m lengths of softwood timbers aligned vertically and spaced evenly around the trunk (with an approx. 50 mm gap between the timbers).

The timbers must be secured using galvanised hoop strap (aluminium strapping). The timbers shall be wrapped around the trunk but not fixed to the tree, as this will cause injury/damage to the tree.



Tree protection fencing



Trunk protection fencing

## E4 Ground protection

Tree roots are essential for the uptake/absorption of water, oxygen and mineral ions (solutes). It is essential to prevent the disturbance of the soil beneath the dripline and within the TPZ of trees that are to be retained. Soil compaction within the TPZ will adversely affect the ability of roots to function correctly.

If temporary access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Maintain a thick layer of mulch around all retained trees to a depth of 100 mm using coarse pine bark or wood chip material that complies with AS 4454. Where the existing landscape within the TPZ is to remain unaltered (e.g. garden beds or turf) mulch may not be required.

For heavy vehicle access within TPZ, ground protection may include a permeable membrane such as geotextile fabric beneath a layer of crushed rock or rumble boards.

If the grade is to be raised within the TPZ, the material should be coarser or more porous than the underlying material.



## E5 Root protection and investigation

If incursions/excavation within the TPZ are unavoidable, root investigation may be needed to determine the extent and location of roots within the area of construction activity. The location and distribution of roots are found through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation. Root investigation does not guarantee the retention of the tree.

If the project arborist identifies conflicting roots that requiring pruning, they must be pruned with a sharp implement such as; secateurs, pruners, handsaws or a chainsaw back to undamaged tissue. The final cut must be a clean cut.

## E6 Underground services

All underground services should be routed outside of the TPZ. If underground services need to be installed within the TPZ, they should be installed using horizontal directional drilling (HDD), non-destructive excavation (NDE) methods such as hydro-vacuum, Air Spade or manually excavated trenches. The horizontal drilling/boring must be at minimum depth of 600 mm below grade. Trenching for services is to be regarded as "excavation". The project arborist should assess the likely impacts of boring and bore pits on retained trees.

## Appendix F Site photos



Figure 6: Trees 1 to 8 on the east side of Hospital Road and Tree 9 on west side of Hospital Road



Figure 7: Construction work occurring in proximity to trees recommended for trunk protection within the garden bed





Figure 8: Tree 5



Figure 9: Tree 6





Figure 10: Tree 7



Figure 11: Tree 8

