

Barangaroo Metro Station

Tree Report

N217

BR COP

21 March 2022

Project overview

Project Site Address:

Hickson Road
Barangaroo
NSW 2000

BESIX Watpac State Division Address:

Level 24, 44 Market Street
SYDNEY
NSW 2000

Project Commencement Date:

12 March 2021

BESIX Watpac ABN:

71 010 462 816

Document Control

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Version	Date	Revision Description	Release Sign off
A	21/03/22	Submission for Review	Mike Nevin / Planning & Environment Manager

BESIX Watpac Approvals

Name	Role & Title	Signature	Date
Mike Nevin	Author / Planning & Environment Manager		21/03/2022
Daniel Gooch	Reviewer / Engineering Manager		21/03/2022

Note: A controlled copy of the Tree Report will be distributed to the Sydney Metro Principal's Representative, Environmental Representative (ER) and other nominated stakeholders, and it will be made available to all BR COP employees and subcontractors in soft copy format through the project document control system.

The Tree Report associated sub-plans and procedures, when printed, will be uncontrolled and it will be the responsibility of each user to confirm the currency of the plan through the project document control system.

Acronym and Definitions

Acronym	Term and/or Definitions
AA	Acoustic Advisor
AIA	Arboricultural Impact Assessment
BDA	Barangaroo Development Authority (known as iNSW)
BR-CODD	Barangaroo 'Construct Only Delivery Deed'
BR-COP	Barangaroo 'Construct Only Package' (also various documents refer to: BZZ Contractor / STME)
BW	BESIX Watpac
CEMP	Construction Environmental Management Plan
CMP	Contract Management Plan
CoA	Conditions of Approval
CSG	Construction Safety Group
CSSI	Critical State Significant Infrastructure Project
CWQMR	Construction Water Quality Monitoring Report
DBH	Diameter at Breast Height
DITP	Detailed Inspection and Test Plan
DPIE	NSW Department of Planning Industry and Environment
EIS	The Sydney Metro City and Southwest Chatswood to Sydenham Environmental Impact Statement dated 3 May 2016 submitted to the Secretary seeking approval to carry out the CSSI and as revised if required by the Secretary under the EP&A Act.
EMS	The BESIX Watpac certified Environmental Management System
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EPA	NSW Environmental Protection Authority
EPL	Environmental Protection License
GS	General Specification
HMP	Heritage Management Plan
ICNG	<i>Interim Construction Noise Guideline</i>
KPI	Key performance Indicator
CNVMP	Construction Noise & Vibration Management Plan
N/A	Not applicable
PS	Particular Specification
SFAIRP	So Far As Is Reasonably Practicable (in terms of the RSNL, NSW)
SM	Sydney Metro - Sydney Metro (https://www.sydneymetro.info)
SME	Subject Matter Expert, a person with expert knowledge and competency in a specified subject or topic matter area.
SMP	Sustainability Management Plan
SMCSW	Sydney Metro City & Southwest (the overall program of works, which Barangaroo Station is part of)
SRZ	Structural Root Zone
SWMS	Safe Work Method Statement

Acronym	Term and/or Definitions
Sydney Metro	Transport for New South Wales (https://www.transport.nsw.gov.au)
TPZ	Tree Protection Zone
TSE	Tunnel and Station Excavation Contractor
UCLAFP	Unexpected Contaminated Land and Asbestos Finds Procedure
VAMP	Visual Amenity Management Plan
WDIA	Water Discharge Impact Assessment
WQMP	Water Quality Monitoring Program
WHS	Work Health and Safety
WTP	Water Treatment Plant

Terms and Definitions

Glossary	Definitions and Responsibilities
Aboriginal object	The same meaning as in the <i>National Parks and Wildlife Act 1974</i> (NSW)
Ancillary Facility	A facility established for construction of the project which will be decommissioned at the end of construction including and office and amenities compound, construction compound, materials crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory and materials stockpile area.
Business Management Plan	the Business Management Plan required by the Project Planning Approval.
CEMP	Construction Environmental Management Plan
Contractor	Particular Specification (PS) must be read as a reference to the "BR Contractor" as defined in the BR-CODD
Contractors Activities	Particular Specification and General Specification must be read as a reference to the "BR Contractor's Activities" as defined in the BR-CODD
Construction	The same meaning as in the CSSI Sydney Metro City & Southwest Chatswood to Sydenham Conditions of Approval (SSI 7400)
Crisis Event	an event that may have an impact on the community, commuters, environment, personnel or subcontractors or has attracted or can reasonably be expected to attract the attention of the media, the Minister for Transport, a local Member of Parliament, local Authority or the local community. This includes emergencies, incidents or crises unrelated to the Contractor's Activities that may be deemed to be caused by the Contractor's Activities due to locality.
Design Documentation	Means the "Final Design Documentation" as defined in the BR-CODD.
Emergency Event	A situation in which there is an unacceptable risk, to the health and wellbeing of occupants, staff, or the general public, which needs intervention by staff or emergency services to control, limit escalation, suppress or address the risk and return to normal operations.
Environmental Aspect	Element of an organisation's activities, products or services that interacts or can interact with the environment (AS/NZS ISO 14001:2016)
Environmental Impact	Change to the environment whether adverse or beneficial, wholly or partly resulting from an organisation's environmental aspects
Environmental Policy	Statement by an organisation on its intention and principles for environmental performance
Incident	An occurrence or set of circumstances that causes, or threatens to cause, material harm to the environment, community or many member of the community, being actual or potential hard to the health and safety of human beings or to threatened species, endangered ecological communities or ecosystems that is not trivial
Inspection and Test Plan	Inspection and test plans prepared and implemented by the Contractor in accordance with the requirements in AS/NZS ISO 9001 Quality Management systems – Requirements.
Interface Contractors	Any contractor, consultant, artist, tradesperson or other person engaged by Sydney Metro that is carrying out ,or that will carry out Interface Work including: <ul style="list-style-type: none"> • TSE Contractor • TSOM Contactors • The Operator • LW Contractor • ETS Contractor
Interface Work	Any activities undertaken by an Interface Contractor which interface with or affect, or are affected by, the Contractor's Activities, the Project Works or the Temporary Works.
Non-Compliance	Failure to comply with the requirements of the Project Approval or any applicable license, permit or legal requirements.
Non-Conformance	Failure to conform to the requirements of project system documentation including this CEMP or supporting documentation
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
Relevant Council	City of Sydney

Glossary	Definitions and Responsibilities
Secretary	Secretary of the NSW Department of Planning and Environment or nominee,
Sensitive receiver	<p>Includes residences, educational institutions (including preschools, school, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation area (including parks and sports grounds).</p> <p>Receivers that may be considered to be sensitive include commercial remises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping ground, restaurants, offices premises, and retail spaces and industrial premises, and others identified by the Secretary.</p>
Staging Report	Sydney Metro City & Southwest Chatswood to Sydenham – Staging Report V7
Unexpected heritage Finds	A potential heritage item discovered unexpectedly (usually during construction) having the same meaning as in the CSSI Sydney Metro City & Southwest Chatswood to Sydenham Conditions of Approval (SSI 7400)

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BARANGAROO STATION

Construction Environmental Management Plan

1.1 Introduction

BESIX Watpac have prepared this Tree Report to identify impacts to trees within the Barangaroo Metro Station project (BRCOP). This report has been prepared to satisfy the requirements of the project's Conditions of Approval (CoA) E6. Table 1 below outlines how compliance with CoA E6 will be met.

Table 1 Compliance Matrix

Condition E6	Compliance / Reference
The CSSI must be designed to retain as many trees as possible and provide replacement trees such that there is a net increase in the number of trees.	The BR COP is being designed in accordance with the EIS and PIR. Any trees that need to be removed will be replaced such that there is a net increase in the number of trees.
The Proponent must commission an independent, experienced and suitably qualified arborist to prepare a comprehensive Tree Report before removing any trees as detailed in the EIS, as amended by the documents listed in A1. The Tree Report must include:	<p>The arborists who have produced the Arboricultural Impact Assessment (AIA) are independent of the project and suitably qualified with the following qualifications:</p> <ul style="list-style-type: none">• AQF Level 5 Qualified.• Quantified Tree Risk Assessment (QTRA) Advanced User Qualified.• Arboriculture Australia (AA) Members.• Society for Risk Analysis: Australia & New Zealand Work Cover NSW – General Construction Induction (White Card) trained.• National Rail Industry Worker (RIW) trained (formerly RISI).• Assess Corridor Safety (ACS) qualified.• International Society of Arboriculture (ISA) members.
(a) a description of the conditions of the tree(s) and it's amenity and visual value;	Refer to the Tree Schedule in Appendix II of the AIA in Appendix A of this report.
(b) consideration of all options to avoid tree removal, including relocation of services, redesign or relocation of ancillary components (such as substations, fencing etc.) and a reduction of standard offsets to underground services, and;	Refer to Section 1.1.3
(c) measures to avoid tree remove, minimise damage to, and ensure the health and stability of those trees to be retained and protected. This includes details of any proposed canopy or root pruning, root protection one, excavation, site controls on waste disposal, vehicular access, materials storage and protection of public utilities.	Refer to Section 6.0 of the AIA in Appendix A.
In the event that tree removal cannot be avoided, then replacement trees are to be planted within, or in close proximity to the CSSI or other location on consultation with the Relevant Councils and agreed by the Secretary. The size of the replacement trees will be determined in consultation with the relevant Council.	The trees contemplated for removal will be replaced. Refer to the Landscaping documentation in Appendix B.
The size of the replacement trees will be determined in consultation with the relevant Council.	The size of the replacement trees will be determined in consultation with Infrastructure NSW and City of Sydney Council
A copy of the Tree Report must be submitted to the Secretary before the removal, damage and/ or pruning of any trees, including those affected by the site establishment works.	This Tree Report will be submitted to the Secretary for the proposed works prior to any pruning/ damage or removal being undertaken.
All recommendations of the Tree Report must be implemented by the Proponent, unless otherwise agreed by the Secretary,	The recommendations made in the Tree Report as outlined in Section 6 of the AIA attached in Appendix A will be implemented.

BARANGAROO STATION

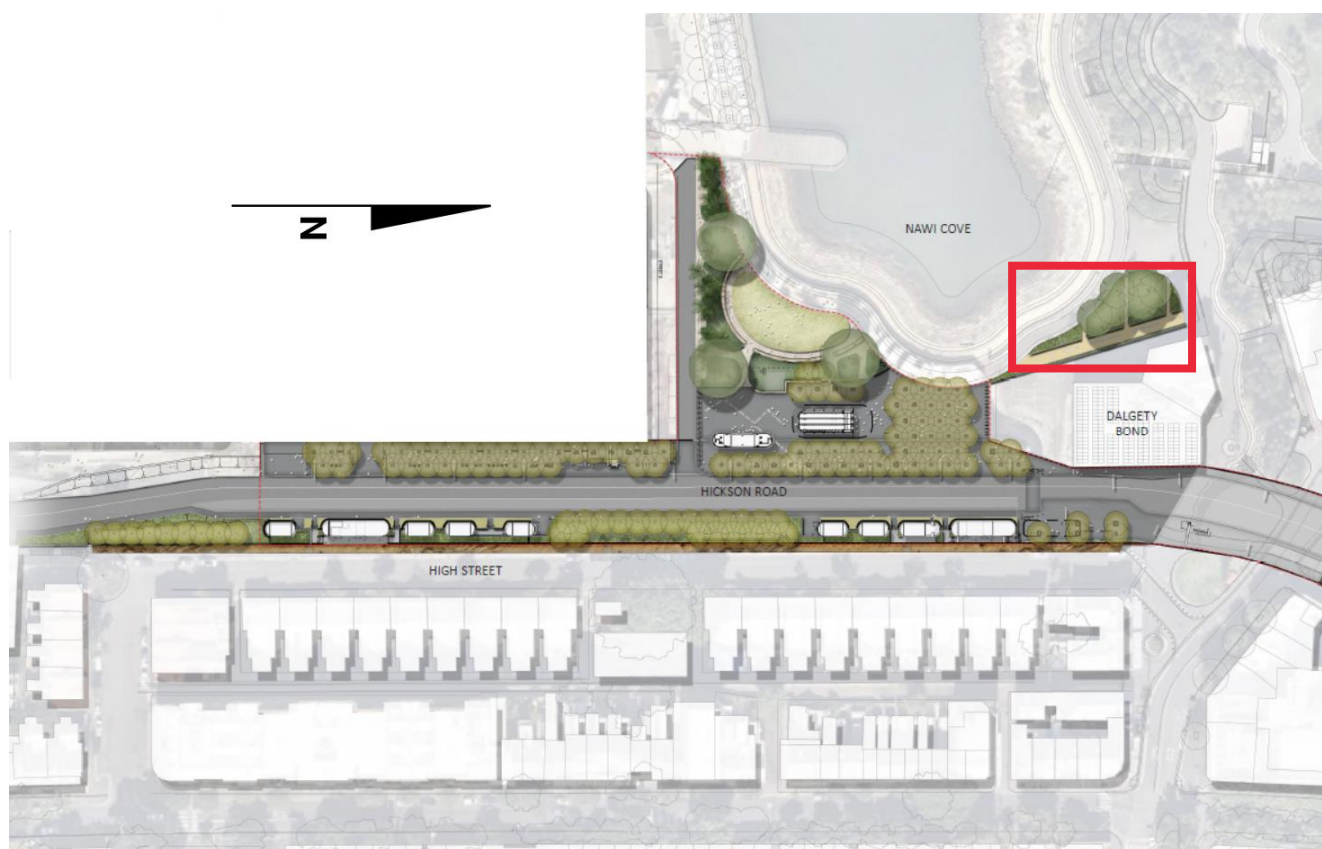
Construction Environmental Management Plan

Condition E6	Compliance / Reference
The Tree Report may be prepared for the entire CSSI or separate reports may be prepared for individual areas where tree removal and/ or pruning is proposed.	This Tree Report has been prepared for the Barangaroo Metro Station Project only.

1.1.1 Site Location and Context

The Barangaroo Metro station is part of the Sydney Metro City & Southwest Chatswood to Sydenham project located between the future Victoria Cross and Martin Place stations. The location of the trees referred to in this Tree Report are as highlighted in red as shown in Figure 1 below:

Figure 1 Tree Report – Assessment area



1.1.2 Summary of Arboricultural Impact Assessments

The Barangaroo Metro Station project is located on Hickson Road in Barangaroo, adjacent to the Headland Park. This report assesses trees located between 25 Hickson Rd and Nawi Cove as shown in Figure 1 above.

An assessment of the trees has been undertaken by an independent, experienced and suitably qualified Arborist, Lex Atkins of Tree Report (TR) who produced the AIA in Appendix A. The AIA has assessed 12 trees that will be impacted by construction activities associated with the Barangaroo Metro Station project.

The AIA includes the following:

- Genus, species and common name

BARANGAROO STATION

Construction Environmental Management Plan

- Height, spread, trunk diameter, diameter at breast height (DBH), age
- Description of the condition of the tree, including health, vigour and structural condition
- Significance, amenity visual value and ecological value
- Form and structural condition
- Visible defects, evidence of wounding and disease
- Structural Root Zone (SRZ) and Tree Protection Zone (TPZ)
- Potential impact from the project and retention potential

The purpose of the AIA is to assess these trees for significance and suitability for retention from an arboricultural perspective. This is reviewed against the proposed impacts of the construction activities occurring in the vicinity of the trees. Recommendations are made based on the tree's suitability for retention and their significance. The AIA includes a tree location schematic to indicate the location of the trees in plan, a tree schedule and each tree has been photo-documented and given a unique identifying number.

The AIA recommends that:

- Seven (7) trees are located wholly within the construction footprint and are recommended for removal
- Five (5) trees are located in the vicinity of the construction footprint and are only to be removed as a contingency if the construction activities taking place necessitate this, or if require for safety reasons. These trees are to be retained if it is possible for the construction activities to occur without their removal

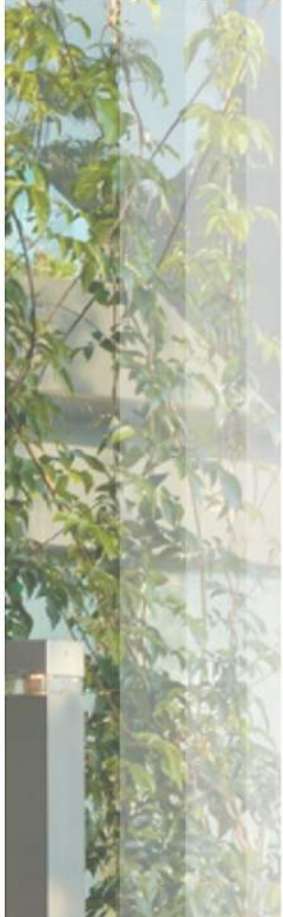
Refer to Appendix A for the specific details of the AIA prepared by Tree Report for the trees indicated in Figure 1.

1.1.3 Tree Removal Considerations

CoA E6 (b) requires that all options to avoid tree removal be considered. Consideration was undertaken by Sydney Metro as part of the design of the station and it was found that the works necessitating the removal of the trees discussed in this Tree Report could not be relocated or redesigned due to the area being constrained, and heavily restricted by other services. The corridor between 25 Hickson Road and Nawi cove is quite narrow with a significant number of existing services. With respect to the chosen condensed water alignment, there are a number of existing services on the eastern side immediately adjacent to 25 Hickson Road and within the adjacent footpath on the western side. If the condensed water route was moved either to the east or the west these existing services would need to be routed into the chosen condensed water corridor. Additionally, the route into the cutaway structure is constrained by the High Voltage substation to the east and by the structural column for the building to the west.



Appendix A Arboricultural Impact Assessment





treeREPORT.

ARBORICULTURAL CONSULTING

Arboricultural Impact Assessment

**Barangaroo Metro Station
Barangaroo NSW 2000**

Version 3

Prepared for:
Ward Civil

March 2022

Document information

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Document status

Document version	Date	Revision description
Version 1	22/12/21	FINAL
Version 2	22/02/22	Minor amendments following client comments
Version 3	03/03/22	Additional text included in relation to tree transplant feasibility

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Abbreviations

Ø	Diameter
R	Radius
AGL	Above Ground Level
AQF	Australian Qualifications Framework
AS	Australian Standards
BGL	Below Ground Level
DBH	Diameter at Breast Height
DBR	Diameter at Root Flare
Id	Identification
m	Metre
mm	Millimetre
NDE	Non-Destructive Excavation
NO	Number
NSW	New South Wales
SP	Species
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment

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1 Introduction

Report Purpose

Tree Report has been engaged by Ward Civil to prepare an Arboricultural Impact Assessment (herein referred to as the 'AIA') for works associated with the construction of a new Metro Station located at Barangaroo NSW 2000 (herein referred to as the 'Site') and has been prepared to address *Condition of Approval (CoA E6) of the Planning Approval (Critical State Significance Infrastructure Sydney Metro City & Southwest Chatswood to Sydenham 7400 Mod 8)*. The purpose of this report is to:

- Identify trees (herein referred to as the 'Subject Trees') that are likely to be affected by the proposed works.
- Assess the current overall health and condition of the Subject Trees.
- Assess and discuss likely impacts to the Subject Trees as a result of the proposed development.
- Evaluate the significance of the Subject Trees and assess their suitability for retention.

Project Overview

The works are related to the installation of belowground services in association with construction of the new Barangaroo Metro Station. Key features of the proposal likely to affect the Subject Trees are summarised as follows:

- Site preparation, including removal of existing landscaping, and trench excavation activities.
- Installation of new condensed water pipes 300m above existing HV cables.
- Re-instatement of landscaping following completion of construction works.

The Subject Trees

Inspection of the site was undertaken on the 8th of December 2021.

A total of **twelve** individual trees were identified and recorded during the site inspection. Of these:

- **Seven** Subject Trees (**id. 1-5, 11 & 12**) are of Low retention value
- **Five** Subject Trees (**id. 6-10**) are of Medium retention value

Further information, observations and measurements specific to each of the Subject Trees can be found in **Chapter 6** and **Appendix II**.

The Study Area

The Study Area is comprised of an irregular parcel of vegetation approximately 529 m² and is situated along the Nawli Cove foreshore area in Barangaroo NSW 2000. The Site falls within the City of Sydney Council Local Government Area (LGA).

The Site is shown in **Figure 1**.

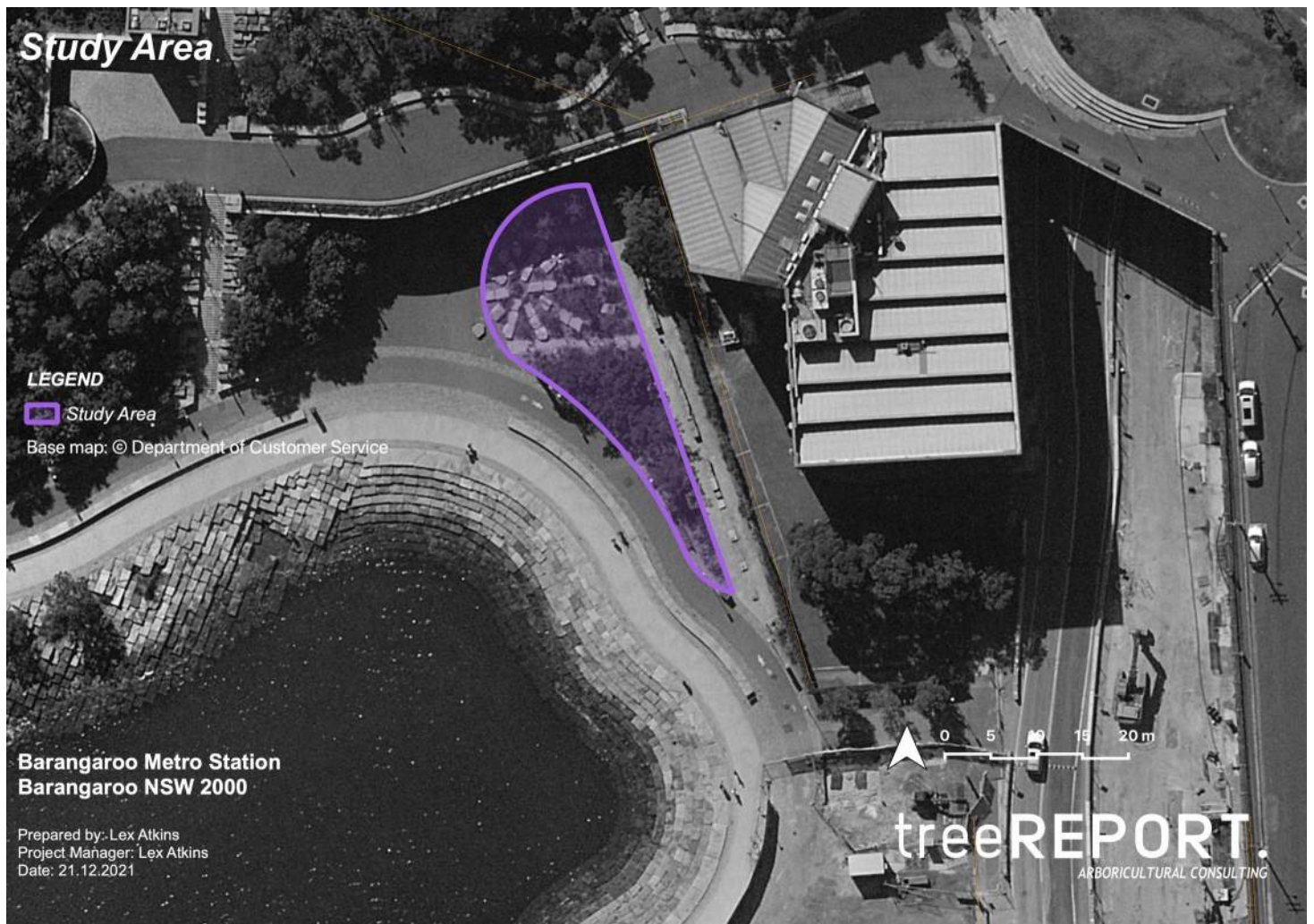


Figure 1: The Study Area

2 Method

Visual Tree Assessment

The Subject Trees were assessed in accordance with a stage one visual tree assessment (VTA) as formulated by Mattheck & Breloer (1994)¹, and practices consistent with modern arboriculture.

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 within adjacent properties or restricted areas were not subject to a complete visual inspection (i.e. defects and abnormalities may be present but not recorded).
- Trunk Diameter at Breast Height (DBH) has been accurately measured using a diameter tape measure. Tree height and canopy spread has been estimated unless otherwise stated.
- Tree identification was based on broad taxonomical features present and visible from ground level at the time of inspection.

Retention Value

The retention value of a tree or group of trees is determined using a combination of environmental, cultural, physical and social values.

- **Low:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
- **Medium:** These trees are moderately important for retention. Their removal should only be considered if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
- **High:** These trees are considered important for retention 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 AS4970 Protection of trees on development sites*.

This tree retention assessment has been undertaken in accordance with the Institute of Australian Consulting Arboriculturalists (IACA) Significance of a Tree, Assessment Rating System (STARS). The system uses a scale of High, Medium and Low significance in the landscape. Once the landscape significance of a tree has been defined, the retention value can be determined. Each tree must meet a minimum of three (3) assessment criteria to be classified within a category. Further details and the assessment criteria are in **Appendix VI**.

¹ VTA is an internationally recognised practice in the visual assessment of trees as formulated by Mattheck & Breloer (1994). Principle explanations and illustrations are contained within the publication, Field Guide for Visual Tree Assessment by Mattheck, C., and Breloer, H. Arboricultural Journal, Vol 18 pp 1-23 (1994).

3 Arboricultural Impact Assessment

Impact Assessment

AS 4970-2009 defines two types of 'zones' which have to be considered when undertaking and arboricultural impact assessment. These zones are:

- **Tree protection zone (TPZ):** The TPZ is the optimal combination of crown and root area (as defined by AS 4970-2009) that requires protection during the construction process so that the tree can remain viable. The TPZ is an area that is isolated from the work zone to ensure no disturbance or encroachment occurs into this zone. Tree sensitive construction measures must be implemented if work is to proceed within the Tree Protection Zone.
- **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. Severance of structural roots (>50 mm in diameter) within the SRZ is not recommended as it may lead to the destabilisation and/or decline of the tree.
- **Root investigation:** When assessing the potential impacts of encroachment within the TPZ, consideration will need to be given to the location and distribution of the roots, including above or below ground restrictions affecting root growth. Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation. Root investigation is used to determine the extent and location of roots within the zone of conflict. Root investigation does not guarantee the retention of the tree.

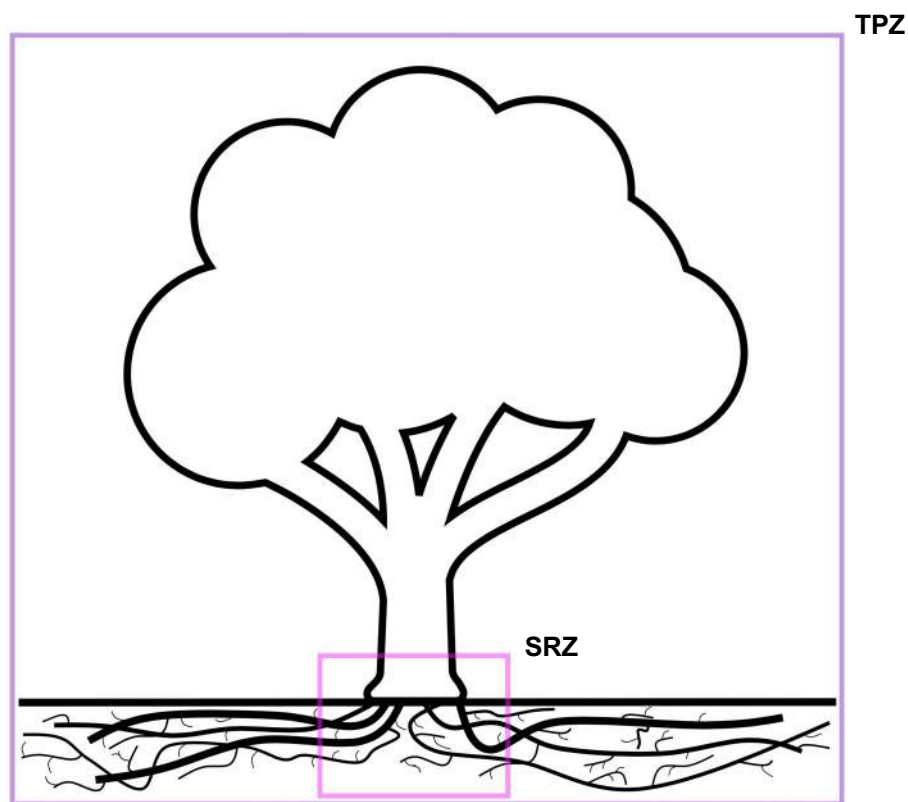


Figure 2: Indicative TPZ and SRZ

Encroachments Within the TPZ

Encroachment within the TPZ of a Subject Tree is acceptable under the AS4970-22009, providing that the consulting arborist can demonstrate that the Subject Tree can remain viable. There are four (4) encroachment thresholds to be considered when assessing a proposed development:

- **No encroachment (0%):** There are no likely or foreseeable encroachment within the TPZ as a result of the proposed development.
- **Minor encroachment (<10%):** The proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ.
- **Major encroachment (>10%):** The proposed encroachment is greater than 10% (total area) of the TPZ.
- **Total encroachment:** The Subject Tree(s) located wholly within the proposed development footprint.

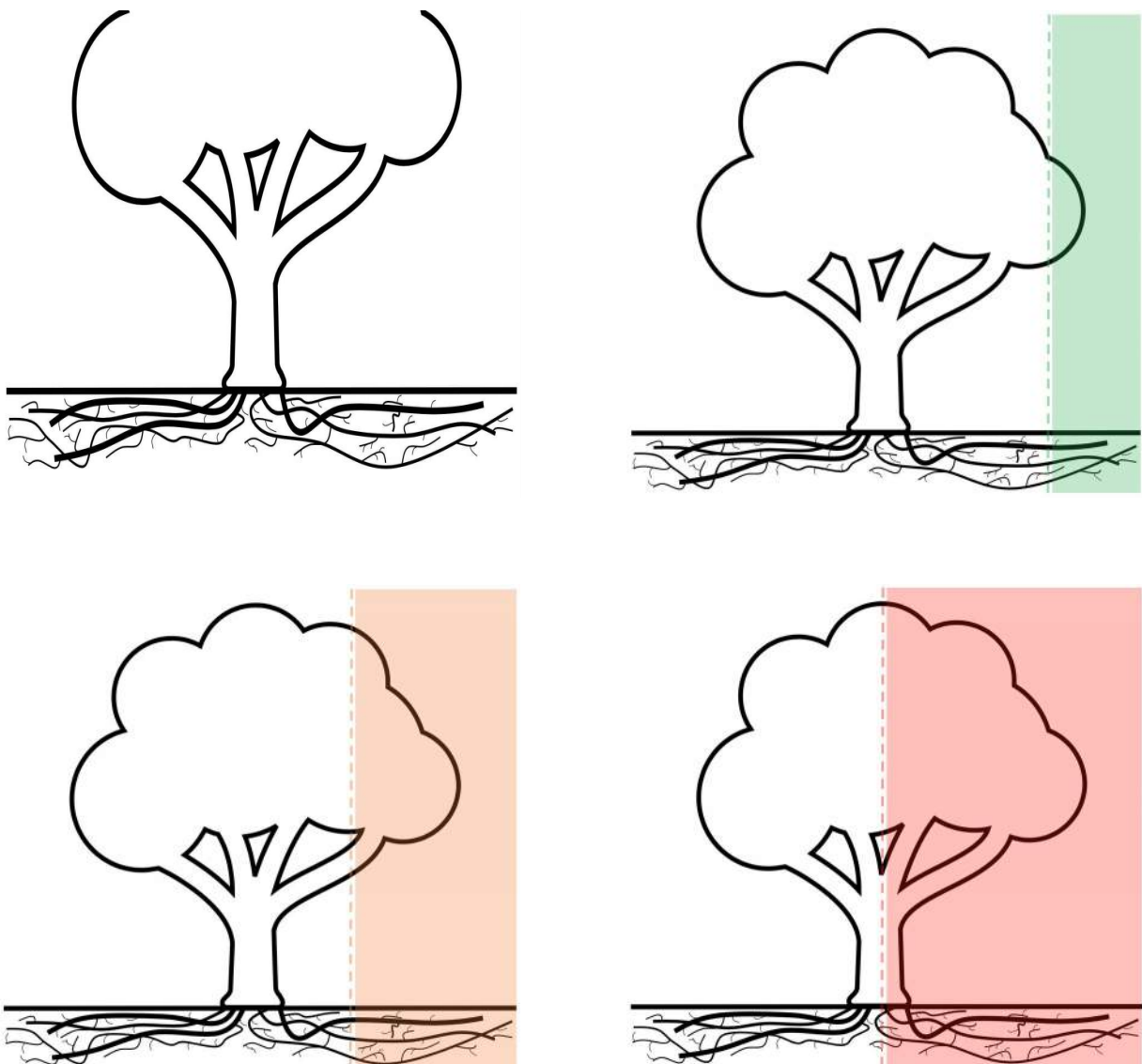


Figure 3: Indicative levels of encroachment

Mitigating Development Impacts

Encroachment within the TPZ must be compensated with a range of mitigation measures to ensure that impacts to the Subject Tree(s) are reduced or restricted wherever possible. Mitigation must be increased relative to the level of encroachment within the TPZ to ensure the Subject Tree(s) remain viable. **Table 1** outlines development impact thresholds (based on TPZ encroachment), and mitigation measures required within each impact threshold. These mitigation measures will only apply if trees are proposed to be retained.

<i>Development impact threshold (TPZ encroachment %)</i>	<i>Development impact mitigation measures</i>
No impact (0%)	<ul style="list-style-type: none"> N/A
Minor impact (1-20%)	<ul style="list-style-type: none"> The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. Detailed root investigations should not be required. Tree protection should be installed.
Major impact (>20%)	<ul style="list-style-type: none"> The project arborist must demonstrate the tree(s) would remain viable. The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. Non-destructive root investigation may be required for any trees proposed for retention. The project arborist will be required to supervise any works within the TPZ. Tree protection must be installed.
Total impact	<ul style="list-style-type: none"> Subject Tree(s) cannot be successfully retained.

Table 1: Impact mitigation measures

4 Results

Nil Impact (0% TPZ encroachment)

A total of **three** Subject Trees (**id. 3, 4 & 6**) are located outside of the proposed area of disturbance and are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.

Minor Impact (1-20% TPZ encroachment)

A total of **two** Subject Trees (**id. 1 & 7**) will require excavation activities <20% of total TPZ and are unlikely to have a significant impact on the Subject Tree's ability to store carbohydrates, use stored carbohydrates in times of stress and are unlikely to have a significant impact on the health, condition and/or stability of the subject trees long term and are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.

Total Impact

A total of **seven** Subject Trees (**id. 2, 5 & 8-12**) are located wholly within the construction footprint of the proposed development.

Under the current proposal, these trees cannot be successfully retained.

*Further information specific to each of the Subject Trees can be found in **Tables 2, 3 & 4 and Appendix II.***

5 Discussion

Trees on development sites

Construction and development can change the way an area is utilised by adding buildings, infrastructure and pedestrians to the location. This can result in an increased potential of damage and harm to property and people. Therefore, trees that contain significant defects, are structurally poor or have a short useful life expectancy should be considered for removal.

Furthermore, it is not always possible or reasonably practicable to retain all trees within a proposed development. It can be better to select the higher retention value trees and protect these well, rather than trying to retain all trees and decreasing the quality of tree protection (Matheny & Clark, 1998).

Trees can be negatively affected in a number of ways during construction. These include root loss, lack of water and oxygen to the root zone, damage to the trunk or canopy and/or poisoning. Failure to protect trees, particularly root zones, during development can lead to an increased risk of tree death and/or failure post construction.

Impacts - Roots

Most tree roots will usually be found in the top 600mm of soil (Harris, Clark & Matheny, 1999). Radiating outwards from the base of the trunk are several large woody roots. These structural roots anchor the tree in the ground. Cutting or affecting those roots is likely to undermine the stability of the tree. The spread of a tree's structural roots, herein termed its Structural Root Zone (SRZ), is generally proportioned to the diameter of its trunk (Mattheck & Breloer, 1994).

Beyond this zone extends the network of woody transport roots and fine absorbing roots, which absorb and transport water and nutrients. Most of these roots are found in the top 150mm of soil (Harris, Clark & Matheny, 1999). Trees can lose a portion of their absorbing roots without being significantly affected in the long term.

Impacts – Canopy

Fundamentally, pruning is the removal of plant parts. Tree pruning involves the removal of living and dead tissues in an attempt to control or redistribute growth and to create a structurally sound mature form. Tree health and the ability to recover from the myriad of urban stressors are directly related to canopy area and the loss of live foliage and woody transport tissue can lead to a significant negative impact a Subject Tree's ability to photosynthesise light energy into chemical energy necessary for the normal physiological functioning and survival of the tree. Live crown ratios of 50%-60% maintain tree vitality while reducing the risk of premature limb/tree failure.

Natural Target Pruning is the removal of branches, stems, and stubs such that final cuts are achieved as close as possible to the branch collar without cutting into the branch collar or leaving a protruding stub. The branch collar is an area of overlapping trunk and branch tissue forming a swelling around the base of many branches. It contains defensive chemicals that can prevent infection from bacterial and/or fungal pathogens. **Figure 2.3** shows final cut locations when undertaking pruning works.

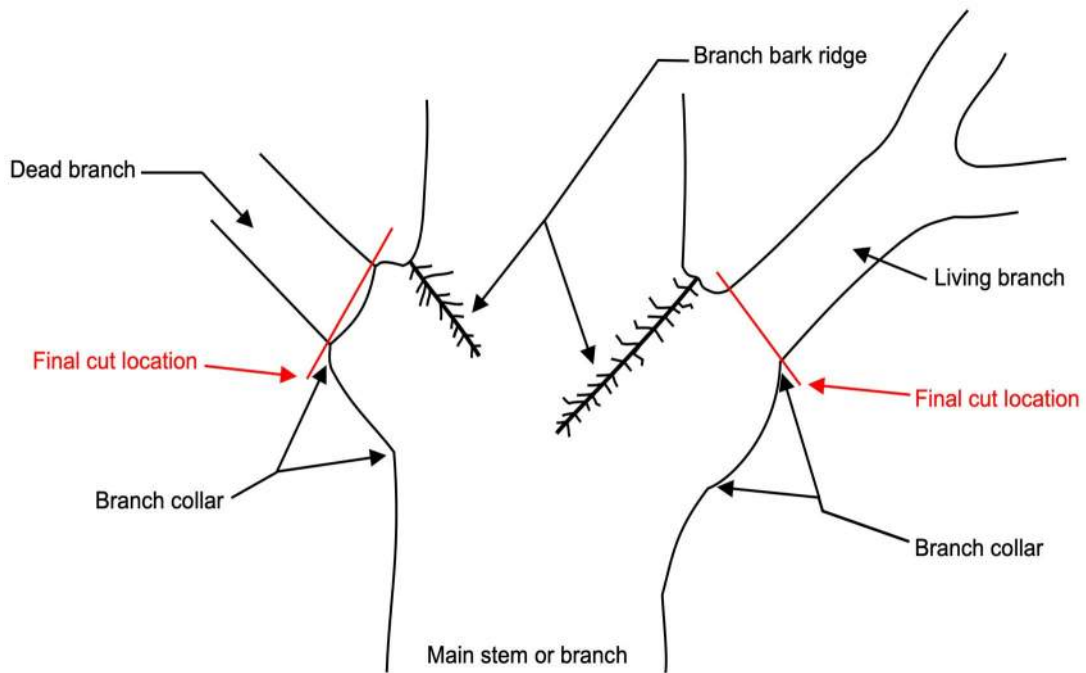


Figure 2.3

On branches where the branch bark collar cannot be found, the branch bark ridge is to be used as a pruning guide. **Figure 2.4** shows final cut location where – Line A to X is a line parallel to the trunk occurring just outside the branch bark ridge. Line A to C indicates the angle of the branch bark ridge and Line A to B represents the angle and location of the final cut. Angle 'a' should equal angle 'b'.

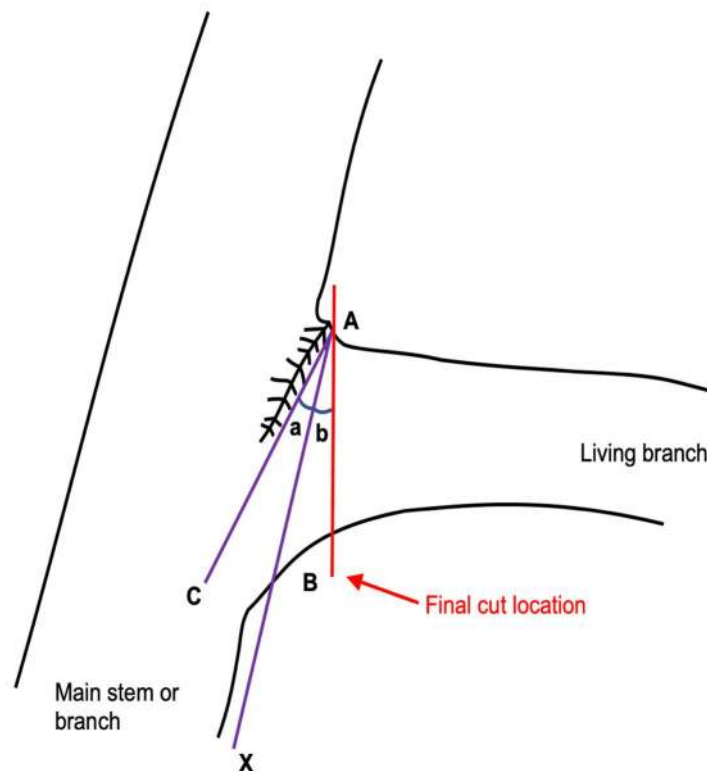


Figure 2.4

The cutting of branches which results in a stub, referred to as lopping is regarded as an unacceptable practice, except in certain circumstances. Lopping may result in:

- An increased rate of shoot production and elongation, which is weakly attached to the parent tree.
- Decay of the stubs.
- Poor form and visual amenity.
- Reduced life expectancy of the tree.
- Pre-disposing the tree to pathogenic infection and insect attack.

Tree Transplanting

Consideration was given to the option to the removal and transplantation; however this was deemed to be unfeasible due to the retention value of the Subject Trees as well as budgetary and time constraints.

Table 2: Results of Arboricultural Assessment – No Impact

Id.	Botanical name	Impact	Encroachment within TPZ (%)	Description of impacts	Impact mitigation	Result
3	<i>Eucalyptus punctata</i>					
4	<i>Eucalyptus saligna</i>	Nil	0	<ul style="list-style-type: none">Subject Trees located outside the proposed area of disturbance.Anticipated conflict between Subject Trees and plant/vehicle movements and material access.	<ul style="list-style-type: none">Subject Trees are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.	Retain if possible
6	<i>Ficus microcarpa</i>					

Table 3: Results of Arboricultural Assessment – Minor Impact

Id.	Botanical name	Impact	Encroachment within TPZ (%)	Description of impacts	Impact mitigation	Result
1	<i>Eucalyptus saligna</i>	Minor	1	<ul style="list-style-type: none">Minor impact due to TPZ encroachment of 1m disturbance buffer.Anticipated conflict between Subject Tree and plant/vehicle movements and material access.	<ul style="list-style-type: none">Subject Trees are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.	Retain if possible
7	<i>Ficus microcarpa</i>	Minor	5			

Table 4: Results of Arboricultural Assessment – Total Impact

Id.	Botanical name	Impact	Encroachment within TPZ (%)	Description of impacts	Impact mitigation	Result
2	<i>Eucalyptus saligna</i>					
5	<i>Eucalyptus punctata</i>					
8	<i>Ficus microcarpa</i>					
		Total	100	<ul style="list-style-type: none">Subject Tree is located wholly within the development footprint.Subject Tree cannot be successfully retained		Remove
9	<i>Ficus microcarpa</i>					
10	<i>Ficus microcarpa</i>					
11	<i>Eucalyptus saligna</i>					

Table 4: Results of Arboricultural Assessment – Total Impact

Id.	Botanical name	Impact	Encroachment within TPZ (%)	Description of impacts	Impact mitigation	Result
12	<i>Eucalyptus punctata</i>	Total	100	<ul style="list-style-type: none">Subject Tree is located wholly within the development footprint.	<ul style="list-style-type: none">Subject Tree cannot be successfully retained	Remove

6 Recommendations

Trees Proposed for Removal

Total Impact: Subject Trees **id. 2, 5 & 8-12** are located wholly within the construction footprint and are recommended for removal as part of the proposed development.

Trees to be Retained Where Possible

Minor Impact: Subject Trees **id. 1 & 7** are located adjacent to the construction footprint and are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.

Nil Impact: Subject Trees **id. 3, 4 & 6** are located adjacent to the construction footprint and are only to be removed as a contingency if the construction activities taking place necessitate this, or if required for safety reasons, ie. If the construction activities can take place without these trees being removed, then they are to be retained.

Vegetation Offset

Offset replacement planting to compensate for the loss of the tree as part of this development should be undertaken in accordance with the relevant vegetation offset replacement policy, consist of tree species which are endemic to the local area, are suited to the size of the area of which they are planted and provide a net increase in the number of trees removed.

Tree Removal

The following tree removal measures are recommended:

- Any approved pruning and/or tree removal work is to be carried out by an arborist with a minimum AQF Level 3 qualification in Arboriculture.
- Any approved pruning must be in accordance with *AS 4373-2007, Pruning of Amenity Trees*.
- Any approved pruning and/or tree removal work is to be carried out in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).
- Permission must be granted from the relevant consent authority, prior to removing or pruning of any of the subject trees.

Tree Protection

In the event that Subject Trees are able to be retained, the following tree protection measures are recommended:

- Tree protection plan must be implemented under consultation with an AQF Level 5 (Arboriculture) Arborist.
- Tree protection measures are to be installed in accordance with *AS 4970-2009, Protection of Trees on Development Sites*.
- All proposed works within the TPZ must be carried out under the supervision of the project arborist.

- The area lost to encroachment should be compensated for elsewhere, contiguous with the TPZ (**Appendix IV**).

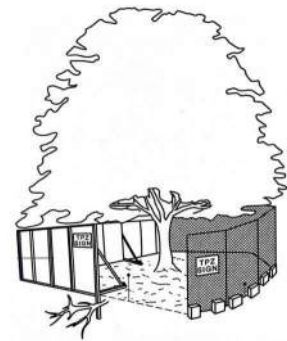
Tree Protection Fencing

Tree protection fencing must be established in the locations shown in **Appendix III**. Existing fencing, site hoarding or structures (such as a wall or building) may be used as tree protection fencing, providing the TPZ remains isolated from construction footprint.

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.

Tree protection fencing shall be:

- Enclosed to the full extent of the TPZ (or as specified in the Recommendations and Tree Protection Plan).
- Temporary mesh panel fencing (minimum height 1.8m).
- Certified and inspected by the project arborist.
- Installed prior to the commencement of works.
- Prominently signposted with 300mm x 450mm boards stating, "NO ACCESS - TREE PROTECTION ZONE".



If tree protection fencing cannot be installed due to sloping or uneven ground, tree protection barriers must be installed as an alternative.

Specifications for tree protection barriers are as follows:

- Star pickets spaced at 2m intervals,
- Connected by a continuous high-visibility barrier/hazard mesh.
- Maintained at a minimum height of 1m.

Where approved works are required within the TPZ, fencing may be setback to provide construction access. Trunk, branch and ground protection shall be installed and must comply with AS 4970-2009, *Protection of Trees on Development Sites*. Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist.

Trunk Protection

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

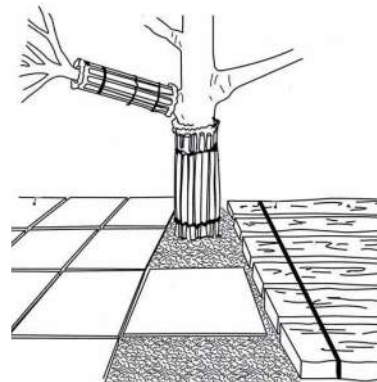
Specifications for trunk protection are as follows:

- A thick layer of carpet underfelt, geotextile fabric or similar wrapped around the trunk to a minimum height of 2m.
- 1.8m lengths of softwood timbers aligned vertically and spaced evenly around the trunk (with a small gap of approximately 50mm 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.

Ground Protection

If temporary access for vehicle, plant or machinery is required within the TPZ ground protection shall be installed. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Where possible, areas of existing pavement shall be used as ground protection.



Specifications for light traffic access (<3.5 tonne) are as follows:

- Permeable membrane such as geotextile fabric.
- Layer of mulch or crushed rock (at minimum depth of 100mm)

Specifications for heavy traffic access (>3.5 tonne) are as follows:

- Permeable membrane such as geotextile fabric.
- Layer of lightly compacted road base (at minimum depth of 200mm)
- Geotextile fabric shall extend a minimum 300mm beyond the edge of the road base.

Pedestrian, vehicular and machinery access within the TPZ shall be restricted solely to areas where ground protection has been installed.

Excavations

All approved excavations (including root investigations) within the TPZ must be carried out using tree sensitive methods under supervision of the project arborist. These methods may include:

- Manual excavation (hand tools).
- Air spade.
- Hydro-vacuum excavations (sucker-truck).

Where approved by the project arborist, excavations using compact machinery fitted with a flat bladed bucket is permissible. Excavations using compact machinery shall be undertaken in small increments and guided by the Project Arborist who is to look for and prevent root damage to roots (>50mm in diameter).

Exposed roots shall be protected from direct sunlight, drying out and extremes of temperature by covering with geotextile fabric, and plastic membrane or glad wrap (where practical). Coverings shall be weighted to secure them in place. The geotextile fabric shall be kept damp at all times.

No over-excavation, battering or benching shall be undertaken beyond the footprint of any structure unless approved by the project arborist. Hand excavation and root mapping shall be undertaken along excavation lines within the TPZ prior to the commencement of mechanical excavation (to prevent tearing and shattering of roots from excavation equipment). Any conflicting roots (>50mm in diameter) shall be pruned using clean, sharp secateurs or a pruning saw to ensure a clean cut, free from tears. All root pruning must be documented and carried out by the project arborist.

Underground Services

All underground services should be routed outside of the TPZ. If underground services need to be installed within the TPZ, they must be installed using tree sensitive excavation methods under supervision of the project arborist. Alternatively, boring methods such as horizontal directional drilling (HDD) may be used for underground service installation, providing the installation is at minimum depth of 800mm below grade. Excavations for entry/exit pits must be located outside the TPZ

7 References

General References

- *Australian Standard, AS 4373-2007, Pruning of Amenity Trees.*
- *Australian Standard, AS 4970-2009, Protection of Trees on Development Sites.*
- *Harris, R., Clark, J., Matheny, N. and Harris, V. 2004. Arboriculture. Upper Saddle River, N.J.: Prentice Hall.*
- *Lonsdale, D. 1999. Principles of tree hazard assessment and management. London: Stationery Office.*
- *Loughran, A. 2007. Native plant or weed. Paterson, N.S.W.: Tocal College, NSW Dept. of Primary Industries.*
- *Mattheck, C. 2007. Updated field guide for visual tree assessment. Karlsruhe: Forschungszentrum Karlsruhe.*
- *Mattheck, C., Bethge, K. and Weber, K. 2015. The body language of trees. Karlsruhe: Karlsruher Inst. für Technologie.*
- *Mattheck, C., Lonsdale, D. and Breloer, H. 1994. The body language of trees. London: H.M.S.O.*
- *MacLeod, R D. and Cram, W J. 1996. Forces Exerted by Tree Roots, Arboriculture Research Information Note, 134/96/EXT.*
- *Smiley, T. and Fite, K. 2008. Managing Trees During Construction. Arborist News. WorkCover NSW. 1998. Code of Practice: Amenity Tree Industry.*

Specific References

The conclusions and recommendations of this report are based on the *Australian Standard, AS 4970-2009, Protection of Trees on Development Sites*, the findings from the site inspections and analysis of the following documents/plans:

- *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017.*
- *Civil Scope Surveying: Drawing: Untitled; Project: Barangaroo; Client: Ward, dated 15.10.2021.*
- *City of Sydney Council: Sydney Development Control Plan (SDCP) 2012.*
- *NSW Government: Condition of Approval (CoA E6) of the Planning Approval (Critical State Significance Infrastructure Sydney Metro City & Southwest Chatswood to Sydenham 7400 Mod 8).*

Civil Scope Surveying: Drawing: Untitled; Project: Barangaroo; Client: Ward has been used as a base map for **Appendix I & III**.

Appendix I **Impact Assessment**

Arboricultural Impact Assessment

LEGEND

- Tree Location
- Structural Root Zone
- Tree Protection Zone
- Encroachment
- Condensed Water Pipe Alignment
- 1 m Disturbance Buffer

Base map © Department of Customer Service

Barangaroo Metro Station
Barangaroo NSW 2000

Prepared by: Lex Atkins
Project Manager: Lex Atkins
Date: 21.12.2021



treeREPORT.
ARBORICULTURAL CONSULTING

Arboricultural Impact Assessment

LEGEND

- Tree Location
- ▭ Structural Root Zone
- ▭ Tree Protection Zone
- ▭ Encroachment
- ▭ Condensed Water Pipe Alignment
- ▭ 1 m Disturbance Buffer

Base map: © Department of Customer Service

Barangaroo Metro Station
Barangaroo NSW 2000

Prepared by: Lex Atkins
Project Manager: Lex Atkins
Date: 21.12.2021



treeREPORT.
ARBORICULTURAL CONSULTING

Appendix II **Tree Schedule**

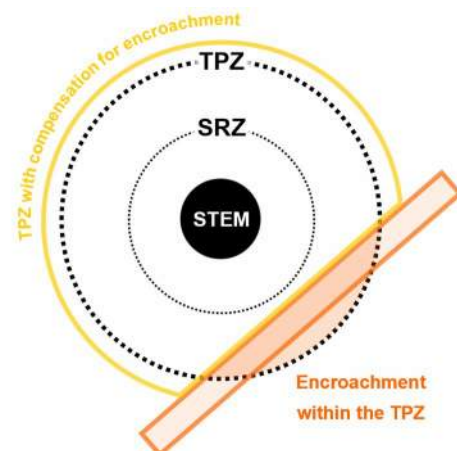
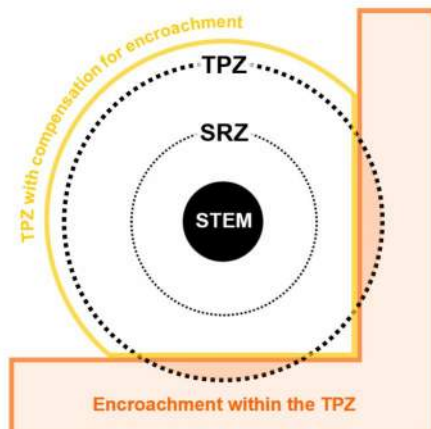
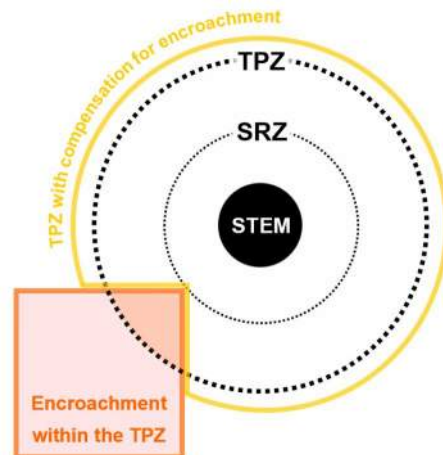
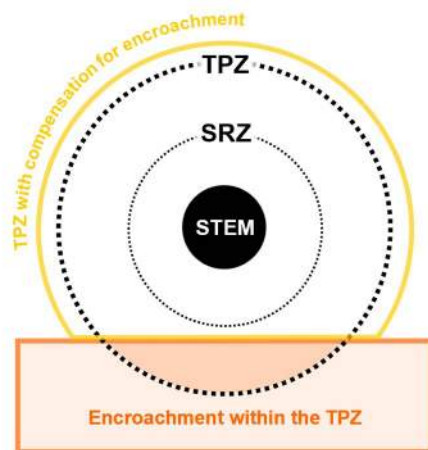
Id.	Botanical name	Height (m)	Spread (m)	Health	Structure	Age class	Tree significance	Useful life expectancy	Priority for retention	DBH 1 (Ømm)	DBH 2 (Ømm)	DBH 3 (Ømm)	Calculated DBH (mmØ)	SRZ (Rm)	TPZ (Rm)	Other notes
1	<i>Eucalyptus saligna</i>	9	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Retain where possible
2	<i>Eucalyptus saligna</i>	9	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Remove
3	<i>Eucalyptus punctata</i>	8	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Retain where possible
4	<i>Eucalyptus saligna</i>	8	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Retain where possible
5	<i>Eucalyptus punctata</i>	7	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Remove

Id.	Botanical name	Height (m)	Spread (m)	Health	Structure	Age class	Tree significance	Useful life expectancy	Priority for retention	DBH 1 (Ømm)	DBH 2 (Ømm)	DBH 3 (Ømm)	Calculated DBH (mmØ)	SRZ (Rm)	TPZ (Rm)	Other notes
6	<i>Ficus microcarpa</i>	4	4	Fair	Good	Mature	Medium	Medium (15-40yrs)	Medium	200	-	-	200	1.7	2.4	<ul style="list-style-type: none"> Minor pest infestation. Sparse canopy. Retain where possible
7	<i>Ficus microcarpa</i>	4	5	Good	Good	Mature	Medium	Medium (15-40yrs)	Medium	200	-	-	200	1.7	2.4	<ul style="list-style-type: none"> Minor pest infestation. Retain where possible
8	<i>Ficus microcarpa</i>	4	4	Good	Good	Mature	Medium	Medium (15-40yrs)	Medium	200	-	-	200	1.7	2.4	<ul style="list-style-type: none"> Minor pest infestation. Sparse canopy. Remove
9	<i>Ficus microcarpa</i>	4	4	Good	Good	Mature	Medium	Medium (15-40yrs)	Medium	200	-	-	200	1.7	2.4	<ul style="list-style-type: none"> Minor pest infestation. Sparse canopy. Remove
10	<i>Ficus microcarpa</i>	4	5	Good	Good	Mature	Medium	Medium (15-40yrs)	Medium	200	-	-	200	1.7	2.4	<ul style="list-style-type: none"> Minor pest infestation. Sparse canopy. Remove

Id.	Botanical name	Height (m)	Spread (m)	Health	Structure	Age class	Tree significance	Useful life expectancy	Priority for retention	DBH 1 (Ømm)	DBH 2 (Ømm)	DBH 3 (Ømm)	Calculated DBH (mmØ)	SRZ (Rm)	TPZ (Rm)	Other notes
11	<i>Eucalyptus saligna</i>	9	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Remove
12	<i>Eucalyptus punctata</i>	8	2	Fair	Good	Semi-mature	Low i	Medium (15-40yrs)	Low	<150	-	-	<150	1.5	2	• Remove

Appendix III **Encroachment within the TPZ**

The images below show how encroachment within the tree protection zone can be compensated for elsewhere.



Reference

Council of Standards Australia (August 2009)
AS 4970-2009 Protection of Trees on Development Sites
Standards Australia, Sydney.

Appendix IV **STARS® assessment matrix**

Tree Significance - Assessment Criteria - STARS®

Low	Medium	High
<p>i) Significance in landscape</p> <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>The tree is in fair to good condition</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 councils' 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>
<p>ii) Environmental Pest/Noxious Weed Species</p> <p>The tree is an environmental pest species due to its invasiveness or poisonous/allergenic properties.</p> <p>The tree is a declared noxious weed by legislation</p>		
<p>iii) Hazardous/Irreversible Decline</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</p>		

Useful Life Expectancy - Assessment Criteria

Dead / Dying	Short	Medium	Long
Trees with a high level of risk that would need removing within the next 5 years.	Trees that appear to be retainable with an acceptable level of risk for 5-15 years.	Trees that appear to be retainable with an acceptable level of risk for 15-40 years.	Trees that appear to be retainable with an acceptable level of risk for more than 40 years.
Dead trees.			
Trees that should be removed within the next 5 years.	Trees that may only live between 5 and 15 more years.	Trees that may only live between 15 and 40 more years.	Structurally sound trees located in positions that can accommodate future growth.
Dying or suppressed or declining trees through disease or inhospitable conditions.	Trees that may live for more than 15 years but would be removed to allow the safe development of more suitable individuals.	Trees that may live for more than 40 years but would be removed to allow the safe development of more suitable individuals.	Storm damaged or defective trees that could be made suitable for retention in the long term by remedial tree surgery.
Dangerous trees through instability or recent loss of adjacent trees.	Trees that may live for more than 15 years but would be removed during the course of normal management for safety or nuisance reasons.	Trees that may live for more than 40 years but would be removed during the course of normal management for safety or nuisance reasons.	Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long-term retention.
Dangerous trees through structural defects including cavities, decay, included bark, wounds or poor form.			
Damaged trees that considered unsafe to retain.	Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	
Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting.			
Trees that will become dangerous after removal of other trees for the reasons.			

Tree Significance

		Tree Significance			Low		
		High	Medium		i	ii	iii
Useful Life Expectancy	Long >40 years						
	Medium 15-40 years						
	Short 5-15 years						
	Dead/Dying <5 years						

Legend for Matrix Assessment

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

Appendix V **Site Images**



Image 1: Subject Trees 1, 2, 5, 11 & 12



Image 2: Subject Trees 3 & 4



Image 3: Subject Trees 6, 7, 9 & 10



Image 4: Subject Tree 8



tR.

Beautiful Arboriculture.

tR.

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Website treereport.com.au

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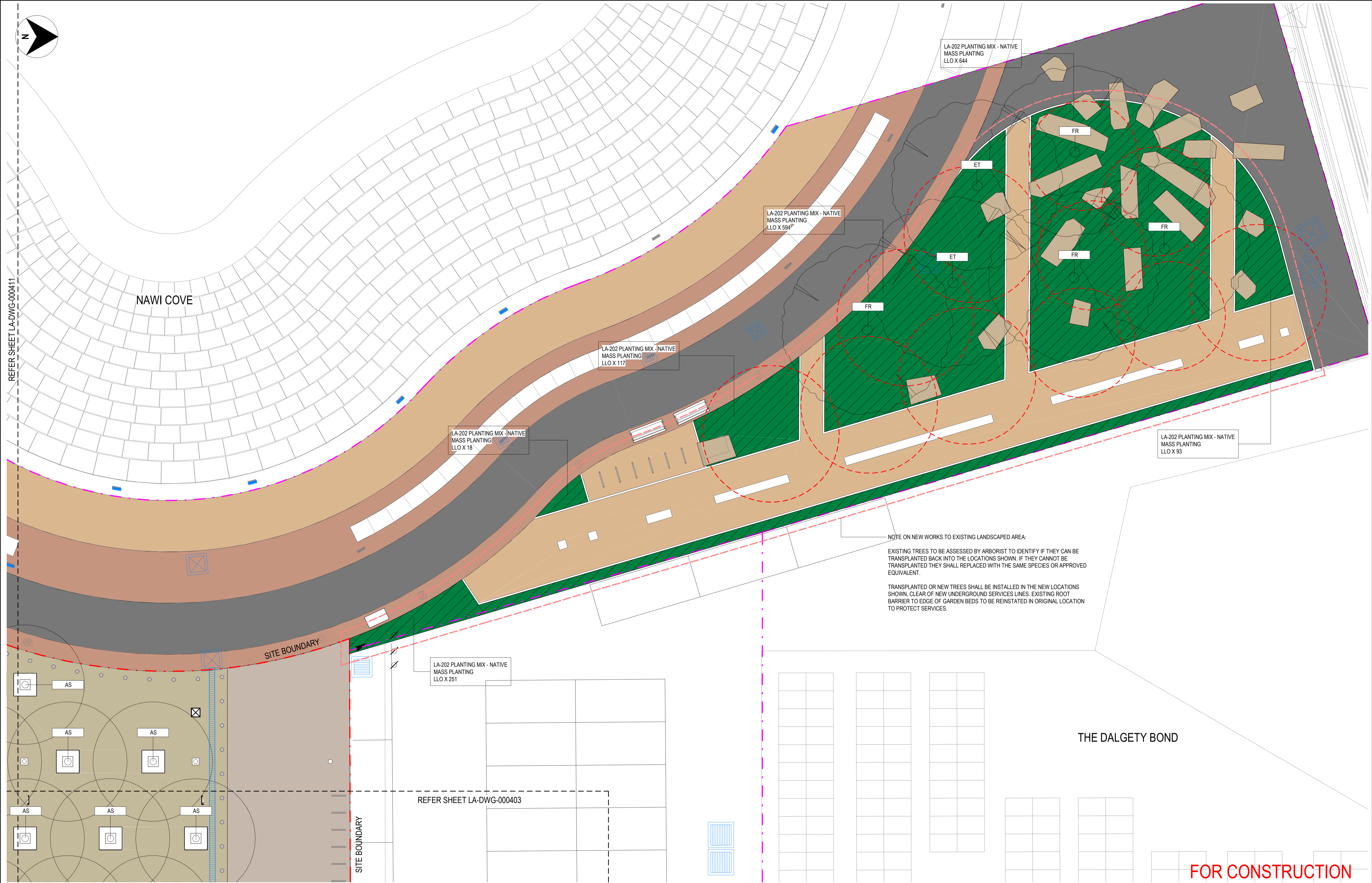


Appendix B Landscaping Documentation



Caption: One Central Park, Sydney

100mm AT FULL SIZE Plot Date & Time 29/09/2021 10:24:00 AM



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