Project No: USYD/ETP/17 Report No: USYD/ETPSSDA/AIA/A

ARBORICULTURAL IMPACT ASSESSMENT
TREE PROTECTION SPECIFICATION

Engineering & Technology Precinct – Stage 1 (SSDA)
University of Sydney

Prepared for: LAING O'ROURKE

3rd April 2018
Revision A

Authors:

Anna Hopwood
Grad. Cert (Arboriculture), Dip. Horticulture (Arboriculture)
Dip. Horticulture (Landscape Design)

Martin Peacock
BSc (Hons.) Arboriculture, Dip. Horticulture (Landscape Design)
HN Dip. Arboriculture, N Dip. Horticulture

Nicole O'Connell
Grad. Cert (Heritage Conservation), Dip. Hort (Landscape Design)

Matthew Laurence
BSc. (Hons) Biology, PhD Plant Pathology
Grad. Cert (Arboriculture)

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

Arboriculture Australia MEMBER

INSTITUTE OF AUSTRALIAN CONSULTING ARBORICULTURISTS
IACA
MANAGING URBAN TREES™

Contents

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

1.0 INTRODUCTION

1.1 Background

1.1.1 This Arboricultural Impact Assessment Report and Tree Protection Specification was prepared for Laing O'Rouke, on behalf of the the University of Sydney, in relation to the proposed Engineering and Technology Precinct – Stage 1 project. The purpose of this Report is to undertake a Visual Tree Assessment[1] (VTA), determine the impact of the proposed works on the trees, and where appropriate, recommend the use of tree sensitive construction methods and tree protection measures to minimise adverse impacts.

1.1.2 In preparing this report, the author is aware of and has taken into account the objectives of the City of Sydney's *Sydney Local Environmental Plan 2012*, *Development Control Plan 2012 (Section 3.5 Urban Ecology),* University of Sydney's *Tree Management Plan (2016), Australian Standard 4970 Protection of Trees on Development Sites (2009)*, *Australian Standard 4373 Pruning of Amenity Trees (2007)* and *Australian Standard 2303 Tree Stock for Landscape Use (2015).*

Refer to Methodology **(Appendix 1)**

1.1.3 This Report utilises the University's Tree Management Inventory Database (ArborPlan) numbering system.

1.1.4 This impact assessment is based on an assessment of the following supplied documentation/plans only:

- Landscape Concept – prepared by T.C.L, not dated
- Trees Proposed for Removal – prepared by T.C.L, not dated

Refer to Plans **(Appendix 2)**

2.0 RESULTS

2.1 The Site

2.1.1 The site is located within the University of Sydney's Darlington Campus and contains the existing Electrical Engineering Building. The site is bound by Blackwattle Creek Lane to the north, Maze Crescent to the west and the P.N.R Building to the south. The Mechanical Engineering Building, Engineering Link Building and the Rose Street Building border the site on the eastern boundary.

2.1.2 The site contains a number of landscape areas which include hardscape and turf areas, and shrub and tree plantings.

2.2 The Proposal

2.2.1 The supplied plans show the works include:

- Demolition of existing structures and pavements
- Construction of a new twelve (12) storey building
- Associated works and landscaping

[1] Mattheck & Breloer (2003)

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832
treeiQ.com.au

2.3 The Trees

2.3.1 Eight (8) trees/groups of trees were assessed using the Visual Tree Assessment[2] (VTA) criteria and notes, and comprise of Australian native and exotic species including *Platanus occidentalis* (American Sycamore), *Lophostemon confertus* (Brush Box), and *Archcontophoenix cunninghamii* (Bangalow Palm).

2.3.2 None of the trees are listed on the *City of Sydney Register of Significant Trees 2013*.[3]

2.3.3 None of the trees are listed as high value or significant trees within *University of Sydney Tree Management Plan* 2016.[4]

2.3.4 A search of the BioNet Atlas of NSW Wildlife Database was undertaken in July 2017. No individual threatened tree species listed within this database for the area were identified during the current field investigations of the site.[5] In addition, an ecological assessment of the University was conducted in 2013 and determined that no threatened flora species or threatened ecological communities exist on the Camperdown and Darlington Campuses.[6] The ecological significance and habitat value of the trees has not been assessed and is beyond the scope of this report.

2.3.5 As required by Clause 2.3.2 of *Australian Standard 4970 Protection of Trees on Development Sites (2009)*, each of the trees assessed has been allocated a Retention Value. The Retention Value is based on the trees' Useful Life Expectancy and Landscape Significance with consideration to their health, structural condition and site suitability. The Retention Values do not take into account any proposed development works and are not a schedule for tree retention or removal. The trees have been allocated one of the following Retention Values:

- Priority for Retention
- Consider for Retention
- Consider for Removal
- Priority for Removal

Refer to Tree Assessment Schedule **(Appendix 3)**

3.0 ARBORICULTURAL IMPACT ASSESSMENT

3.1 Tree 493

3.1.1 Tree 493 has been identified as *Platanus occidentalis* (American Sycamore) and is located within a garden bed adjacent to Maze Crescent. This tree has been allocated a high Landscape Significance and a Retention Value of *Priority for Retention.*

3.1.2 The supplied plans show Tree 493 is to be retained as part of the proposed landscape treatment. Works are proposed within its Tree Protection Zone (TPZ) and represent a *Major Encroachment* as defined by *Australian Standard 4970 Protection of Trees on Development Sites 2009 (AS-4970)*. Clause 3.3.4 of AS-4970 outlines that design factors and tree sensitive construction methods should be considered when determining the potential impact of the encroachment.

[2] Mattheck & Breloer (2003)
[3] City of Sydney (2013)
[4] TreeiQ (2016)
[5] NSW Office of Environment and Heritage (2011)
[6] Australian Museum Consulting (2013)

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832
treeiQ.com.au

3.1.3 Recommendations: The following tree sensitive design/demolition/construction methods should be used to minimise the impact of works on Tree 493:

- **Demolition Works:** Tree sensitive methods should be used for the demolition of existing walls, structures and pavements within the TPZ. Where possible, existing footings and sub-base materials should be left in situ and reused. Where footings of demolished walls cannot be left in situ, these structures should be demolished in small sections and removed by hand.

- **Landscape Levels:** Existing levels within the TPZ should be maintained. if required, lowering or raising of levels should be limited to no greater than 10% of the TPZ and outside of the Structural Root Zone. Other than the installation of soil conditioners to a maximum depth of 50mm above the existing soil profile, excavation and installation of imported soil mixes should be excluded from the TPZ. No excavation should be undertaken within the garden bed area to the rear of the existing walls.

- **Pavement Installation:** New pavements (including sub-base materials) within the TPZ should be installed above or at existing grade and utilise existing sub-base layers where possible. Surfaces and sub-base materials should be thinned as required above roots (with appropriate root protection installed). New pavements/kerbs should be modified to enable the retention of roots (>25mmø), where deemed necessary by the Project Arborist.

- **Landscape Structures:** Walls and seating (and other structures as required) within the TPZ should be supported on piered footings (with all other parts of the structures positioned above existing ground levels). Excavation for the pier holes should be undertaken using tree sensitive methods. Pier hole locations should be flexible to enable the retention of roots (>25mmø) as determined by the Project Arborist.

- **Drainage:** Drainage for retaining walls (where required) should be designed and constructed as to avoid the requirement for over-excavation within the TPZ. Where standard drainage (i.e. slotted ag pipe and aggregate drainage) is proposed to the rear of walls, these materials should be substituted for a slimline draincell type product to reduce the requirement for additional excavation. No excavation should be undertaken within the garden bed area to the rear of the existing walls.

- **Landscape Planting:** The installation of plants within the TPZ should be undertaken using hand tools and roots (>25mmø) should be protected. No mechanical cultivation/ripping of soils should be undertaken within the TPZ.

- **Underground Services**: Underground services including the gross pollutant trap should be installed using tree sensitive excavation (hand/hydrovac/airspade etc) methods with the services located around/below roots (>25mmø, or as determined by the Project Arborist). Alternatively, boring methods may be used for underground service installation where the installation depth is greater than 1500mm below existing grade (measured from top of pipe). Excavations for starting and receiving pits for boring equipment should be located outside of the TPZ or located to avoid roots (>25mmø, or as determined by the Project Arborist).

3.2 Tree 625

3.2.1 Tree 625 has been identified as *Lophostemon confertus* (Brush Box) and is located adjacent to Blackwattle Creek Lane. This tree has been allocated a moderate Landscape Significance and a Retention Value of *Consider for Retention.*

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832
treeiQ.com.au

3.2.2 The supplied plans show Tree 625 is to be retained as part of the proposed landscape treatment. Works are proposed within its TPZ and represent a *Major Encroachment* as defined by AS-4970. Clause 3.3.4 of AS-4970 outlines that design factors and tree sensitive construction methods should be considered when determining the potential impact of the encroachment.

3.2.3 Recommendations: The following tree sensitive design/demolition/construction methods should be used to minimise the impact of works on Tree 625:

- **Demolition Works:** Tree sensitive methods should be used for the demolition of existing pavements within the TPZ.

- **Landscape Levels:** Existing levels within the TPZ should be maintained. if required, lowering or raising of levels should be limited to no greater than 10% of the TPZ and outside of the Structural Root Zone. Other than the installation of soil conditioners to a maximum depth of 50mm above the existing soil profile, excavation and installation of imported soil mixes should be excluded from the TPZ.

- **Pavement Installation:** New pavements (including sub-base materials) within the TPZ should be installed above or at existing grade. New pavements/kerbs should be modified to enable the retention of roots (>25mmø), where deemed necessary by the Project Arborist.

- **Landscape Structures:** Walls and seating (and other structures as required) within the TPZ should be supported on piered footings (with all other parts of the structures positioned above existing ground levels). Excavation for the pier holes should be undertaken using tree sensitive methods. Pier hole locations should be flexible to enable the retention of roots (>25mmø) as determined by the Project Arborist.

- **Drainage:** Drainage for retaining walls (where required) should be designed and constructed as to avoid the requirement for over-excavation within the TPZ. Where standard drainage (i.e. slotted ag pipe and aggregate drainage) is proposed to the rear of walls, these materials should be substituted for a slimline draincell type product).

- **Landscape Planting:** The installation of plants within the TPZ should be undertaken using hand tools and roots (>25mmø) should be protected. No mechanical cultivation/ripping of soils should be undertaken within the TPZ.

3.3 Trees 634-639

3.3.1 Trees 634-639 have been identified as *Archcontophoenix cunninghamii* (Bangalow Palm) and are located within a circular garden area to the east of the site. These trees have been allocated a moderate Landscape Significance and a Retention Value of *Consider for Retention.*

3.3.2 The supplied plans show Trees 634-639 are to be removed as part of the proposed landscape treatment. *Archcontophoenix cunninghamii* (Bangalow Palm) are arborescent monocots and are generally tolerant of transplanting, even when of a large mature size. Consideration should be given to relocating these trees as part of the proposed landscape treatment.

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

3.4 Replacement Planting

3.4.1 The supplied plans show that replacement trees are to be planted as part of the proposed development.

3.4.2 Replacement planting should be supplied in accordance with *Australian Standard 2303 (2015) Tree Stock for Landscape Use* and the University of Sydney's *Tree Management Plan (2016).*

4.0 CONCLUSION

4.1 Eight (8) trees/groups of trees were assessed using the Visual Tree Assessment[7] (VTA) criteria and notes, and comprise of Australian native and exotic species.

4.2 The supplied plans show the works include demolition of existing structures and pavements, construction of a new twelve (12) storey building, associated works and landscaping.

4.3 The supplied plans show that six (6) trees (Trees 634-639) are proposed for removal as part of the development works. All of these trees have been allocated a Retention Value of *Consider for Retention*.

4.4 The supplied plans show that two (2) trees (Trees 493 and 625) are to be retained as part of the proposed landscape treatment. Works are proposed within their TPZ areas and represent a *Major Encroachment* as defined by AS-4970. Tree sensitive design, demolition and construction methods as outlined in Sections 3.1.3 and 3.2.3 will be required to minimise the impact of works on the trees. The trees should be protected in accordance with the Tree Protection Specification **(Appendix 5)**.

4.5 The supplied plans show that replacement trees are to be planted as part of the proposed development. Replacement planting should be supplied in accordance with *Australian Standard 2303 (2015) Tree Stock for Landscape Use* and the University of Sydney's *Tree Management Plan (2016).*

[7] Mattheck & Breloer (2003)

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

5.0 LIMITATIONS & DISCLAIMER

TreeiQ takes care to obtain information from reliable sources. However, TreeiQ can neither guarantee nor be responsible for the accuracy of information provided by others. Plans, diagrams, graphs and photographs in this Arboricultural Report are visual aids only and are not necessarily to scale. This Report provides recommendations relating to tree management only. Advice should be sought from appropriately qualified consultants regarding design/construction/ecological/heritage etc issues.

This Report has been prepared for exclusive use by the client. This Report shall not be used by others or for any other reason outside its intended target or without the prior written consent of TreeiQ. Unauthorised alteration or separate use of any section of the Report invalidates the Report.

Many factors may contribute to tree failure and cannot always be predicted. TreeiQ takes care to accurately assess tree health and structural condition. However, a tree's internal structural condition may not always correlate to visible external indicators. There is no warranty or guarantee, expressed or implied that problems or deficiencies regarding the trees or site may not arise in the future. Information contained in this report covers only the trees assessed and reflects the condition of the trees at the time of inspection. Additional information regarding the methodology used in the preparation of this Report is attached as Appendix 1. A comprehensive tree risk assessment and management plan for the trees is beyond the scope of this Report.

Reference should be made to any relevant legislation including Tree Management Controls. All recommendations contained within this Report are subject to approval from the relevant Consent Authority.

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

6.0 BIBLIOGRAPHY & REFERENCES

Australian Museum Consulting (2013), *University of Sydney Ecological Assessment*

Barrell (1995), 'Pre-development Tree Assessments', in *Trees & Building Sites, Proceedings of an International Conference Held in the Interest of Developing a Scientific Basis for Managing Trees in Proximity to Buildings*, International Society of Arboriculture, Illinois, USA, pp. 132-142

City of Sydney (2013) *Development Control Plan*
www.cityofsydney.nsw.gov.au/development/planning-controls/development-control-plans (website accessed Dec, 2013)

City of Sydney (2013) *Register of Significant Trees*
ttp://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0007/143395/130617_EC_ITEM05_ATTACHMENTC4.PDF

Harris, Clark & Matheny (1999), *Arboriculture: Integrated Management of Landscape Trees, Shrubs And Vines*, Prentice Hall, New Jersey

Matheny & Clark (1994), *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas*, International Society of Arboriculture, USA

Mattheck & Breloer (1994), *The Body Language of Trees: A Handbook for Failure Analysis*, The Stationary Office, London

NSW Office of Environment and Heritage's Atlas of NSW Wildlife (2011), *BioNet Atlas of NSW Wildlife*

Simon, Dormer &Hartshorne (1973), *Lowson's Botany*, Bell & Hyman, London

Standards Australia (2009), *Protection of Trees on Development Sites AS-4970*

Standards Australia (2007), *Pruning of Amenity Trees AS-4373*

TreeiQ (2016), *University of Sydney Tree Management Plan*

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

7.0 APPENDICES

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

Appendix 1: Methodology

1.1 **Site Inspection**: This report was determined as a result of a comprehensive site during October 2017. The comments and recommendations in this report are based on findings from this site inspection.

1.2 **Visual Tree Assessment (VTA)**: The subject tree(s) was assessed using the Visual Tree Assessment criteria and notes as described in *The Body Language of Trees – A Handbook for Failure Analysis*.[8] The inspection was limited to a visual examination of the subject tree(s) from ground level only. No internal diagnostic testing was undertaken as part of this assessment. Trees outside the subject site were assessed from the property boundaries only.

1.3 **Tree Dimensions**: The dimensions of the subject tree(s) are approximate only.

1.4 **Tree Locations:** The location of the subject tree(s) was determined from the supplied plans.

1.5 **Trees & Development**: Tree Protection Zones, Tree Protection Measures and Sensitive Construction Methods for the subject tree were based on methods outlined in *Australian Standard 4970-2009 Protection of Trees on Development Sites*.

The *Tree Protection Zone* (TPZ) is described in AS-4970 as a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The *Structural Root Zone* (SRZ) is described in AS-4970 as the area around the base of a tree required for the tree's stability in the ground. Severance of structural roots within the SRZ is not recommended as it may lead to the destabilisation and/or demise of the tree.

In some cases it may be possible to encroach into or make variations to the theoretical TPZ. A *Minor Encroachment* is less than 10% of the area of the TPZ and is outside the SRZ. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. A *Major Encroachment* is greater than 10% of the TPZ or inside the SRZ. In this situation the Project Arborist must demonstrate that the tree would remain viable. This may require root investigation by non-destructive methods or the use of sensitive construction methods.

1.6 **Tree Health**: The health of the subject tree(s) was determined by assessing:

I. Foliage size and colour
II. Pest and disease infestation
III. Extension growth
IV. Crown density
V. Deadwood size and volume
VI. Presence of epicormic growth

1.7 **Tree Structural Condition**: The structural condition of the subject tree(s) was assessed by:

I. Assessment of branching structure
(i.e co-dominant/bark inclusions, crossing branches, branch taper, terminal loading, previous branch failures)
II. Visible evidence of structural defects or instability
(i.e root plate movement, wounds, decay, cavities, fungal brackets, adaptive growth)
III. Evidence of previous pruning or physical damage
(root severance/damage, lopping, flush-cutting, lions tailing, mechanical damage)

1.8 **Useful Life Expectancy (ULE)**: The ULE is an estimate of the longevity of the subject tree(s) in its growing environment. The ULE is modified where necessary to take in consideration tree(s) health, structural condition and site suitability. The tree(s) has been allocated one of the following ULE categories (Modified from Barrell, 2001):

I. 40 years +
II. 15-40 years
III. 5-15 years
IV. Less than 5 years

[8] Mattheck & Breloer (2003)

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832
treeiQ.com.au

1.9 **Landscape Significance**: Landscape Significance was determined by assessing the combination of the cultural, environmental and aesthetic values of the subject tree(s). Whilst these values are subjective, a rating of high, moderate, low or insignificant has been allocated to the tree(s). This provides a relative value of the tree's Landscape Significance which may aid in determining its Retention Value. If the tree(s) can be categorized into more than one value, the higher value has been allocated.

Landscape Significance	Description
Very High	The subject tree is listed as a Heritage Item under the *Local Environmental Plan* with a local or state level of significance.
	The subject tree is listed on Council's Significant Tree Register or is considered to meet the criteria for significance assessment of trees and/or landscapes by a suitably qualified professional. The criteria are based on general principles outlines in the Burra Charter and on criteria from the Register of the National Estate.
	The subject tree is a remnant tree.
High	The subject tree creates a 'sense of place' or is considered 'landmark' tree.
	The subject tree is of local, cultural or historical importance or is widely known.
	The subject tree has been identified by a suitably qualified professional as a species scheduled as a Threatened or Vulnerable Species or forms part of an Endangered Ecological Community associated with the subject site, as defined under the provisions of the *Threatened Species Conservation Act* 1995 (NSW) or the *Environmental Protection and Biodiversity Conservation Act* 1999.
	The subject tree is known to provide habitat to a threatened species.
	The subject tree is an excellent representative of the species in terms of aesthetic value.
	The subject tree is of significant size, scale or makes a significant contribution to the canopy cover of the locality.
	The subject tree forms part of the curtilage of a heritage item with a known or documented association with that item.
Moderate	The subject tree makes a positive contribution to the visual character or amenity of the area.
	The subject tree provides a specific function such as screening or minimising the scale of a building.
	The subject tree has a known habitat value.
	The subject tree is a good representative of the species in terms of aesthetic value.
Low	The subject tree is an environmental pest species or is exempt under the provisions of the local Council's Tree Management Controls
	The subject tree makes little or no contribution to the amenity of the locality.
	The subject tree is a poor representative of the species in terms of aesthetic value.
Insignificant	The subject tree is declared a Noxious Weed under the Noxious Weeds Act

1.10 **Retention Value**: Retention Value was based on the subject tree's Useful Life Expectancy and Landscape Significance. The Retention Value was modified where necessary to take in consideration the subject tree's health, structural condition and site suitability. The subject tree(s) has been allocated one of the following Retention Values:

I. Priority for Retention
II. Consider for Retention
III. Consider for Removal
IV. Priority for Removal

<table>
<tr><th>ULE</th><th></th><th colspan="4">Landscape Significance</th></tr>
<tr><td></td><td>Very High</td><td>High</td><td>Moderate</td><td>Low</td><td>Insignificant</td></tr>
<tr><td>40 years +</td><td rowspan="3">Priority for Retention</td><td colspan="2">Priority for Retention</td><td rowspan="3">Consider for Removal</td><td rowspan="3">Priority for Removal</td></tr>
<tr><td>15-40 years</td><td>Priority for Retention</td><td>Consider for Retention</td></tr>
<tr><td>5-15 years</td><td colspan="2">Consider for Retention</td></tr>
<tr><td>Less than 5 years</td><td>Consider for Removal</td><td colspan="4">Priority for Removal</td></tr>
</table>

The above table has been modified from the Footprint Green Tree Significance and Retention Value Matrix.

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

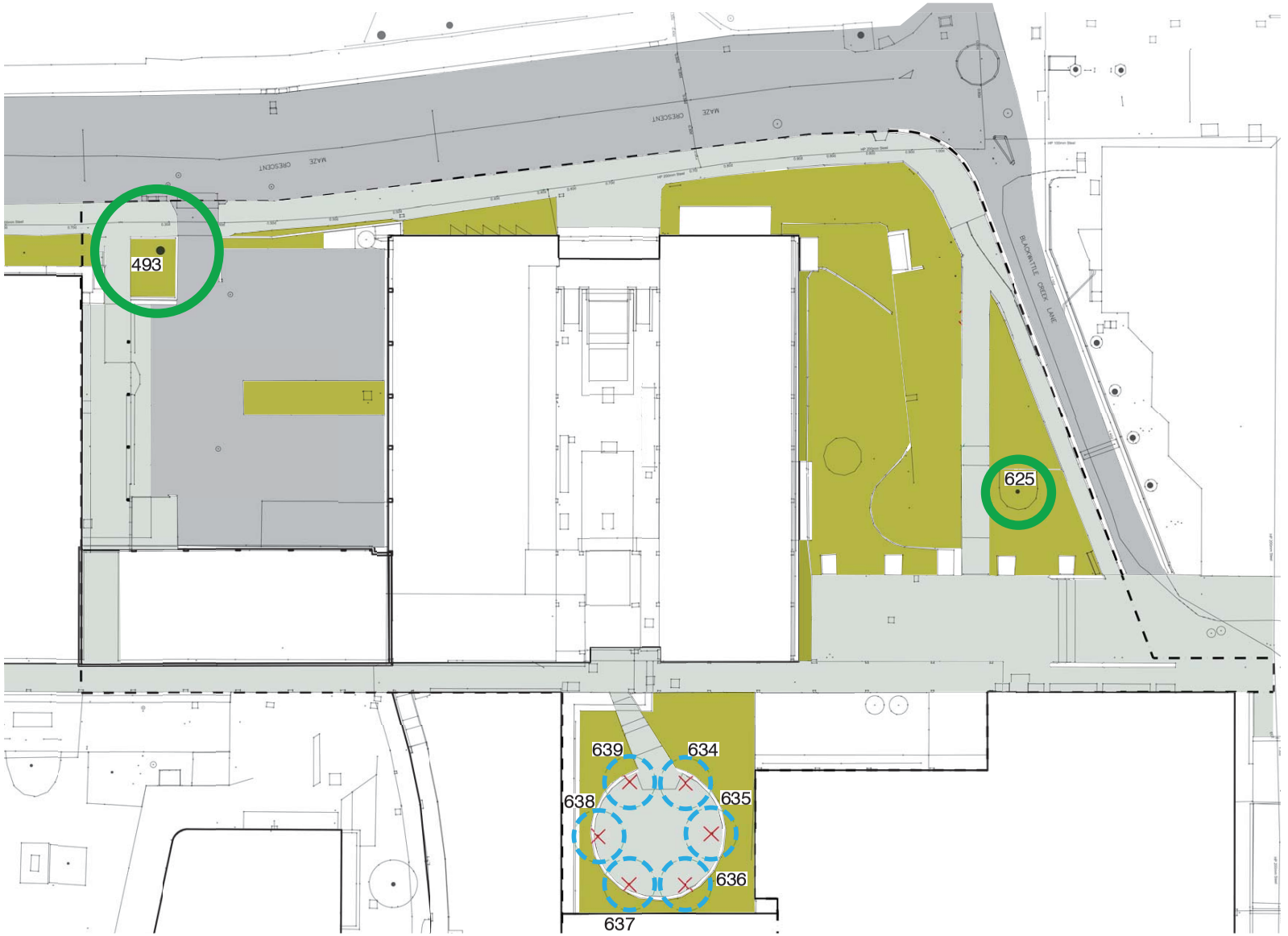
Appendix 2: Plans

p. 0404 424 264
f. 02 9012 0924
po box 146 summer hill 2130
info@treeiQ.com.au
abn 62 139 088 832

treeiQ.com.au

Landscape Concept

Trees Proposed for Removal



Tree proposed for retention (2 total)

Tree proposed for removal and possible relocation (6 total)

488 Tree ID number - as referenced in Arborist's Report (Tree IQ, Arboricultural Impact Assessment Tree Protection Specification, 29 November 2017)

1:500@A3

Appendix 3: Tree Assessment Schedule

Tree No.	Species	DBH (mm)	Height (m)	Radial Crown Spread (m)	Health Rating	Structural Rating	Comments	ULE (years)	L/Significance	Retention Value	Radial TPZ (m)	Radial SRZ (m)	Implication
493	*Platanus occidentalis* (American Sycamore)	800	20	9	Good	Good	Small (<25mm) diameter deadwood in low volumes.	15-40	High	Priority for Retention	9.6	3.1	Retain. Major encroachment, landscape works.
625	*Lophostemon confertus* (Brush Box)	500	12	4	Good	Good	Lopped at 2m crown comprises mature epicormic growth. Small (<25mm) diameter deadwood in low volumes.	15-40	Moderate	Consider for Retention	6	2.5	Retain. Major encroachment, landscape works.
634	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.
635	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.
636	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.
637	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.
638	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.
639	*Archcontophoenix cunninghamii* (Bangalow Palm)	250	12	2	Good	Good		15-40	Moderate	Consider for Retention	3	n/a	Remove.

Appendix 4: Plates

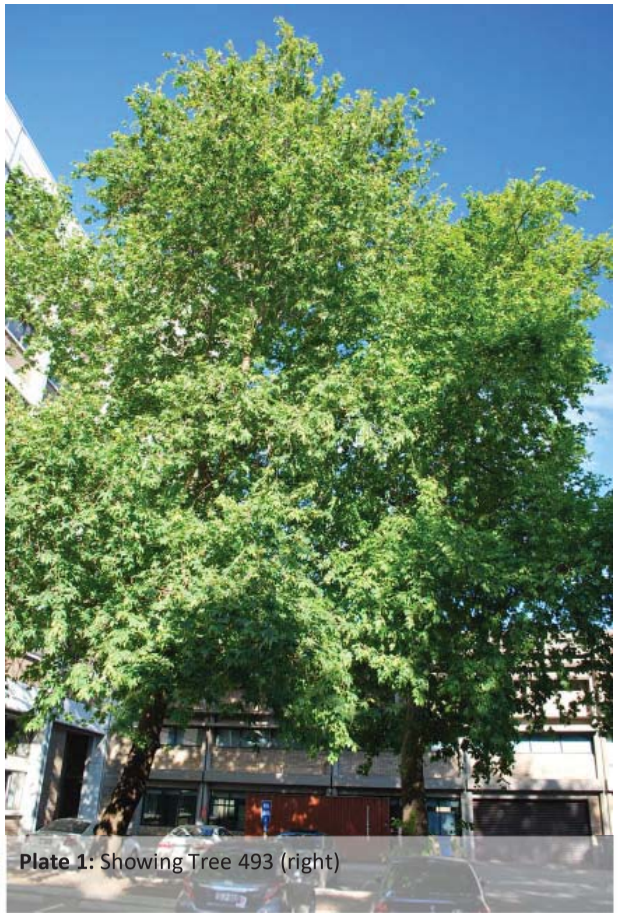


Plate 1: Showing Tree 493 (right)

Plate 2: Showing Trees 634-639

Appendix 5: Tree Protection Specification

1.0 Appointment of Project Arborist

A Project Arborist shall be engaged prior the commencement of work on-site and monitor compliance with the protection measures. The Project Arborist shall inspect the tree protection measures and Compliance Certification shall be prepared by the Project Arborist for review by the Principal Certifying Authority prior to the release of the Compliance Certificate.

The Project Arborist shall have a minimum qualification equivalent (using the Australian Qualifications Framework) of NSW TAFE Certificate Level 5 or above in Arboriculture.

The site specific requirement for mulching, irrigation, the location of tree protection fencing and temporary access, and other specific tree protection measures shall be confirmed through consultation between the Head Contractor/Project Manager and the Project Arborist prior to the commencement of works.

1.1 Compliance

Contractors and site workers shall receive a copy of these specifications a minimum of 3 working days prior to commencing work on-site. Contractors and site workers undertaking works within the Tree Protection Zone shall sign the site log confirming they have read and understand these specifications, prior to undertaking works on-site.

1.2 Tree & Vegetation Removal

The trees to be removed shall be removed prior to the establishment of the tree protection measures. Tree removal works shall be undertaken in accordance with the *Safe Work Australia Guide for Managing Risks of Tree Trimming and Removal Work (2016).*

Tree and vegetation removal shall not damage the trees to be retained.

1.3 Tree Protection Zone

The tree to be retained shall be protected prior and during construction from activities that may result in an adverse effect on their health or structural condition. The area within the Tree Protection Zone (TPZ) shall exclude the following activities, unless otherwise stated:-

- Modification of existing soil levels, excavations and trenching
- Mechanical removal of vegetation
- Movement of natural rock
- Storage of materials, plant or equipment or erection of site sheds
- Affixing of signage or hoarding to the trees
- Preparation of building materials, refueling or disposal of waste materials and chemicals
- Lighting fires
- Movement of pedestrian or vehicular traffic
- Temporary or permanent location of services, or the works required for their installation
- Any other activities that may cause damage to the tree

NOTE: If access, encroachment or incursion into the TPZ is deemed essential, prior authorisation is required by the Project Arborist.

1.4 Tree Protection Fencing

TPZ fencing shall be located at perimeter of the TPZ. Refer to Tree Assessment Schedule **(Appendix 3)**. The exact location of the fencing shall be confirmed through consultation between the Head Contractor/Project Manager and the Project Arborist prior to the commencement of works. Fencing may be setback to allow for demolition/construction access and for the installation of pavements only where appropriate ground protection is installed and approved by the Project Arborist.

As a minimum, the Tree Protection Fence shall consist of 1.8m high wire mesh panels supported by concrete feet. Panels shall be fastened together and supported to prevent sideways movement. The tree shall not be damaged during the installation of the Tree Protection Fencing. Refer to Typical Tree Protection Details (3) **(Appendix 6)**.

1.5 Signage

Signs identifying the TPZ should be placed around the edge of the TPZ and be visible from within the development site. The lettering on the sign should comply with *Australian Standard - 1319 (1994) Safety signs for the occupational environment*. The signage shall be installed prior to the commencement of works on-site and shall be maintained in good condition for the duration of the development period.

1.6 Site Management

Materials, waste storage, and temporary services shall not be located within the TPZ.

1.7 Scaffolding

Where possible, scaffolding shall not be located within the TPZ. Scaffolding shall not be in contact with the tree. As necessary, this shall be achieved by erecting scaffolding around branches. Branches shall be tied back and protected as deemed necessary by the Project Arborist. Refer to Typical Tree Protection Details (5) **(Appendix 6)**.

1.8 Ground Protection

To protect the underlying soil from compaction, machinery movements shall be restricted to areas of existing pavement or from areas of temporary ground protection such as ground mats or steel road plates. Refer to Typical Tree Protection Details (3) **(Appendix 6).**

1.9 Works within the Tree Protection Zones

In some cases works within the TPZ may be authorized by the determining authority. **These works shall be supervised by the Project Arborist**. When undertaking works within the TPZ, care should be taken to avoid damage to the tree's root system, trunks and lower branches.

If roots (>25mmø) are encountered during the demolition, excavation and construction works, these roots must be retained in an undamaged condition and advice sought from the Project Arborist. Adjustment of final levels and design shall remain flexible to enable the retention of roots (>25mmø) where deemed necessary by the Project Arborist.

1.10 Structure & Pavement Demolition

Demolition of existing structures/pavement within the TPZ shall be supervised by the Project Arborist. Machinery is to be excluded from the TPZ unless operating from the existing slabs, pavements or areas of ground protection (refer to Section 1.8). Machinery should not contact the tree's roots, trunk, branches and crown.

Where deemed necessary by the Project Arborist, structures shall be shattered with a hand-operated pneumatic/electric breaker to minimise disturbance to the tree's roots, and demolition waste removed by hand.

The existing pavement shall be carefully lifted to minimise damage to the underlying soil profile (or sub-base materials) and to prevent damage to tree roots. Wherever possible, existing sub-base materials shall remain in-situ.

When removing slab sections within TPZ, machinery shall work backwards out of the TPZ to ensure machinery remains on un-demolished sections of slab at all times. Wherever possible, footings or elements below grade shall be retained to minimise disturbance to the tree's roots.

If roots (>25mmø) are encountered during the demolition works, these roots must be retained in an undamaged condition and advice sought from the Project Arborist. Exposed roots shall be protected from direct sunlight, drying out and extremes of temperature by covering with a 10mm thick jute geotextile fabric. The geotextile fabric shall be kept in a damp condition at all times. Where the Project Arborist determines that the tree is using underground elements (i.e footings, pipes, rocks etc.) for support, these elements shall be left in-situ.

1.11 Pavement Installation

New pavements (including sub-base materials & kerbs) within TPZ areas shall be installed above or at existing grade and utilise existing sub-base layers where possible. Pavement sub-base layers shall be either, thinned or finished pavement levels amended as required to enable the retention of significant roots (as determined by the Project Arborist).

1.12 Landscape Walls, Seating, Isolated Structures etc.

Walls and seating (and other structures as required) within TPZ areas shall be supported on piered footing with all other parts of the structures positioned above existing ground levels. Excavation for the pier holes shall be undertaken using tree sensitive methods. Pier holes shall be flexible to enable the retention of roots (>25mmø) as determined by the Project Arborist.

1.13 Underground Services

Underground service installation within the TPZ shall be supervised by the Project Arborist.

The installation of underground services shall be located outside of the TPZ. Where this is not possible, they shall be installed using tree sensitive excavation methods (hand/hydrovac/airspade) with the services installed around/below roots (>25mmø, or as determined by the Project Arborist). Excavation using compact machinery fitted with a flat bladed bucket is permissible where approved by the Project Arborist. Excavation using compact machinery should be undertaken in small increments, guided by a spotter who is to look for and prevent damage to roots (>25mmø).

Alternatively, boring methods may be used for underground service installation where the installation depth is greater than 1500mm below existing grade. Excavations for starting and receiving pits for boring equipment shall be located outside of the TPZ or located to avoid roots (>25mmø, or as determined by the Project Arborist).

1.14 Plant Installation

Plant installation within TPZ areas shall be undertaken using hand tools and roots (>25mmø) shall be protected. No mechanical cultivation/ripping of soils shall be undertaken within TPZ areas.

Landscape planting shall be completed in the final stage of the development works and tree protection fencing and trunk protection shall remain in place until these works are due to commence.

1.15 Excavations, Root Protection & Root Pruning

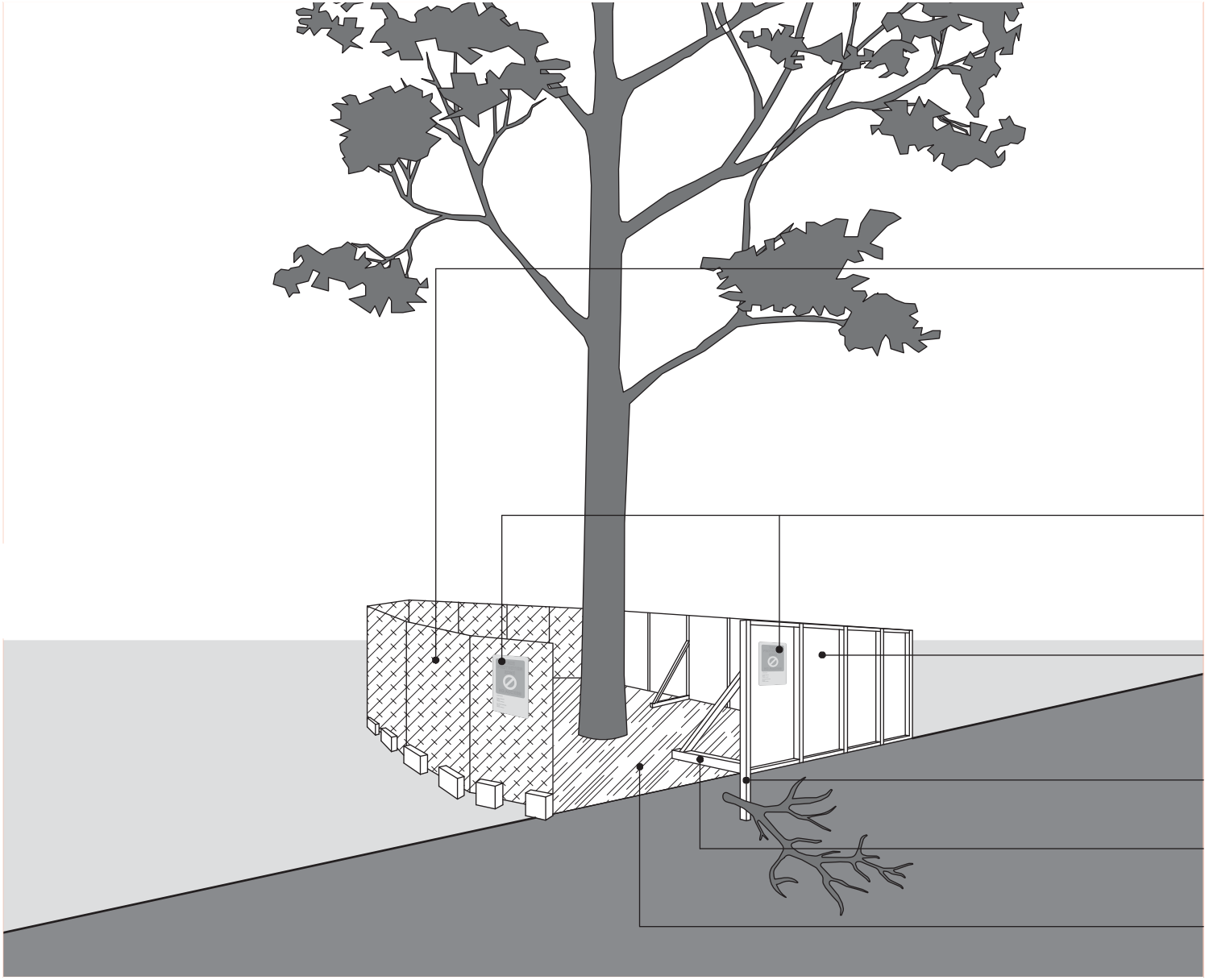
All excavation works (including root investigations) within TPZ areas shall supervised by the Project Arborist and utilise tree sensitive methods (hand/hydrovac/airspade). Excavation using compact machinery fitted with a flat bladed bucket is permissible where approved by the Project Arborist. Excavation using compact machinery should be undertaken in small increments, guided by a spotter who is to look for and prevent damage to roots (>25mmø).

Exposed roots shall be protected from direct sunlight, drying out and extremes of temperature by covering with a 10mm thick jute mat, followed by a layer of plastic membrane. Coverings shall be weighted to secure them in place. The mat shall be kept in a damp condition at all times.

No over-excavation, battering or benching shall be undertaken beyond the footprint of any structure unless approved by the Project Arborist. Tree sensitive excavation and root pruning shall be undertaken along the excavation line prior to the commencement of mechanical excavation to prevent tearing and shattering damage to the roots from excavation equipment.

Roots (>25mmø) shall be pruned by the Project Arborist only. Roots (<25mmø) may be pruned by the Principal Contractor. Root pruning shall be undertaken with clean, sharp secateurs or a pruning saw to ensure a smooth wound face, free from tears. Damaged roots shall be pruned behind the damaged tissues with the final cut made to an undamaged part of the root.

Appendix 6: Typical Tree Protection Details



Note:
No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.

Option 1 - Fencing
1.8m high chain wire mesh panels with shade cloth attached (if required), held in place with concrete feet.

Tree Protection Zone (TPZ) sign

Option 2 - Fencing
Plywood or wooden panel paling fence. This type of fencing material also prevents building materials or soil entering the TPZ.

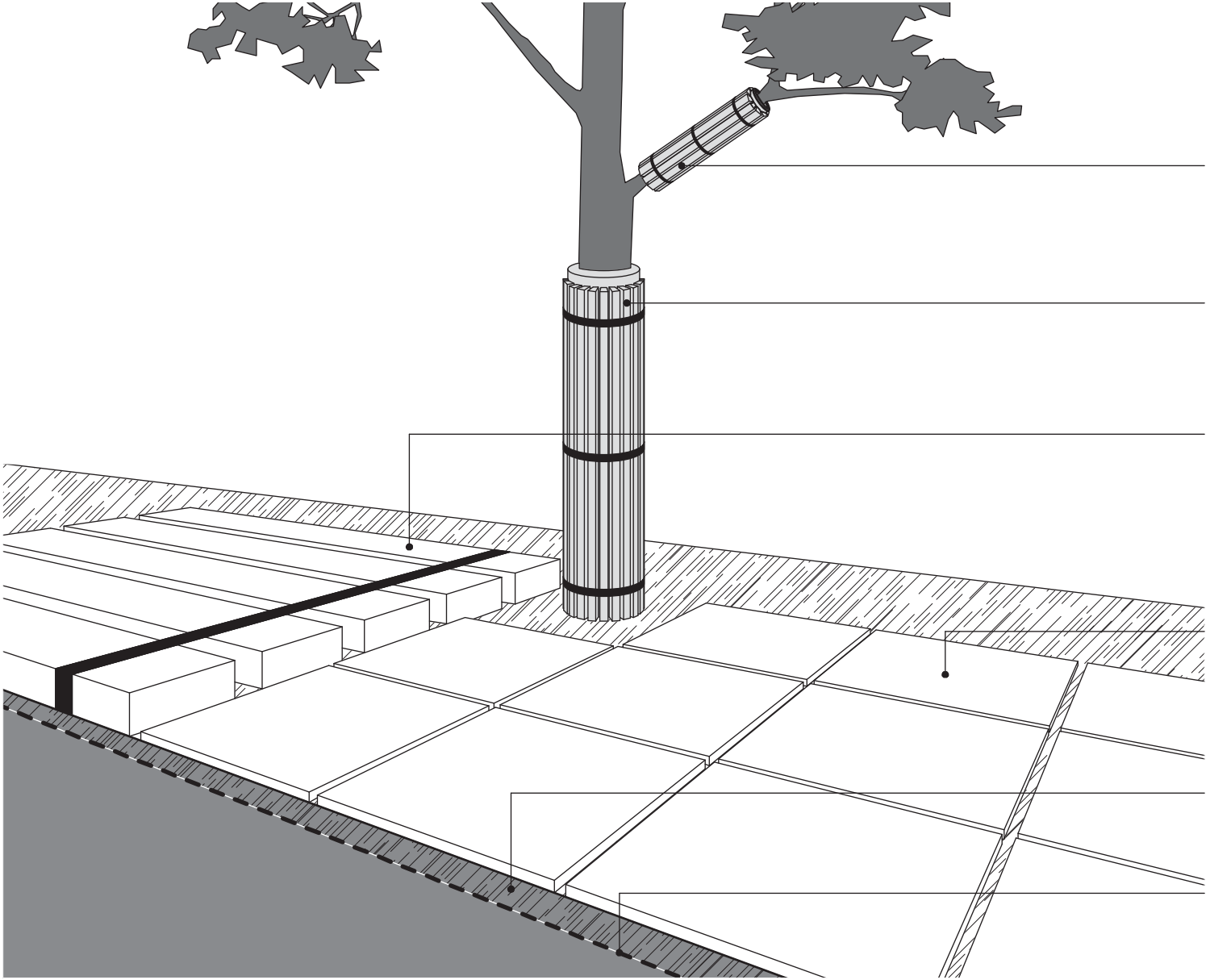
Installation of supports should avoid damaging roots.

Bracing is permissible within the TPZ.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer installed across surface of TPZ.

03 Tree Protection Fencing

Not to Scale



Branch Protection - use boards and padding to prevent damage to bark on branch. Boards are to be strapped, not screwed or nailed to the branch.

Trunk Protection - use boards and padding to prevent damage to bark (minimum 2m). Boards are to be strapped, not screwed or nailed to the trunk.

Ground Protection - use device strapped over mulch or aggregate layer. Ground protection device should be of a suitable thickness to prevent soil compaction and root damage.

Steel plates (or approved equivalent) with or without mulch or aggregate layer below.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer.

Geotextile fabric underneath mulch or aggregate layer.

04 Examples of Branch, Trunk and Ground Protection

Not to Scale

Branches may require pruning to erect scaffolding. Pruning may be subject to local regulations. Flexible branches should be tied back in preference to pruning.

Minimum 1.8m high hoarding. Temporary fencing may be incorporated into scaffolding as either containment screening or as hoarding.

Note:
If excavation is required for installation of support post for fencing, the Project Arborist should assess any pruning of roots greater than 20mm diameter.

Scaffold planks

Boards or plywood to be installed over mulch or aggregate layer for any areas requiring access within the TPZ.

Soleplate over geotextile. No excavation for soleplate within TPZ.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer within TPZ.

Geotextile fabric

05 Indicative Scaffolding within a Tree Protection Zone (TPZ) Not to Scale