TREETALK
ARBORICULTURAL CONSULTING

ABN 36 323 568 677

Arboricultural Impact Assessment

One Sydney Harbour
Barangaroo South
1B Basement SSD6960
Development Application
Finalisation

Project No 5029/D/T2016

June 2016

Prepared for

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By Consulting Arborist

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Appendices

Arboricultural Impact Assessment:

One Sydney Harbour - Barangaroo South: Stage 1B Basement SSD6960

1.0 Summary

Several trees at One Sydney Harbour - Barangaroo South - Hickson Road, have been assessed and are discussed for their suitable retention or removal within works proposed.

Thirteen have been assessed (four in an earlier TreeTalk report) relative to the scope of the Stage 1B Basement at Barangaroo South. Eight trees are within the area of works and cannot be retained. Five trees are proposed for retention and protection.

Protection measures and set backs are provided for trees being retained.

2.0 Background and Works Proposed

TreeTalk Arboricultural Consulting has been engaged by Lend Lease Construction & Infrastructure, to provide an assessment of street trees along Hickson Road, trees impacted or likely to be impacted upon by current works proposed. This report is prepared in relation to the proposed Stage 1B Basement and associated landscape works at Barangaroo South.

An earlier TreeTalk report provided for *Barangaroo South Stage 1A Hickson Road/Sussex Street Road Works* August to December 2014 (TreeTalk Ref. 4870 – Trees 6, 7, 8 9 and 9a), considered trees further south of the current works processes. Some of these trees will be referred to within this report due to overlapping works processes and works timing.

Works Proposed

Currently three applications that will impact on trees on Hickson Road:

- Hickson Road Raising Review of Environmental Factors (REF) (adjacent to the Stage 1A Basement)
- Block 4 Remediation DA (excavation of the whole for the Stage 1B Basement)
- Interim public road connections
- Hickson Road Remediation DA

Stage 1B including basement supports three proposed new residential towers, referred to as the buildings R4A, R4B and R5.

The application also includes interim public road connections, Hickson Road north and south of the proposed Stage 1B Basement from Barangaroo site, which will impact on trees.

The aims of this report are:

- To satisfy the requirements of the consent authority by providing information about the trees, their overall health and suitability for retention. Also to provide information on appropriate best practice tree protection measures for trees able to be retained.

- To advise of stages where arboricultural advice may be required.

- To provide information to the site manager on work methods required near trees so as to retain them in good order and minimise any impact upon them also to provide information about the importance of tree management and protection measures to avoid a later hazard due to site works.

3.0 Method

Consulting arborist Sue Wylie visited the site on May 8th and May 20th 2015 to assess the trees and the likely impact by the works proposed.

The trees were assessed from the ground by the Visual Tree Assessment (VTA) method as described in Mattheck & Breloer (1994)[1], using non-invasive tools such as binoculars and acoustic mallet and, neither internal probing of trees nor aerial inspection by climbing was performed.

The VTA considered overall health and vitality, including percentage of canopy, epicormic growth, deadwood and predation by pests and diseases. Structural condition was assessed including faults such as *Bark Inclusions*[2] or poor branch attachments, mechanical or biological damage.

Health and condition was rated as *Good, Fair* or *Poor,* based on overall tree *vigour* and *structure* (see Glossary) at the time of inspection Where evidence was found that is outside normal tree development, this is noted (see Tree Schedule Appendix F).

Tree height was estimated and where relevant the orientation of the canopy is given. The trunk diameter was measured or estimated at breast height 1.4 metres (DBH) or above root buttress (arb.).

The Tree Protection Zone (TPZ)[3] and Structural Root Zone (SRZ)[4] has been arrived at using widely recognised methods as detailed in *Australian Standard AS 4970– 2009* (see Appendix B2).

Tree numbers have been added to plans provided (see Appendix A1).

Additional plans used to consider the works in relation to the trees (not appended):

- Plan by: Lend Lease: One Sydney Harbour. Barangaroo. Stage 1B Basement SSD6960. Demolition, Excavation & Services Zone Plan. Drawing BB2_PA2_A003. Revision 0A. Development Application. Dated 10 August 2015
- Plans by Lend Lease (Millers Point) Pty Limited. Plans: One Sydney Harbour. Barangaroo South. Bulk Excavation and Basement Car Parking Development Application. Drawing B1B_PA1_A003. Revision 05. Dated 2 April 2015.

1. Mattheck, Claus; Breloer, Helge (1994) *The Body Language of Trees: A Handbook for Failure Analysis - Research for Amenity trees No 4*, Pub. Forestry Commission, London.
2. Included Bark: Patterns of development at branch junctions where bark is turned inwards rather than pushed out. – A potentially weak attachment.
3. Tree Protection Zone: TPZ = an area around tree with radius of 12 x DBH.
4. Structural Root Zone: SRZ = $64(D \times 50)^{0.42}$. As per Australian Standard AS 4970 – 2009, *Protection of trees on development sites*.

4.0 The Site and Tree Location

The site is part of and adjacent to the Barangaroo South development. The area covered by this report is the section of Hickson Road adjacent to 36 and 38 The Bond. See Plan in Appendix A1 for tree location.

Trees to the south of this have been considered in an earlier TreeTalk report addressing Hickson Road Raising REF works. The trees were numbered 9, 9a, 8, 7, 6 and 5.

New trees assessed are numbered from 100. Trees 100 and 101 are on the eastern side of Hickson Road (101 above footpath). Trees 102 – 107 are street trees on the western side of Hickson Road.

All street trees are *Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig), and one tree above roadway is a *Ficus rubiginosa* (Port Jackson Fig).

5.0 Findings

Most trees are Council managed street trees Ficus microcarpa var. ‘*Hillii*’ (Hills Weeping Fig). They are well established and in *Good* to *Fair* health and condition. Trunk diameters range in size from 40cm to 95cm and height are from 6 to 14 metres in height with several share canopy space.

See Appendix F for Data and details of findings and Appendix E for ideal Tree Protection Zones as per AS4979.

6.0 Removal or Retention

Factors likely to impact upon the trees are works associated with:

- Interim road and public domain works associated with the stage 1B basement DA will necessitate the removal of 8, 9 and 9a. (If not removed under the Hickson Road REF or the Hickson Road Remediation DA).
- Remediation of the soil adjacent to the Trees 100, (101), 102, 103 and 104.
- New roadways near the trees for the future road connections Trees 105, 106 and 107.

Trees 6, 7, 8, 9 and 9a are likely to be impacted upon by both the Hickson Road raising works and the basement works.

6.2 Trees suitable for retention

Trees 100, 102, 103 and 104 are in *Good to Fair* health and structural condition and can be considered for retention. They are immediately adjacent to the road kerbing and some roots are evident within the guttering and lifting paving nearby.

These street trees are subjected to normal stresses by pedestrians and traffic. Works proposed will pose an additional stress on the trees as changes are proposed within both their Tree Protection Zones and their Structural Root Zones.

Trees 102, 103 and 104 are in contaminated soil that must be remediated. This will be the subject of a separate application.

The method of remediation undertaken, will determine possible retention of these trees. If in situ treatment is successful, the trees should be reassessed for any adverse affects of remediation works and if the trees remain in good health, post remediation, it may be possible to retain them.

If ex-situ remediation is required, the tree roots will be damaged and the trees cannot be retained.

Tree 101 is above the roadway and footpath and roots a appear to be contained within a planter or within the upper section of the patio/forecourt. Further investigation could be undertaken to confirm that is the case, if works are necessary within 5 metres - the Tree Protection Zone (TPZ) of this tree.

7.0 Discussion

Removal of road and footpath surfaces must be performed with care within the TPZ of trees being retained, to avoid damage to large roots and minimise drying-out of smaller roots.

Any newly exposed surfaces must be covered to prevent soil drying out if replacement of surfaces is delayed.

Replacement of surfaces or kerbing, must be installed above existing roots and may require some small mounding of surfaces to accommodate roots within SRZ and root crown.

Details of area around tree and installation methods should be discussed further when works are proposing to be performed.

Table 1: Stages when damage to trees is possible

Stages	Possible Damage	Management Required
Preparation for works	Inadvertent damage by machinery.	Trees should be considered and isolated to the greatest extent from any equipment or works processes.
Works near tree canopy	Branch tearing	Where works could impact on tree foliage or branches these must be wrapped (see Appendix C2) or be assessed for preliminary pruning (see Appendix D).
Removal of road surfaces	Damage to roots below surfaces.	Perform with care and consideration of roots below. Do not excavate below existing soil level. Do not damage roots
Removal of footpath	Damage to roots below surfaces.	Perform works with care and consideration of roots below. Do not excavate below existing soil level.
Modifications to Kerbs	Destabilise tree	Where roots are supported by kerbing this should remain in place.
Period between surface removals and replacement.	Drying out of soil.	If delays between removal and resurfacing occur, cover area with hessian/geotextile fabric and keep moist,
Installation of drainage or other services	Damage to roots below surfaces.	Further consideration and assessment of design and installation methods is required.
Installation of edging around trunk	Damage to root crown and structural roots.	Further consideration and assessment of design and installation methods is required.

Where roots are exposed and likely to be damaged further advice must be sought from your project arborist.

Removal of road and footpath surfaces must be performed with care within the TPZ of trees being retained, to avoid damage to both large roots and minimise drying-out of smaller roots. Any newly exposed surfaces must be covered to prevent soil drying out if replacement of surfaces is delayed.

Replacement of surfaces or kerbing, must be installed above existing roots and may require some small mounding of surfaces to accommodate roots within SRZ and root crown.

Details of area around tree and installation methods should be discussed further when works are proposed to be performed.

8.0 Protection of Retained Trees

Trees suitable for retention have trunk diameters from 40 to 70 centimetres and Structural Root Zones (SRZ) of 2.3metres to 2.9 metres and Tree Protection Zones (TPZ) of 4.8 metres to 8.4 metres

Table 2: Tree Protection Calculations as per AS 4970 - 2009

Tree No.	Species	DBH arb. cm	SRZ Radius	Tree Protection Area	TPZ Radius
100	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	40cm	2.3m	72m^2	4.8m
101	*Ficus rubiginosa* (Port Jackson Fig)	50cm	2.5m	113m^2	6.0m
102	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	70cm	2.9m	222m^2	8.4m
103	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	55cm	2.6m	137m^2	6.6m
104	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	60cm	2.7m	163m^2	7.2m

Each tree being retained must be protected, both above and below ground, so they can make a contribution to future landscaping and amenity. Lack of necessary protection will risk the trees becoming a hazard.

The most important protection is for all roots within the SRZ and most of the area within the Tree Protection Zone (TPZ) to the area given in Table 1. Tree protection measures should be undertaken as per Appendix C2. The trunk should be wrapped to with breathable material and boards attached to prevent mechanical damage. Where any impact on foliage or branches is likely, this must be specifically considered for protection wrapping or pruning before damage occurs.

8.1 Removal of Existing Surfaces

The removal of bitumen must be performed with care so as to prevent damage to roots below. Once existing surfaces are removed, an assessment of where roots are located will be useful in appropriate management methods.

Note: **Roots must not be cut or shaved.** New paving levels may require modification (raising to accommodate the tree roots any fill must be limited).

As deep fill over roots is not ideal for the health and longevity of the trees, it would be best if modifications to the works can be considered. Fill by as little as 5cm deep can limit tree root access to air and roots are likely to die (a 10% loss of soil access to air and water is unacceptable according to AS4970). An alternative may be to bridge over roots or install 'structural' or gap-graded soils.

9.0 Tree Protection at Work Phases

To ensure that adequate tree protection is in place, it is important that protection measures are the first works on site. (Site preparation is often the time that most tree damage occurs).

- Fencing should be installed to the extent of works proposed (See Appendices A3, C1 and C2 for diagrammatic representation).
- Protect soil with geotextile fabric, mulch and rumble boards where fencing is not possible.
- Consider branches that may interfere with works process and manage or prune (see Appendix D). Consult your Project Arborist if this involves branches greater than 5cm in diameter at branch collar.
- Consider where materials are to be stored and keep this outside tree protection zones.
- DO NOT CHANGE SOIL LEVELS within TPZ without arboricultural advice. (Tree roots are usually located in the top 30cm of soil. Reductions in soil level can remove most of a tree's roots.
- Increases in soil can reduce available air to roots and cause them to die).

Table 3:Tree Protection at Stages of Works

Works Phase	Protection Required	Solution
Site Preparation	Protect Tree canopy, Tree roots and soil surface (from compaction).	Fence and isolate all trees being retained.
Removal of road surface	Tree Protection Zone to remain undisturbed	Works should be performed with care to reduce or damage to roots.
Site Works	Roots' - Soil moisture	Maintain soil surface protection, retain fencing along line of proposed works. In periods of extended dry trees watered.
Services drainage	All roots	No excavation below existing grade within TPZ without specific arboricultural advice being provided.

10.0 Conclusion

10.1 Trees proposed for retention

Trees 100, 101, 102, 103 and 104 may be retained at this time and if so the appropriate protection measures should be implemented. All works within the TPZ of trees being retained must be above existing grades and any roots located must be considered.

Removal of existing surfaces must be performed with care so as avoid damage to any roots >3cm. Once surfaces are removed, your project arborist should be contacted to assess what roots are present and to consider their management.

Other factors likely to impact on the trees are: any modifications to road surfaces, roadside kerbing, drainage or services changes, removal and resurfacing of adjacent footpaths.

Tree protection measures for trees being retained will include isolating them to the extent of works with temporary fencing before any other works begin and maintaining most of the soil area as existing.

Reassessment of tree viability should be undertaken once in-situ soil remediation is performed.

10.2 Trees proposed for removal and within area of works

Trees 5, 6, 7, 8 and 9a will be removed under a separate planning approval for which a separate TreeTalk report was prepared. Should the trees remain at the time of the subject works are to be carried out then these trees would need to be removed under this development application.

The basement excavation and new roadways will impact on trees 105, 106 and 107. It is not possible to retain these trees as they will require removal to perform the works.

11.0 Recommendations

Trees being retained must be protected to the extent of works proposed, as discussed in Sections 6, 7, 8, 9 and Tables 1, 2 and 3 of this report. There must not be any level changes with TPZ by an area greater than 10% unless specific arboricultural consideration is given to the works proposed.

All works within the SRZ distance must be above existing grade and where any variations of this occur your project arborist must be consulted and on site.

Please contact me directly, if any sections of this report require clarification.

Sue Wylie
Principal Arboriculturist
TreeTalk Arboricultural Consulting
Diploma of Horticulture (Arboriculture)
Australian Qualification Framework (AQF5)

"*The Voices of Arboriculture*"

Age of Tree:

Young: Less than 1/3 life expectancy
Semi-mature: 1/3 to 2/3 life expectancy
Mature: Older than 2/3 life expectancy
Over-Mature /Senescent: Older than 2/3 life expectancy and showing signs of irreversible decline

Condition of tree:

Good: Tree is generally healthy and free from and obvious signs of structural weakness or significant adverse effects of pests and diseases or infection.

Fair: Tree is generally vigorous although has some indication of being adversely affected by the early effects of disease or infection or environmental or mechanical damage. Appropriate tree maintenance can usually improve trees overall health and halt decline.

Poor: Tree in decline and is not likely to improve with reasonable maintenance practices or has a structural fault such as bark *inclusion*.

Dead: Tree no longer capable of sustained growth

Diameter at breast height (DBH): The nominal trunk diameter at 1.4 m above ground level
D = Ø arb = Trunk diameter, measured above the root buttress

Project Arborist: The person responsible for carrying out the tree assessment, report preparation, consultation with designers, specifying tree protection measures, monitoring and certification. The project arborist will be suitably experienced and competent in arboriculture, having acquired through training, qualification (minimum Australian Qualification Framework (AQF) Level 5, Diploma of Horticulture (Arboriculture)) and/or equivalent experience, the knowledge and skills enabling that person to perform the tasks required by this Standard.

Structural Root Zone (SRZ): The area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres.
This zone considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which will usually be a much larger area.

Tree: Long-lived woody perennial plant greater than (or usually greater than) 3 m in height with one or relatively few main stems or trunks (or as defined by the determining authority).

Tree Protection Zone (TPZ): A specified area above and below ground and at a given 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 development.

Vigour: Ability of a tree to sustain its life processes. The term 'vigour' in this document is synonymous with commonly used terms such as 'health' and 'vitality'.

Work: Any physical activity in relation to land that is specified by the determining authority.

[1] Australian Standard 4970-2009: *Protection of trees on development sites* Licensed to Ms Sue Wylie

Harris R.W., Clark, J.R., Matheny N., (2004) *Arboriculture – Integrated Management of Landscape Trees, Shrubs and Vines*. Pub. Prentice Hall, New Jersey USA

Lonsdale, D. (1999) *Principles of Tree Hazard Assessment and Management*, Pub. Forests Commission, The Stationery Office, London.

Mattheck, Dr. Claus, Breloer Helge Mattheck, C., and Breloer, H., (2003) *The Body Language of Trees – A handbook for failure analysis*. Research for Amenity Trees No 4. Pub. The Stationary Office London.

Shigo, Alex L. (1991) *Modern Arboriculture - Touch Trees*, Pub. Shigo and Tree Associates, Snohomish, WA, USA.

Standards Australia (2007) Australian Standard AS4373-2007 *Pruning of Amenity Trees,* Pub. Standards Australia, Sydney.

Standards Australia (2009) Australian Standard AS4970-2009 *Protection of Trees on Development Sites*, Pub. Standards Australia, Sydney. Licensed to Ms Sue Wylie

Colony, B., Martin, T., O'Brien, P., 1998. *How to Protect Tree Roots While Replacing Sidewalks and Curbs*; 5 Technology Bulletin, Forestry Report R8-FR 63. USDA Technology Bulletin 5. (1998) Urban and Community Forestry Assistance Program.

Trees are dynamic living structures, growing and adapting to conditions around them. A trees condition will change and vary over time depending on weather, environmental factors and mechanical or human interaction.
Assessment is limited to the conditions at the time of the inspection and only trees discussed in the report have been assessed. Plans used to assess likely impact are those appended (Appendix A).

Ongoing monitoring of all nearby trees is advised and where significant changes are observed, further advice should be requested. Unusual developments or sudden changes in a tree's condition should be addressed immediately.

There should be **NO changes within the Structural Root Zone** (SRZ) of a tree without specific arboricultural advice and supervision being provided by your experienced AQF Level 5 arborist. This particularly applies to underground services such as plumbing, and can also apply to landscaping works such as paving below existing grade and fill greater than 10cm above grade.

Photographs and tree number diagrams are inserted as a guide to matters discussed however these could be misleading and may exaggerate or minimise the elements under discussion. The text should be the main guide to the importance of images and diagrammatic representation on plans.

Where the DA requires certification at stages of works (usually to certify the adequate tree protection measures are in place prior to works proceeding and at various other critical stages) it is incumbent on the project manager to advise TreeTalk of the need for site visits so that timely appointments can be undertaken.

TreeTalk cannot certify any works AFTER the event.

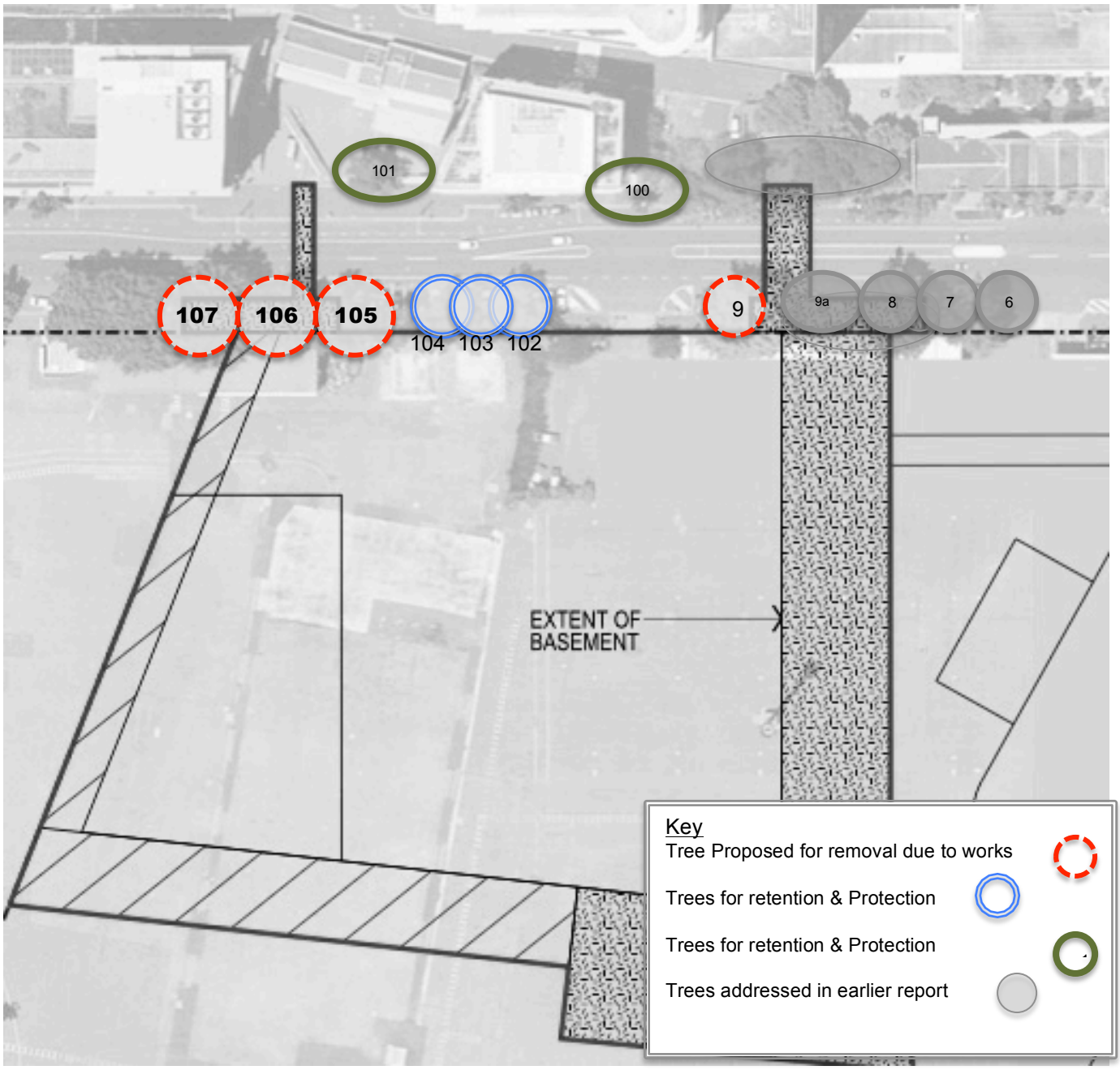
This report is primarily about tree protection measures as they relate to the works proposed (as given in the attached plans) and does not necessarily address tree maintenance or tree management works required.

The report is to be considered in its entirety and where unclear clarification should be sought.

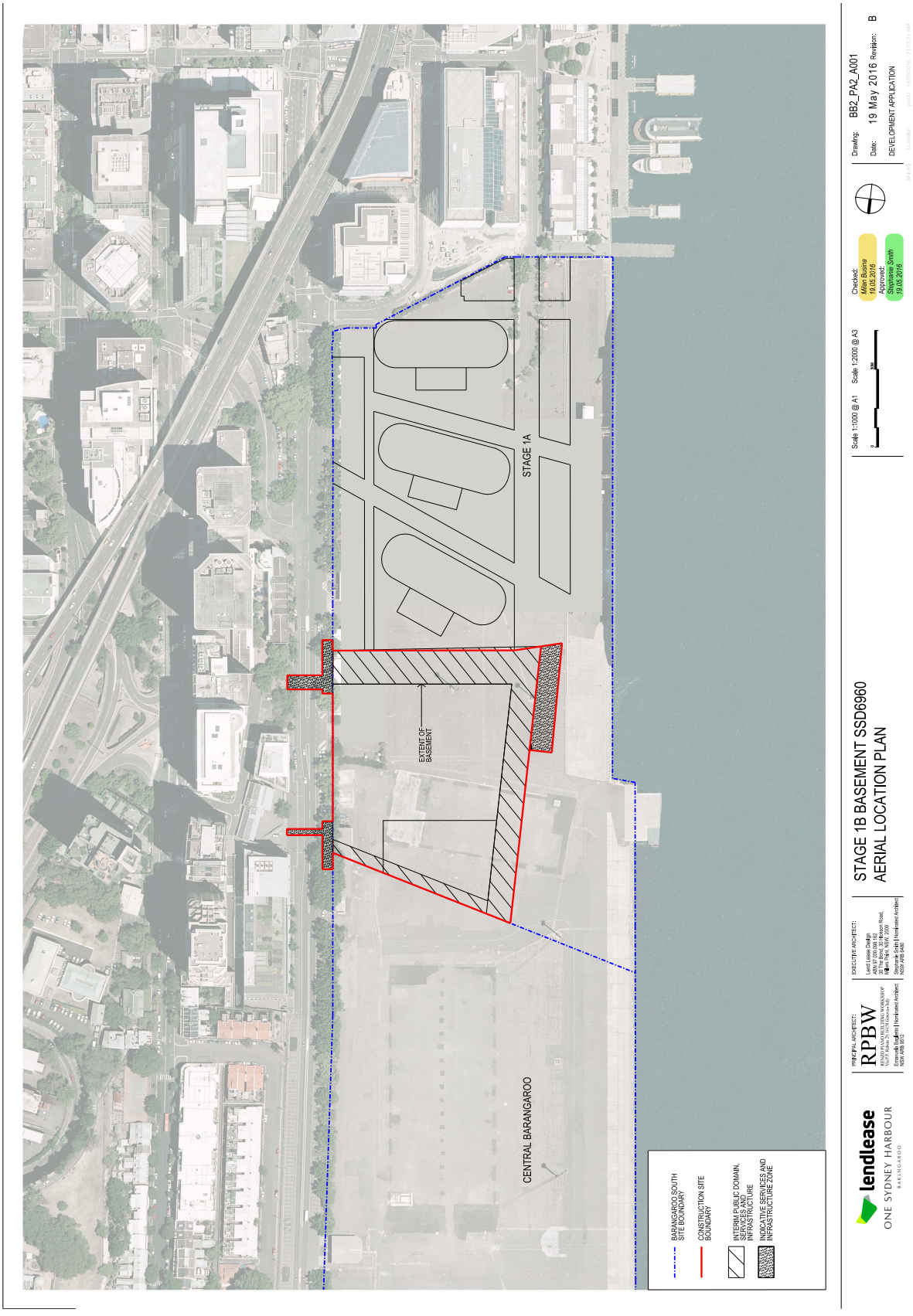
Appendix A1

Tree Location Plan

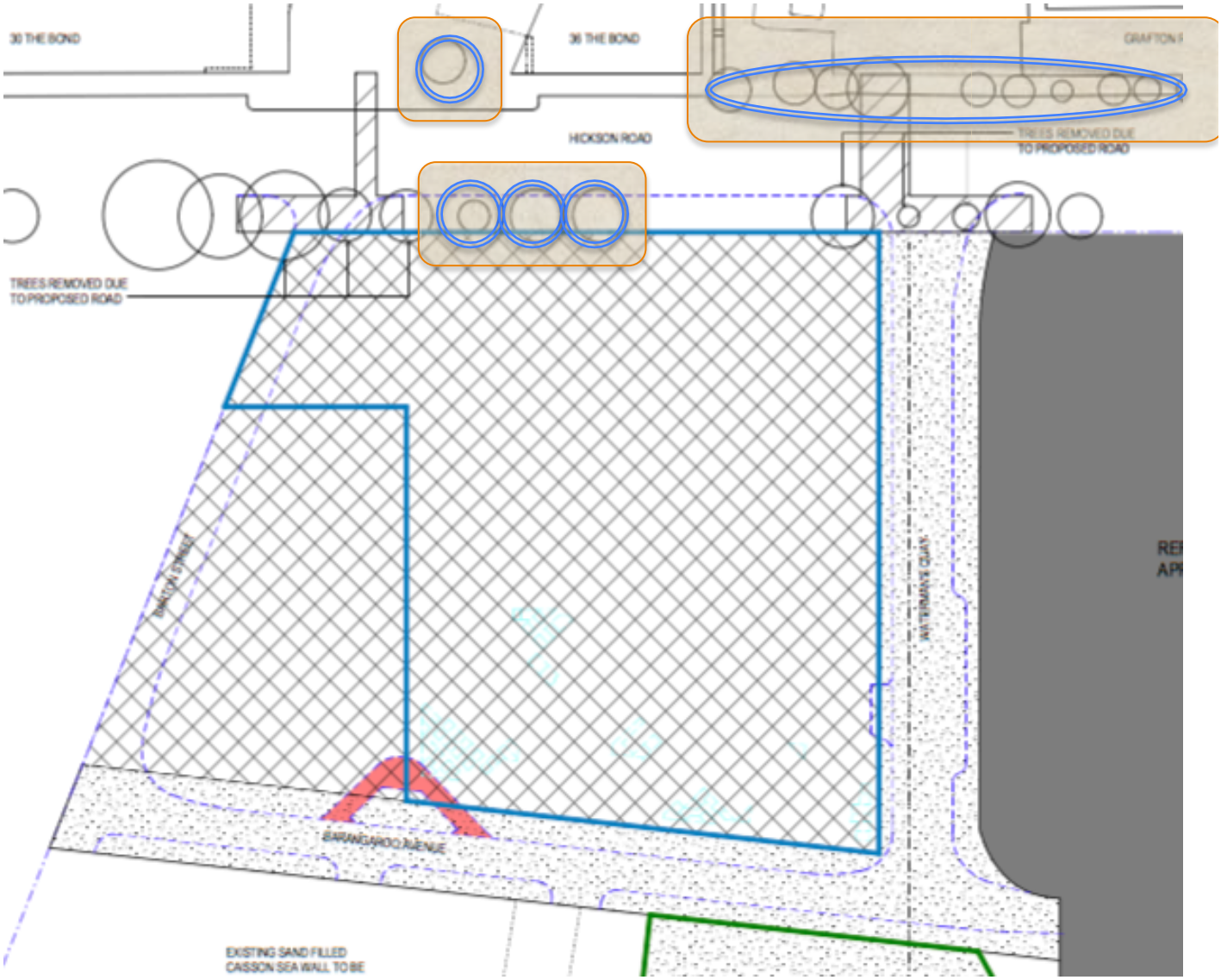
Tree numbers overlay Plan by: Lend Lease: One Sydney Harbour. Barangaroo. Stage 1B Basement SSD6960. Aerial Location Plan. Drawing BB2_PA2_A001. Revision A. Development Application. Dated 10 August 2015



Plan by: Lend Lease: One Sydney Harbour. Barangaroo. Stage 1B Basement SSD6960. Aerial Location Plan. Drawing BB2_PA2_A001. Revision B. Development Application. Dated 19 May 2016



Overlays enlarged part of Plan by: Lend Lease: One Sydney Harbour. Barangaroo. Stage 1B Basement SSD6960. Demolition, Excavation & Services Zone Plan. Drawing BB2_PA2_A003. Revision 0B. Development Application. Dated 19 May 2016.



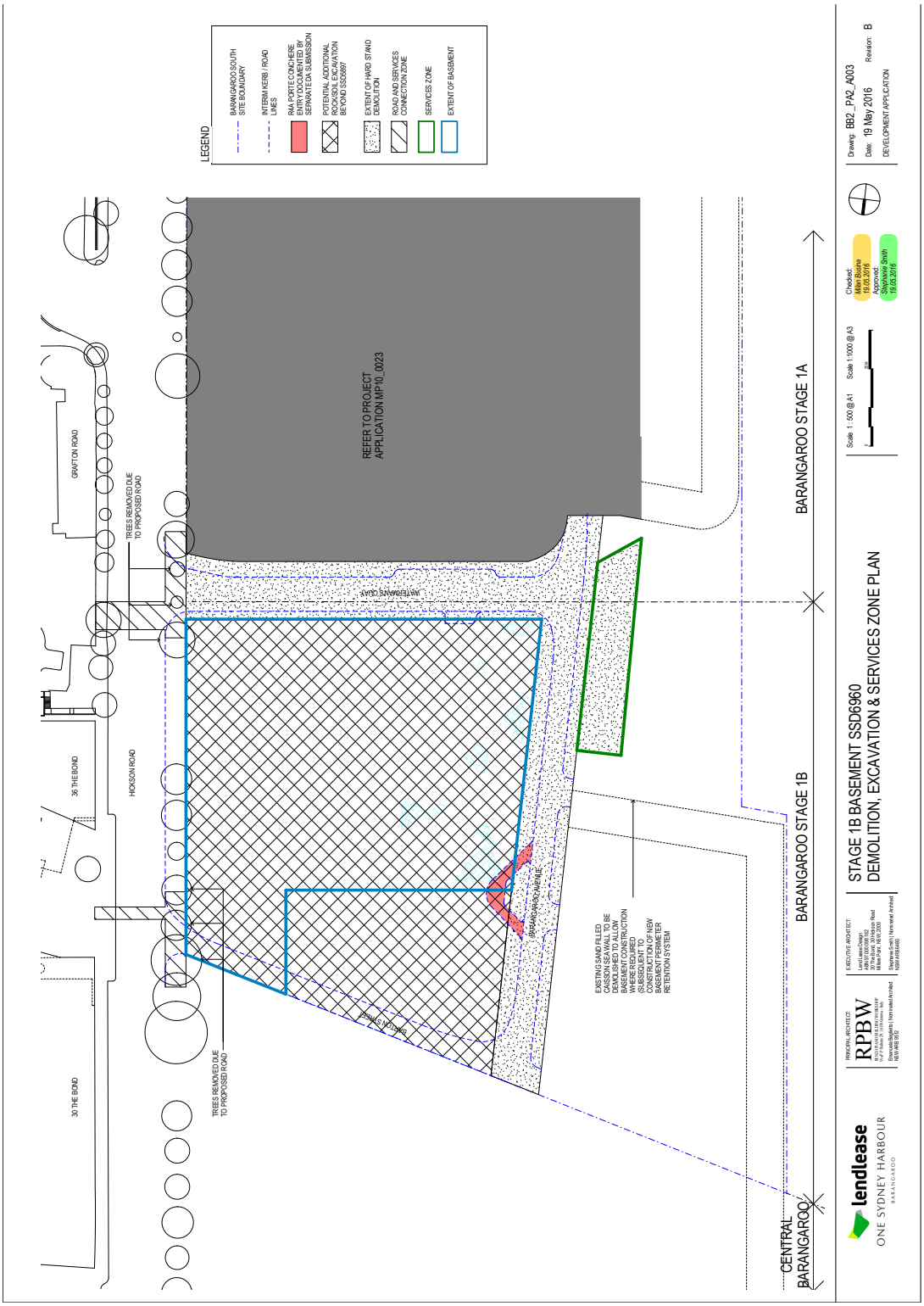
Key

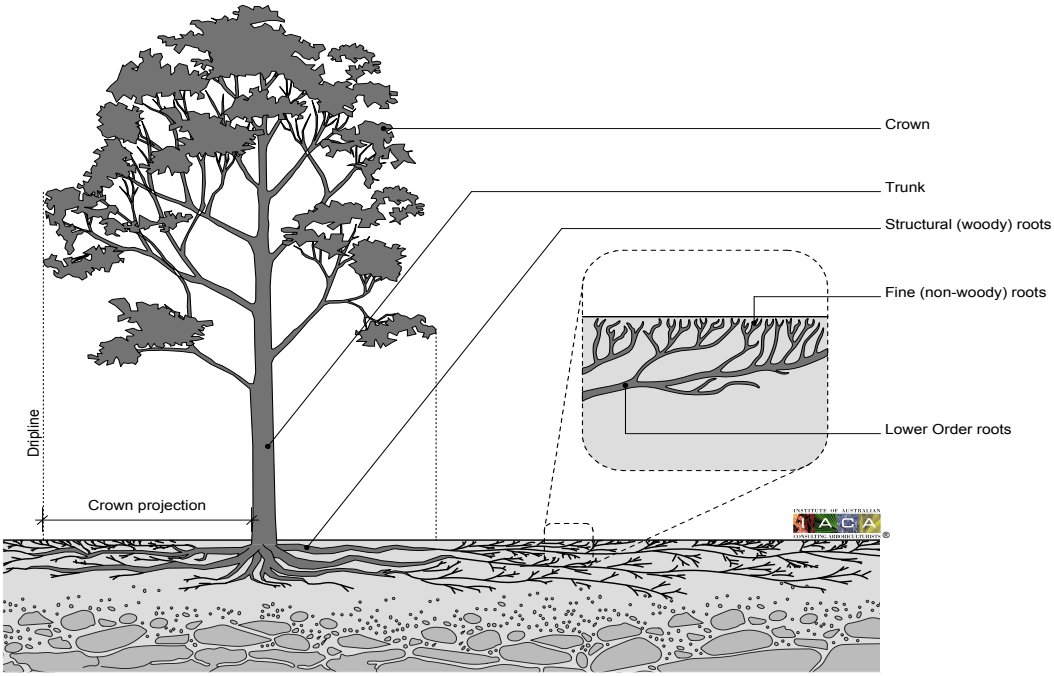
Trees for retention & Protection

Fencing

Manage works within this Area

Plan by: Lend Lease: One Sydney Harbour. Barangaroo. Stage 1B Basement SSD6960. Demolition, Excavation & Services Zone Plan. Drawing BB2_PA2_A003. Revision 0B. Development Application. Dated 19 May 2016.





Structure of a Tree in a Typical Growing Environment — Scale 1:200 @ A4

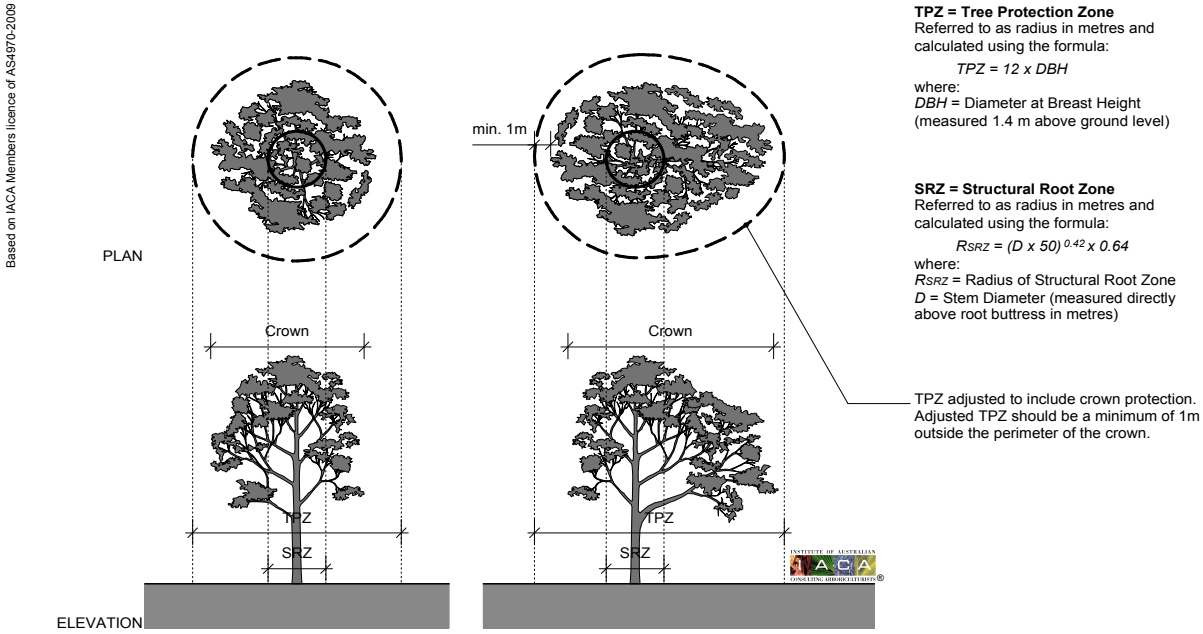
- Most tree roots are in the top 30cm of soil and are easily damaged by compaction and the loss of air spaces necessary for healthy survival. Soil compaction is a common cause of tree decline on development sites.

- Protection of tree roots requires that all new activity be managed and preferably eliminated within the Tree Protection Zone with fencing (ie 12 times trunk diameter or as otherwise specified in the report).

- Roots fall into two main categories:

  Structural woody/Critical roots (SRZ): these are instrumental in tree anchorage, nutrient storage and nutrient transport. The fine/smaller non-woody roots (TPZ) are important in water and nutrient absorption as well as other functions important to tree growth.

- If well managed and protected trees provide an amenity to the immediate area and an environmental benefit to the wider community. Existing vegetation, particularly trees, are valuable assets that can continue to contribute to the property value long after new works have been completed.



Indicative Tree Protection Zone (TPZ) Scale 1:500 @ A4

The theoretical Tree Protection Zones (TPZ) of trees to be retained are given in the appended Tree Protection Calculations section of the report.

Works within area of small roots Tree Protection Zone (TPZ)

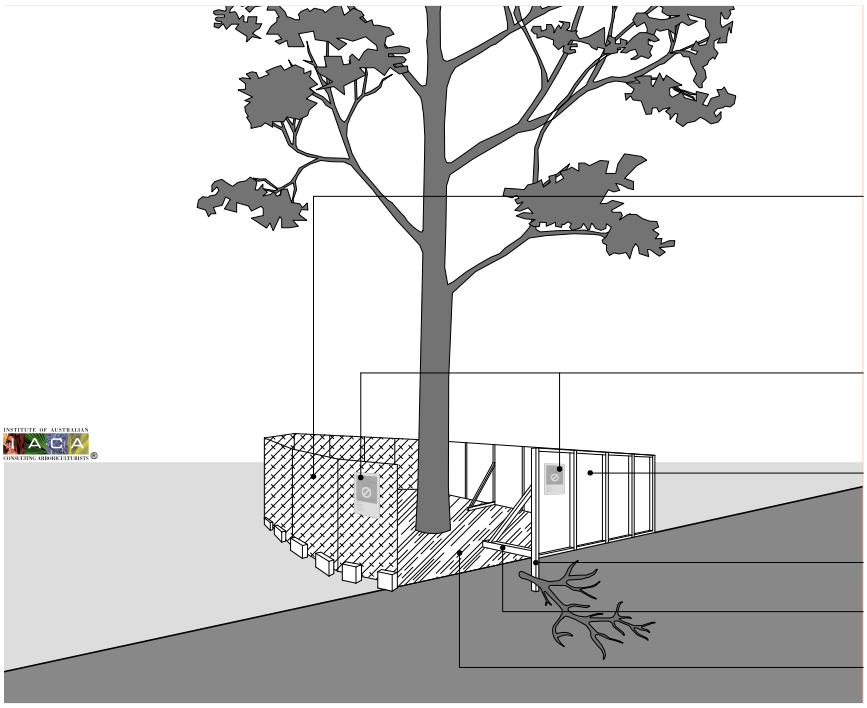
- Minimising soil compaction, by isolating most of the TPZ from works is important in the early stages of site works. Heavy equipment (such as those used in the demolition and the site preparation process) passing over the roots (or materials stockpiling) is detrimental to both the tree as well as the soil proposed for future plant growth (later landscaping).

Works within Structural Root Zone SRZ

- Where works are required near large roots ie within the SRZ it is essential to avoid damaging roots providing tree anchorage.
- If works are proposed within the SRZ by and area of greater than 10%, consideration may be required such as root mapping (careful exploratory digging using hand tools) to locate any large roots (2cm or greater in diameter).
- All works within SRZ should be above ground and to specific arboricultural specifications (provided by your AQF Level 5 arborist and preferably with them on site). Pier and beam construction is the only work possible.
- Piers must avoid roots with 20 – 40mm plus diameters. Careful digging (using hand tools) to find suitable locations.

"*The Tree Protection Zone is the area around the tree or group of trees in which no grading or construction activity may occur. This area should be large enough to retain sufficient root or crown area to maintain tree health and stability.*" [5]

5 Harris, Clark Matheny (2004)



Tree Protection Fencing — Not to Scale

Tree Protection should be the first works on-site: Protecting existing vegetation by isolating it with fencing. This is easier and far less expensive than later replacement or re-establishment.

Exclusion Of Activity Inside the TPZ

- Each tree to be retained should be fenced off to the extent of the Tree Protection Zone excluding all activity unless otherwise indicated in the report. The fencing is to exclude storage of materials, site sheds, machinery, run off (eg concrete, or chemical treatments), the movement of pedestrian or vehicular traffic, the temporary, location of services, eg trenches, pits or canals.

- No works should be performed within the fenced area without specific consideration given. This includes mechanical scouring of existing vegetation and changes of soil levels (either the addition or removal).

- Where access is required adjacent to a tree eg along a driveway trunks and branches will require protection (see Appendix C2).

FENCING

- **For large significant trees** fencing should be 1.8m in height of cyclone chainmesh or similar.

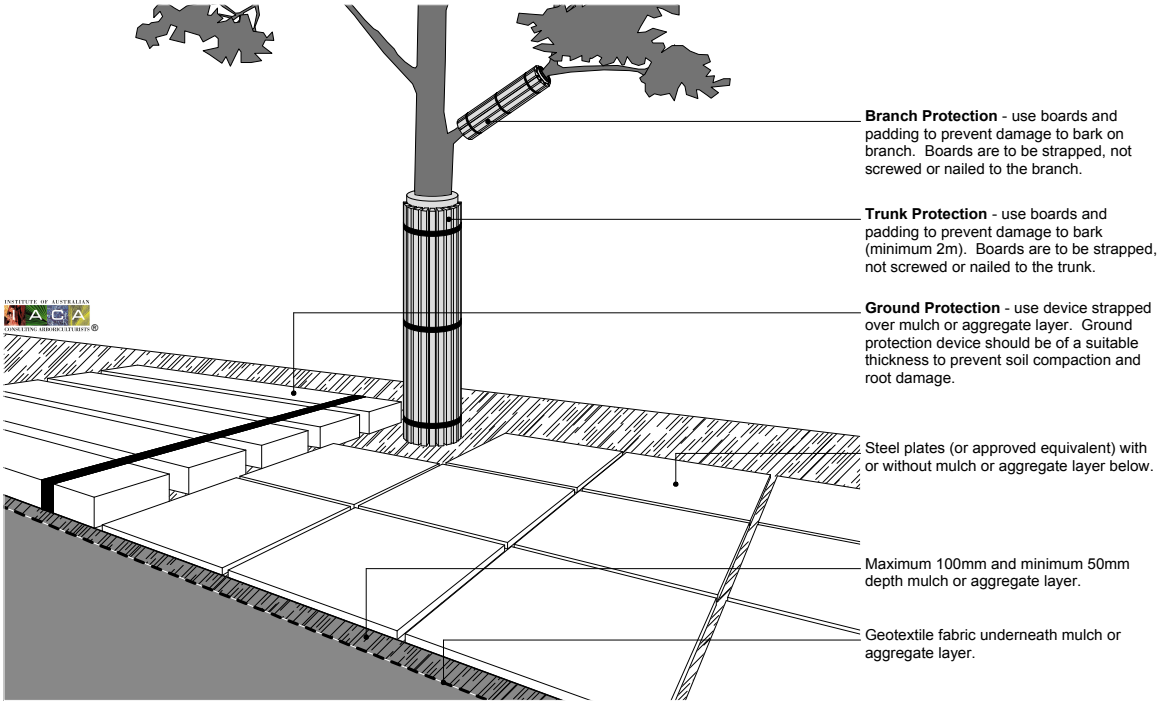
Site Signage on the fencing reminds workers of specific reasons for the fencing – for example:

'This fencing is not to be moved'.

'This Tree Protection Zone is to isolate vegetation from the building process'.

No equipment or materials are to enter or be stored within the fenced area and no chemicals or run off enter this protected zone.

Should fencing need to be moved for any reason first contact …Site Manager on 9999 9999 or Arborist on 0417 022 692'.



Examples of Branch, Trunk and Ground Protection — Not to Scale

WORKS CLOSE TO A TREE

Trunk Protection

Where a tree trunk is likely to be knocked it must be protected from possible damage.

Protection material may be hessian, carpet, underfelt (or similar breathable material) with timber board/planks attached with wire or rope, encircling the materials (not into trunk).

Protection material should cover from the base of the tree to 2m (or to a level that is likely to be damaged by passing equipment) branch protection may be required. Take care that the top and base of the board are not touching the trunk.

Where Access Or Works Within TPZ are required soil surface protection must be installed i.e. a platform (constructed of steel material or timber/rumble boards capable of supporting and distributing the weight over a layer of mulch) and geotextile fabric (see diagram above).

Branch & Foliage Protection

To accommodate works some pruning might be required.

All pruning should be performed by a Qualified Tree Surgeon to ensure pruning is to AS 4373- 1996 'Australian Standards for Pruning Amenity Trees, see Appendix D). (If greater than 10% authority approval may be required).

Where changes are proposed close to a tree, it must be either protected from damage, so as to prevent creating a future hazard, or alternatively it should be removed.

Maintenance of soil within the TPZ
This area should ideally be maintained as least as well as was previously experienced by the tree. Where there are significant changes to the trees normal water supply such as diversion of previous run off or in extended periods of dry, watering should take place. (Check by digging down 10-15cm to ensure water is wetting the root zone and not running off).

Changes to Soil Level
Trees have adapted to their environment and therefore any changes can have a significant affect. Specific information and guidelines should be sought from the reporting arborist, as there should be no level changes near to the tree(s).

Works within SRZ
Where works are required within the SRZ it is important to minimise damage and avoid damage to roots providing tree anchorage. All works within SRZ should be performed using hand tools and to specific arboricultural specifications and preferably with your AQF Level 5 arborist on site to ensure that no roots of 20mm or greater are damaged.

When heavy equipment passes over them or materials are stored within their growing area.
Installation of services, paving and landscaping within the TPZ must be carefully consider likely damaging tree roots and loss of air and oxygen in the soil.

* * * * *

Guidelines are referenced from RW Harris, JR Clark & NP Matheny 'Arboriculture – Integrated Management of Landscaped Trees Shrubs and Vines' Prentice Hall (2004, 4th Edition).

> "The Tree Protection Zone is the area around the tree or group of trees in which no grading or construction activity may occur. This should be large enough to retain sufficient root or crown area to maintain tree health and stability."

As poor pruning practices can create dangerous trees introduce disease and cause trees to decline in health, all tree works recommended in this report should comply with the **Australian Standard for Pruning of Amenity Trees AS4373-2007**, and be performed by a suitably qualified and experienced tree surgeon, preferably with membership of a recognised organisation. Tree Contractors Association (TCA) or National Arborists Association of Australia (NAAA).

Tree works by unqualified, inexperienced or well-meaning cutters who do not perform works to AS 4373 can lead to many long term and detrimental effects on the tree.

Tree Safety concerns include:

- Topping, lopping and structural root removals are inappropriate tree works, likely to create hazardous trees.
- Excessive pruning can lead to inappropriate growth such as the development of epicormic shoots. Epicormic shoots are emergency growth to provide short-term nutrient supply and are rarely strongly attached to branches or trunks. These branches are likely to fall as they become heavier.
- Removal of deadwood in Urban Trees is necessary in high traffic areas as part of the maintenance regime. Excessive deadwood production needs investigation.

Tree Health concerns include:

- Disease can be brought onto a site or transferred between trees by unclean equipment. **All equipment used should be cleaned before use and between trees with either 10% bleach 90% water or 70 % Metho 30% water.**
- Where a tree is suspected of being diseased, the wood should be disposed of with care and not used for mulch.
- Poorly maintained equipment such as unsharpened blades, promotes jagged or poor cuts, leading to unnecessary stress and greater chance of disease entry and insect attack.
- Cutting to inappropriate points along a branch (known as lopping) encourages weakly attached regrowth that is likely to fail.
- The trees natural defence and protection systems can be weakened by inappropriate cutting.

For your protection **Choose a Professional Tree surgeon who**:

- Conducts their business according to The Code of Practice For The Amenity Tree Industry.
- Performs works to Australian Standard for Pruning of Amenity Trees, 4373–1996
- Carries CURRENT Public Liability Insurance – Check currency certificate.
- Is a member of a recognised, professional organisation such as: Tree Contractors Association (TCA) or National Arborists Association of Australia (NAAA). Membership of these organisations requires that works be performed to appropriate standards. These members are monitored for compliance.

About the **Code of Practice for the Amenity Tree Industry** 1998

'*This code has been developed as TREE WORK IS HAZARDOUS. The industry is full of hazards ranging from the tree itself, to the weather, the terrain and difficult sites in which tree work is carried out. Each year, many people in the tree industry are killed or injured. Apart from the enormous impact of injury on individuals and their families, accidents cost the community a significant amount of money. The relatively high incidence of injuries is reflected in the high rates for workers compensation insurance premiums. When injuries are analysed, the overwhelming majority could have been prevented by following the simple safety procedures outlined in this Code of Practice'.* **(Quote from the code)**

This code provides practical guidance on safety requirements for the amenity tree industry. It is intended as a guide to the public and private sectors in meeting their requirements under the Occupational Health and Safety Act 1983. This code applies to the amenity tree industry for pruning, trimming, repairing, maintaining, transplanting and removing trees and for wood chipping, stump grinding and for equipment used in such operations.

About the Australian Standard: Pruning of Amenity Trees 4373–2007

This document outlines 'best practice' methods of tree work, written for compliance by arborists

Appendix E

Trees being retained - Tree Protection Calculations as per AS 4970 - 2009

Tree No.	Species	DBH cm	Tree Protection Area	SRZ Radius	Intrusion into SRZ	TPZ Radius	Intrusion into TPZ	Tree Protection Measures
100	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	40cm	72m^2	2.3m	Yes	4.8m	Yes	Isolate trunk and SRZ as per Appendix C2. Do not change road or paving levels within SRZ.
101	*Ficus rubiginosa* (Port Jackson Fig)	50cm	113m^2	2.5m	Yes	6.0m	Yes	Isolate trunk and SRZ as per Appendix C2. Do not change road or paving levels within SRZ.
102	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	70cm	222m^2	2.9m	Yes	8.4m	Yes	Isolate trunk and SRZ as per Appendix C2. Do not change road or paving levels within SRZ.
103	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	55cm	137m^2	2.6m	Yes	6.6 m	Yes	Isolate trunk and SRZ as per Appendix C2. Do not change road or paving levels within SRZ.
104	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	60cm	163m^2	2.7m	Yes	7.2m	Yes	Isolate trunk and SRZ as per Appendix C2. Do not change road or paving levels within SRZ.

To retain a tree in its current condition it should be fenced to the extent of the TPZ before any other works on site particularly demolition. There should be no entry within TPZ fencing including storage of materials or equipment without further arboricultural advice being sought. Modifications to these distances can be made with specific assessment of works proposed.

Appendix F

Tree Schedule

Tree No.	Species	DBH Arb. cm	Height XSpread M	Vigour/ Health	Structure	Comments
100	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	40cm est.	8 x 7m	Good	Good	Tree appears to be free of the adverse affects of pests and diseases and no major structural faults are observable from the ground
101	*Ficus rubiginosa* (Port Jackson Fig)	50cm est.	7 x 10m	Good	Good	Tree in concourse above public pathway (and may be private property). The roots appear to be enclosed within a constructed planter – part of the upper section of the site.
102	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	70cm est.	9 x 10m	Good	Good	Large structural roots extend for several metres to the south within guttering. These roots must be considered in relation to any works (renewed kerb/guttering performed within the SRZ..
103	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	55cm est.	7 x 8m	Good	Good	Tree appears to be free of the adverse affects of pests and diseases and no major structural faults are observable from the ground
104	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	60cm est.	6 x 6m	Good	Good	Branch failure (inclusion) at 1.5m over street. Damage (12cm x 20cm) where included branching has failed. Roots lifting paving.
105	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	65cm est.	9 x 10m	Good	Good	Tree appears to be free of the adverse affects of pests and diseases and no major structural faults are observable from the ground
06	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	70cm est.	10 x10m	Good	Good	Roots growing over sandstone kerbing blocks. Footpath surfaces have been lifted by large roots and management of this root must be considered (within SRZ) in relation to any resurfacing of pathway.
107	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	95cm est.	11 x 10m	Good	Good	Roots growing over sandstone kerbing blocks.
9	*Ficus microcarpa var. 'Hillii'* (Hills Weeping Fig)	76cm	14 x 11m	Fair	Fair	Beyond crosswalk. Co-dominant from 1.5m. Roots limited by sandstone edging and asphalt. Drainage inspection pit nearby.