



Independent  
Arboricultural  
Services

PLANS AND DOCUMENTS  
referred to in the PDA  
DEVELOPMENT APPROVAL

Approval no: DEV2024/1488

Date: 30/09/2024



## Arboricultural Impact Assessment

Prepared For: Provincial Building Pty Ltd

Job Date: 11 December 2023

67-69 Shore Street East  
Cleveland QLD 4163

IAS13882



## Independent Arboricultural Services - Disclaimer

The material contained in this document has been prepared on an independent basis free of any bias and represents the honest opinion of the consulting arborist.

Tissue or soil samples have not been collected nor submitted for testing unless otherwise stated. Excavation is limited to minor earthworks, and we submit this assessment on the basis that all data is based on visual inspection of the tree/s and its/their location, species, health and condition at the time of writing unless otherwise stated. Measurements and tree locations noted in this report are approximate and have not been determined by survey unless information and analysis has been provided by the consultant or such information is otherwise noted. Please request a more detailed arborist report if further information and analysis is required. Depending on site requirements, specific alternate specialist advice including engineering consultancy and certification maybe required in combination with this assessment. This assessment contains arborist advice and associated general information only and does not purport to provide other site-specific specialist advice such as engineering certification unless arrangement to source such advice for inclusion in this assessment has been requested and authorised.

This report containing opinions, advice and recommendations based on information and data gathered from site inspections carried out by personnel from Independent Arboricultural Services as well as information provided by the client and/or its representatives, is to be relied on by the client in that context. It is assumed that all such information provided to Independent Arboricultural Services is correct. All recommended Arboricultural works detailed in this assessment including pruning of tree canopy or roots, tree removal, tree transplantation or other associated works including stump grinding or the application of any prescribed treatment shall be carried out in accordance with applicable standards including Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 Protection of trees on development sites.

This report is subject to copyright laws and no part of it may be reproduced or used without the express written permission of the client or Independent Arboricultural Services, nor shall it be conveyed to the public through advertising, public relations, news, sales or other media without the written consent of the consultant and no responsibility will be accepted by Independent Arboricultural Services should such unauthorised use of this report be made. The consultant shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements have been made including payment of additional fees for such services.

The invoice for this report will be issued to the person or entity as per the address advised at the time of confirmation of appointment. Assessment in this report is based on plans provided at the time of confirmation of engagement and report preparation. Additional time required for re-assessment of report detail due to subsequent re-issue of plans after report preparation will be subject to an additional fee which will be charged at our hourly rate. This report shall not be conveyed to any third party including regulatory authority/s until full payment of this invoice is received by Independent Arboricultural Services and a finalised report has been issued unless agreement to do so has been granted.

Factors including the absence of historical records or local knowledge, recognition of the variability of the integrity of a tree as a naturally living organism as well as the impact of conditions within its surrounds to which it maybe subject including the impacts of mechanical force and the occurrence of weather events, do not allow an arborist to guarantee the age of a tree, or the length of time a tree/s may live or such time as it /they may fail. There is no warranty or guarantee, expressed or implied that the problems or deficiencies of the plants or property in question may not arise in the future.

## Executive Summary

Independent Arboricultural Services have been engaged by Provincial Building Pty Ltd to assess potential impacts to the nominated vegetation resulting from proposed re-development of 67-69 Shore Street East, Cleveland QLD 4163. Kieran Pentland (AQF Level 9) attended site on 11 December 2023 to undertake the assessment of the impact of the works.

The assessment of the impacts of proposed development on the identified trees in and around the development envelope, roads and services has been undertaken. Advice on both specific and general tree protection measures and Project Arborist Requirements have been detailed in this report. It is important as the design is refined, further reviews are undertaken by the Project Arborist and protection measures are further specified as required.

Further detailed designed will be assessed as available during the project. Protection measures and assessment of incursion has been based on the available information provided.

**Additionally, a Further Issues Letter was received by the client from Qld State Government Department (MEDQ) dated 18 April 2024.**

*Landscape Values: The proposed development will likely have a detrimental effect on the landscape values of the adjoining heritage place. Submit an updated arboricultural report addressing the potential detrimental impact on the Heritage-significant trees.*

*The updated report is to consider the following:*

- *Tree 1 will be exposed to 900mm of cut and Tree 8 will be exposed to 900mm of fill. Clarify how this excavation and filling will not affect tree health, and confirm works will not occur within the structural root zone. (Tree numbers taken from the Survey Plan). To note: Arborist to consider whether test pits are to be dug and roots located to confirm heritage significant trees will not be impacted. Any test pits should use minimally destructive techniques such as hand-digging, compressed air or water-jetting, or non-destructive techniques such as ground penetrating radar and supervised by a qualified arborist with Australian Qualification Framework Level 5 accreditation and in accordance with AS 4970- 2009.*
- *The car park encroaches into the tree protection zone (Architectural drawing 2.1), potentially impacting tree viability. The applicant is requested to confirm if an alternative design has been considered to protect existing trees and their TPZ. The layout of any foundation piers within the TPZ must be flexible in their final positioning and allow for the reduction of piers should roots be encountered. Confirm if the design allows for the floor structure engineering design to bridge between piers or cantilever, where piers are repositioned. Alternative design of bridging component to be available for work in the TPZ (this may include bridging above ground level, rather than in ground). a. Pruning requirement: Arborist to confirm whether pruning of trees in adjacent properties are required during construction as the arboriculture report is silent on this. Confirm trees at the rear of the site are not impacted as these are within an area designated as a koala corridor.*

**As part of the response, a redesign has been undertaken limiting works to less than 10% encroachment into the TPZ of the identified *Subject Trees*. This is a minor incursion in accordance with AS4970:2009 and within acceptable thresholds to retain the *Subject Trees*. The fill required is within the built environment only. It is further acknowledged supporting ground penetrating radar assessment was undertaken (see report #IAS14905). No pruning is required to facilitate any required clearances. The *Subject Trees* and neighbouring trees presented with historical pruning works.**



To facilitate development the Arborist identified the following measures;

Trees affected includes;

- Trees with incursion into the TPZ include Trees 1, 2, and 3.

Specific Tree Protection Measures include;

- Ensure all approvals and permits are in place before works commence.
- Undertake a pre-start meeting with contractors before works commence.
- Tree Protection Fencing is to be erected before works commence and audited by the Project Arborist (Min AQF Level 5).
- The edge of cut within the extent of subject trees TPZs to be vacuum excavated under the supervision of a minimum AQF Level 5 Project Arborist.
- All exposed roots are to be pruned and treated by the Project Arborist.
- A plant healthcare protocol (irrigation, fertilisation, soil conditioners, inoculants) shall be enacted for the life of the project to counter stress caused by root loss.
- All other proposed within the TPZ of retained trees requires supervision of a minimum AQF5 Project Arborist.
- Laydown areas and site shed/office locations are to be identified/finalised and excluded from the Tree Protection Zones of retained trees and minimise public impact.
- Route vehicles and equipment outside of TPZs. If access is required within TPZ, mulch to a depth of 100mm and tree padding needs to be installed with the option of track mats as determined and signed off by a minimum AQF5 Project Arborist.
- Construction materials, spoil, stockpiles, tools and equipment are not permitted within the TPZs of retained trees.



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## Document Tracking & Information

<b>Project Name</b>	Arboricultural Impact Assessment		
<b>Project Arborist</b>	Kieran Pentland (AQF Level 9)		
<b>Client</b>	Provincial Building Pty Ltd		
<b>Address</b>	67-69 Shore Street East, Cleveland QLD 4163		
<b>IAS Reference</b>	IAS13882		
<b>Prepared By</b>	Kieran Pentland (AQF Level 9)		
<b>Checked By</b>	Mick Maher (AQF Level 5)	<b>Date</b>	21 June 2024
<b>Revision</b>	3		
<b>Andrew Rankine Director</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>Arboriculture Australia Registered Professional Arborist</li> <li>QTRA (Lic. 2768)</li> </ul>	<ul style="list-style-type: none"> <li>TRAQ (Qualified)</li> <li>ISA Certified Arborist &amp; Municipal Specialist AU-0269AM</li> <li>QAA Qualified Member</li> </ul>	
<b>Roger Rankine Director</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>Grad Cert Arb. (AQF Level 8)</li> <li>ISA Qualified Arborist (QL-0001A)</li> <li>QTRA (Lic. 4988)</li> </ul>	<ul style="list-style-type: none"> <li>TRAQ (Qualified)</li> <li>Arboriculture Australia Registered Professional Arborist</li> <li>QAA Qualified Member</li> </ul>	
<b>Stephen Catchpoole Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>QTRA (Qualified)</li> <li>Doctor of Philosophy in Forestry (PhD)</li> </ul>	<ul style="list-style-type: none"> <li>TRAQ (Qualified)</li> <li>Bachelor of Science Forestry</li> <li>Bachelor of Science (Hons Botany)</li> <li>QAA Qualified Member</li> </ul>	
<b>Mick Maher Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>Cert IV Project Management</li> <li>Cert III Conservation and Land Management</li> </ul>	<ul style="list-style-type: none"> <li>TRAQ (Qualified)</li> <li>Cert II Horticulture (Turf Management)</li> <li>QAA Qualified Member</li> </ul>	
<b>Garry Rangi Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>Cert III in Civil Construction: (Plant Operations), (Pipe Laying), (Road Construction &amp; Maintenance)</li> <li>Advanced Diploma of Civil Construction</li> <li>Cert III in Conservation Earthworks</li> <li>TRAQ (Qualified)</li> </ul>	<ul style="list-style-type: none"> <li>Diploma Horticulture</li> <li>Diploma Project Management</li> <li>Diploma Business Management</li> <li>Associate Diploma (Wilderness Reserves &amp; Wildlife)</li> <li>Arboriculture Australia Registered Consulting Arborist</li> <li>QAA Qualified Member</li> </ul>	
<b>Sam Gilbey Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>TRAQ (Qualified)</li> <li>QTRA (Qualified)</li> </ul>	<ul style="list-style-type: none"> <li>Bachelor of Science in Ecology and Conservation Biology</li> </ul>	
<b>Kieran Pentland Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>Grad Cert Arb. (AQF Level 8)</li> <li>MSc. Arb. &amp; Urban Forestry (AQF Level 9)</li> <li>QAA Qualified Member</li> <li>QTRA (Qualified)</li> </ul>	<ul style="list-style-type: none"> <li>TRAQ (Qualified)</li> <li>Bachelor of Arts in Leisure Management</li> <li>National Cert in Tree Management</li> <li>National Cert in Horticulture</li> </ul>	
<b>Will Miller Consulting Arborist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>TRAQ (Qualified)</li> <li>QTRA (Lic #5483)</li> </ul>	<ul style="list-style-type: none"> <li>Certificate IV Assessment and Workplace Training</li> <li>Certificate in Horticultural Practices</li> </ul>	
<b>Jessica Andersen Consulting Arborist – GIS / CAD Specialist</b>	<ul style="list-style-type: none"> <li>Diploma Arb. (AQF Level 5)</li> <li>VALID (Qualified)</li> </ul>	<ul style="list-style-type: none"> <li>Bachelor of Design (Landscape Architecture)</li> <li>QAA Qualified Member</li> </ul>	

## Contact Details

<b>Phone</b>	(07) 3399 5865
<b>Enquiries</b>	office@independentarb.com.au
<b>Accounts</b>	accounts@independentarb.com.au
<b>Web</b>	www.independentarb.com.au
<b>Postal Address</b>	PO Box 287, Morningside QLD 4170
<b>ABN</b>	65 062 099 495

## Abbreviations

<b>RCC</b>	Redland City Council	<b>RPA</b>	Root Protection Area
<b>DA</b>	Development Application	<b>TMP</b>	Tree Management Plan
<b>VPO</b>	Vegetation Protection Order	<b>CMP</b>	Construction Management Plan
<b>ULE</b>	Useful Life Expectancy	<b>VMP</b>	Vegetation Management Plan
<b>BLF</b>	Building Location Footprint	<b>AS</b>	Australian Standard
<b>BLE</b>	Building Location Envelope	<b>AS 4373: 2007</b>	Pruning of amenity trees
<b>TPZ</b>	Tree Protection Zone	<b>AS 4970: 2009</b>	Protection of trees on development sites
<b>SRZ</b>	Structural Root Zone	<b>DBH</b>	Diameter at Breast Height

All comments and recommendations in this report have been based, to the greatest extent possible, on relevant Australian Standards, Minimum Industry Standards, Tree Risk Assessment Methodologies, and industry best practice literature. Wherever practicable, the author's professional opinion has been incorporated.



**Kieran Pentland**  
Consulting Arborist



## Map / Subject Site

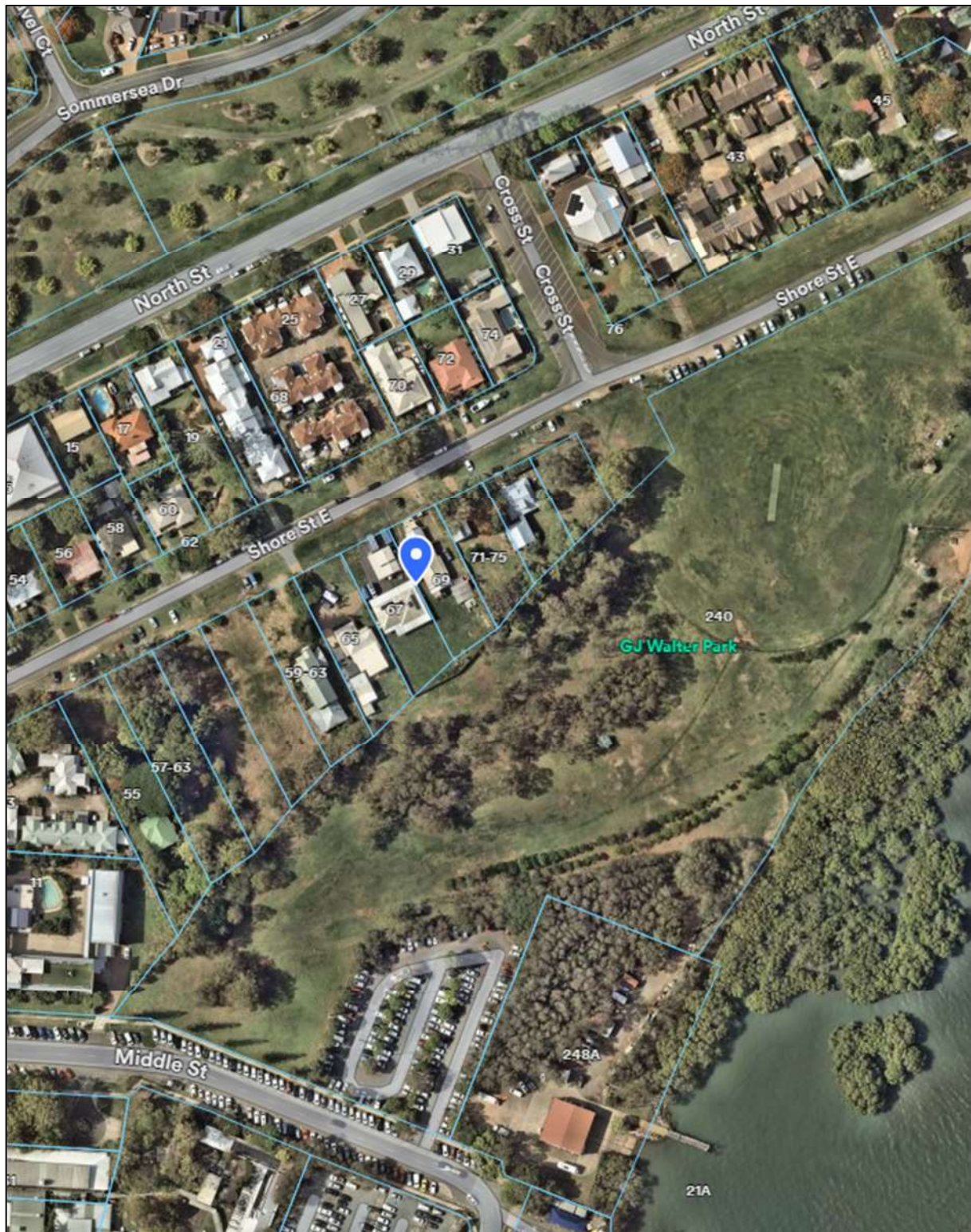


Figure 1: Subject Site – 67-69 Shore Street East Cleveland QLD 4163 (Source: Nearmap. Aerial image captured 19 July 2023)





Figure 2: Subject Site – 67-69 Shore Street East Cleveland QLD 4163. Image captured from road frontage. It is the client's intention to construct a unit complex on the site (Source: IAS 2023).

## Introduction

This report is based on a visual inspection carried out from the ground on 11 December 2023. No soil or tissue sampling has been conducted. Tree assessment and Qualitative Visual Tree Analysis has been carried out in accordance with TRAQ ISA guidelines. Data and information provided to the client by others has been incorporated into this report as appropriate.

All Arboricultural recommendations contained in this report have been determined in accordance with Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 Protection of trees on development sites.

For the purposes of this report reference to a Consulting or Project Arborist is held to mean an Arboricultural specialist who holds minimum Arboricultural qualifications of Dip Arb/AQF 5, appropriate professional insurances and has appropriate experience in the protection of trees on construction sites. Where tree work is specified, all recommended tree work is to be carried out in accordance with the above-mentioned standards by an appropriately trained and AQF qualified arborist practitioner/s with an up-to-date record of training and membership of a recognised Australian Arboricultural association, e.g. Qld Arboricultural Association (QAA), Arboriculture Australia (AA), or a recognised international Arboricultural association. No climbing spikes are to be used if pruning is to be carried out on live trees except in the instance of an emergency.

Qualifications of the report authors include Diploma of Arboriculture/AQF Level 5 and ISA Certified Arborist accreditation. Report authors hold current insurances and memberships including qualified memberships of Queensland Arboricultural Association (QAA), and Arboriculture Australia (AA) as well as current accreditation and membership of International Society of Arboriculture (ISA).

Independent Arboricultural Services is a qualified registrant on the QAA Register of Consulting Arborists.



## Arborist Comment

### Protection of Retained Trees During Construction Works

An exclusion zone is to be established along the perimeters of retained trees and cordoned off with a physical barrier of wire mesh fence, 1.8m in height, which is securely anchored. The role of these fences is to prevent any damage to the complete tree including root system (SRZ & TPZ), stem and branch structure as well as the crown or canopy. Alternatively, and on approval of a minimum AQF5 Project Arborist, plastic mesh fencing, 1.2m in height, secured with star pickets and caps with straining wire can be utilised. All TPZ fencing will require appropriate signage to signify the relevant protection zones. This will require audit and sign off prior to operational works onsite.

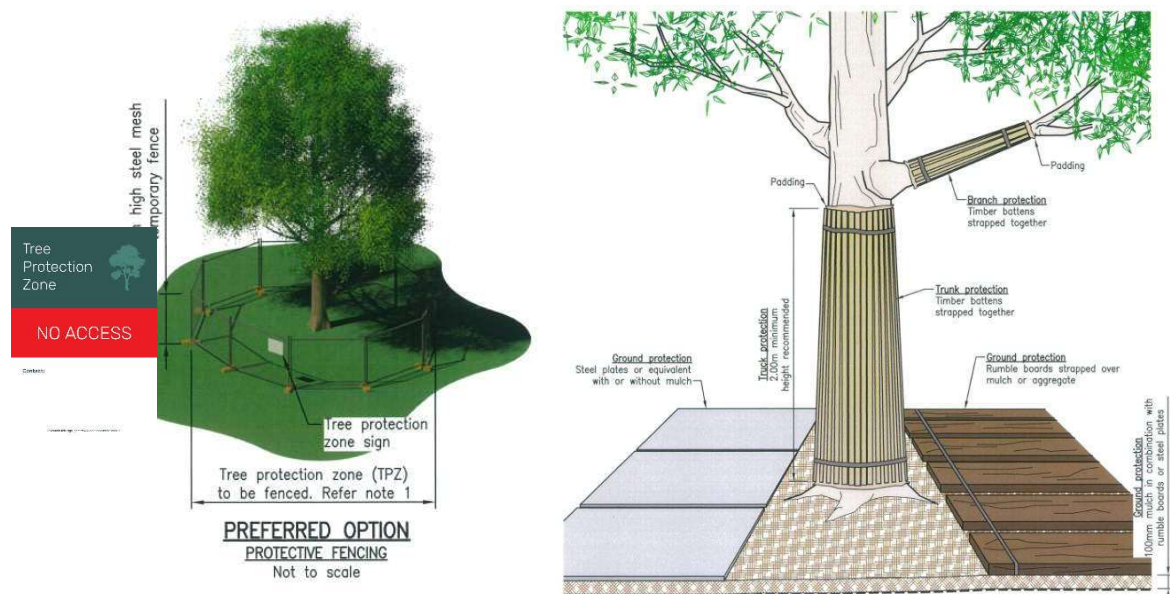


Figure 3: Tree Protection Fencing to be utilised. Where works will be undertaken close to and within Tree Protection Zones specific tree protection measures to be utilised a directed by the project Arborist.

## Project Hold Points

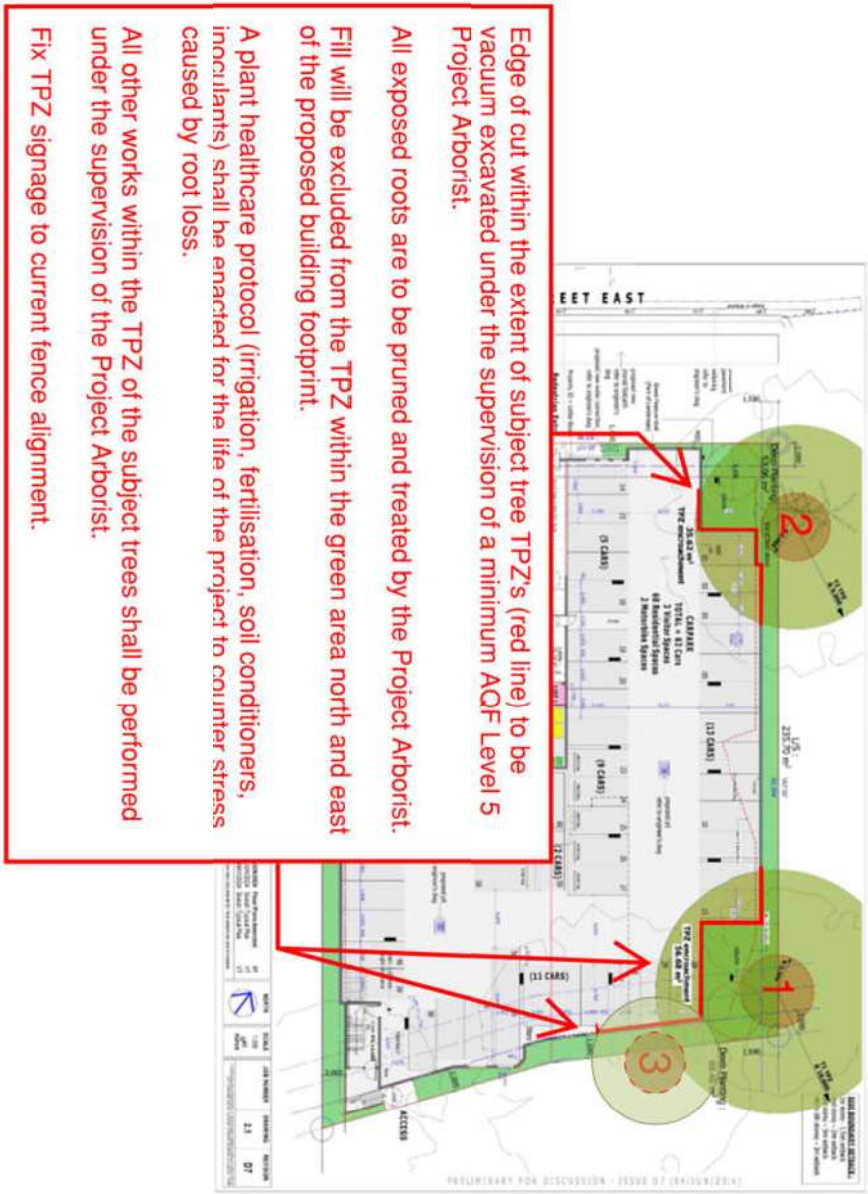
Engage an AQF5 minimum Project Arborist during the project life;

- Once tree protection fencing and signage has been established and finalised. Project Arborist (minimum AQF Level 5) to audit and sign off.
- Supervision of approved tree removals in conjunction with a fauna spotter.
- Any works within the TPZ of retained trees is required.
- If tree roots are encountered over 50mm in diameter outside of TPZs of retained trees.
- Changes to the plans occur.
- On completion of the project to conduct a final audit and summary.

(Site audits/summary reports will be conducted at each hold point interval by the Project Arborist)

Project Arborist Requirements	
1.	Pre-Start Inspection and Audit of Tree Protection Fencing Before Works Commence
2.	Any required Tree Works to be undertaken by a minimum AQF Level 3 Arborist under the Supervision of the Project Arborist (Min AQF Level 5). Tree Services Company to be a member of Queensland Arboricultural Association or Arboriculture Australia.
3.	All works within the Tree Protection Zones of the retained vegetation to be supervised by the Project Arborist (Min AQF Level 5). Audit Reports to be completed and submitted by the Project Arborist. Any below ground incursion to be water excavated under low pressure, under the supervision of the Project Arborist.
4.	All works to be excluded from the Structural Root Zone (SRZ) and supervised if located within Tree Protection Zone.
5.	The Project Arborist to be consulted if changes to plans are made that affect any retained vegetation.
6.	At the Completion of works, Project Arborist to undertake a site assessment and an audit report compile of any further remedial actions required.

# Tree Protection Plan



Please Note: Circles indicate the Tree Protection Zones as defined under AS4970-2009)



Tree Detail

Tree No.	Botanical Name	Common Name	DBH (cm)	TPZ (m)	Height (m)	Spread (m)	Health	Form	Comment
1	<i>Eucalyptus tereticornis</i>	Forest Red Gum	130	15.0	20	14	Fair	Typical	Tree in adjacent property (#71-75). Construction proposed within TPZ of tree (see Tree Protection Plan).
2	<i>Eucalyptus racemosa</i>	Queensland Scribbly gum	75	9.0	20	18	Fair	Poor	Tree in adjacent property (#71-75). Construction proposed within TPZ of tree (see Tree Protection Plan).
3	<i>Casuarina cunninghamiana</i>	River She-oak	44	5.3	18	8	Fair	Poor	Tree in parkland at rear of property (GJ Walter Park). Construction proposed within TPZ of tree (see Tree Protection Plan).

Table Legend:									
Health		Form		Aged Class		Further Detail			
Good: Trees foliage is in exceptional condition and can be considered an excellent specimen of its species. No pests or diseases are present.		Good: Trees structure is exceptional and can be considered an excellent specimen of its species. No visible defects are present.		Juvenile: Tree will generally grow rapidly in this phase of its life cycle.		Diameter at Breast Height (DBH) measured at 1.4m above ground level. Diameter at Root Flare (DRF) measured at the base of the tree, at the trunk / root system transition zone. Diameter = circumference divided by $\pi$			
Fair: Trees foliar condition is satisfactory but may be exhibiting some signs of stress such as tip dieback or chlorosis, pests or diseases may be present but not adversely affecting the tree.		Typical: Trees structure is normal for the species; some minor structural constraints may be present.		Mature: Tree has reached maturity and is producing flowers, fruits and seeds. Tree continues to grow.		Tree Protection Zone (TPZ) defined as metres radius, calculated being $DBH \times 12$ (minimum 2.0m and no greater than 15m).			
Poor: Foliage density is sparse or largely discoloured, tree health is at or approaching a critical value which may be irreversible, pests or diseases are highly prevalent throughout the crown.		Poor: Structure is a poor example of its species and exhibits a combination of structural issues.		Full to Late Maturity: Tree has reached the maximum height for its species, elongation has stopped but the trunk continues to thicken, overall growth rate is starting to slow, foliar density may be starting to thin.		Structural Root Zone (SRZ) displaced as metres radius. Calculation being $(DRF \times 50)^{0.42} \times 0.04$ (never less than 1.5m or greater than 15m).			
Dead: Tree is in advanced decline or completely dead.		Dead: Tree is in advanced decline or completely dead.		Senescent: Tree has / is starting to retract in size through dieback and shedding of limbs. Trees in this age class may be ecologically valuable, as their structure contains habitat necessary for native fauna.					

## Tree Retention Recommendations

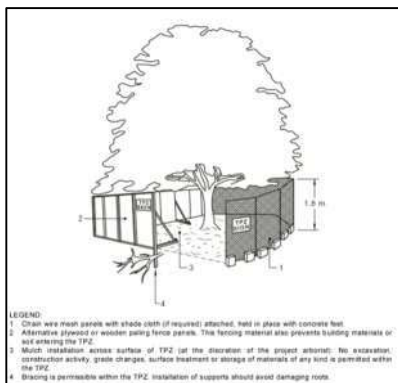
Tree No.	Botanical Name	Common Name	DBH (cm)	TPZ (m)	Impact	Recommendation
1	<i>Eucalyptus tereticornis</i>	Forest Red Gum	130	15.0	Minor	Retain and protect tree. Vacuum excavate edge of cut. Prune exposed roots, enact a plant healthcare protocol for the life of the project. No pruning was deemed necessary to facilitate proposed construction project.
2	<i>Eucalyptus racemosa</i>	Queensland Scribbly gum	75	9.0	Minor	Retain and protect tree. Vacuum excavate edge of cut. Prune exposed roots, enact a plant healthcare protocol for the life of the project. No pruning was deemed necessary to facilitate proposed construction project.
3	<i>Casuarina cunninghamiana</i>	River She-oak	44	5.3	Major	Retain and protect tree. Vacuum excavate edge of cut. Prune exposed roots, enact a plant healthcare protocol for the life of the project. No pruning was deemed necessary to facilitate proposed construction project.

# Tree Protection Measures and Guidelines

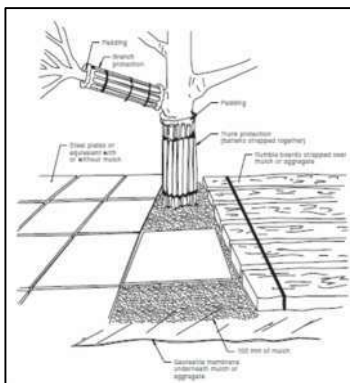
**Note 1:** TPZ perimeter fencing should be grouped where perimeters overlap and appropriate.

**Note 2:** Signage is to be installed in accordance with Australian Standard AS 4970-2009 Protection of trees on development sites as illustrated below.

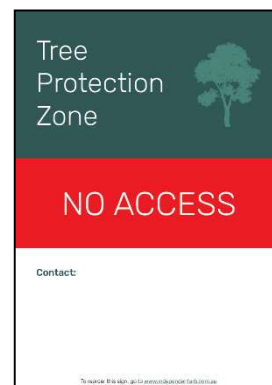
## Protective Fencing



## Examples of Trunk, Branch & Ground Protection



## Tree Protection Zone Signage



## Low pressure Ground Excavation & Water Cutting



## Example of Fauna Friendly Rigid Style Temporary Fencing



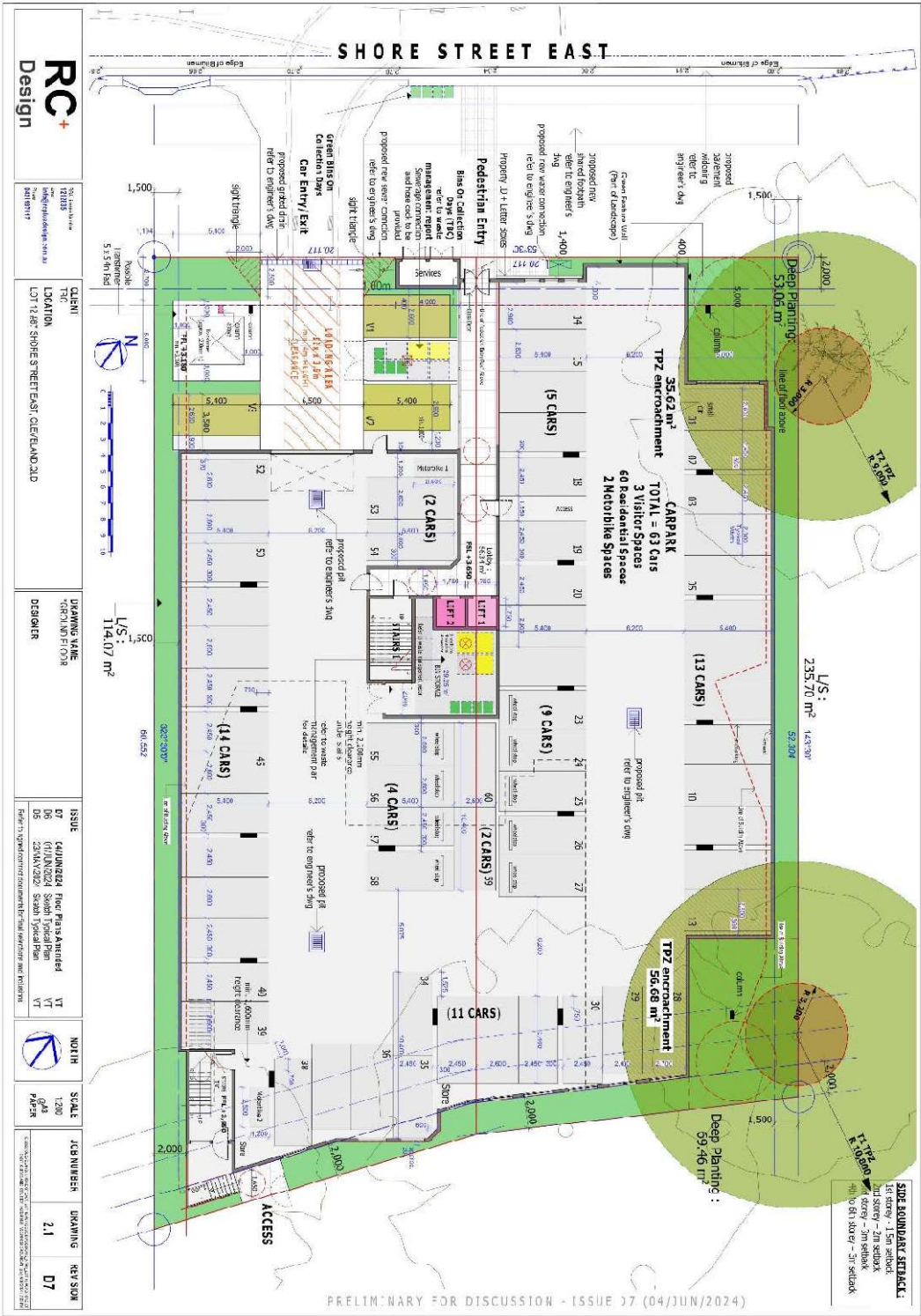
Source: AS4970-2009 Protection of Trees on Development Sites



## Tree Management Plan (TMP) – Works Progress: Development Phase

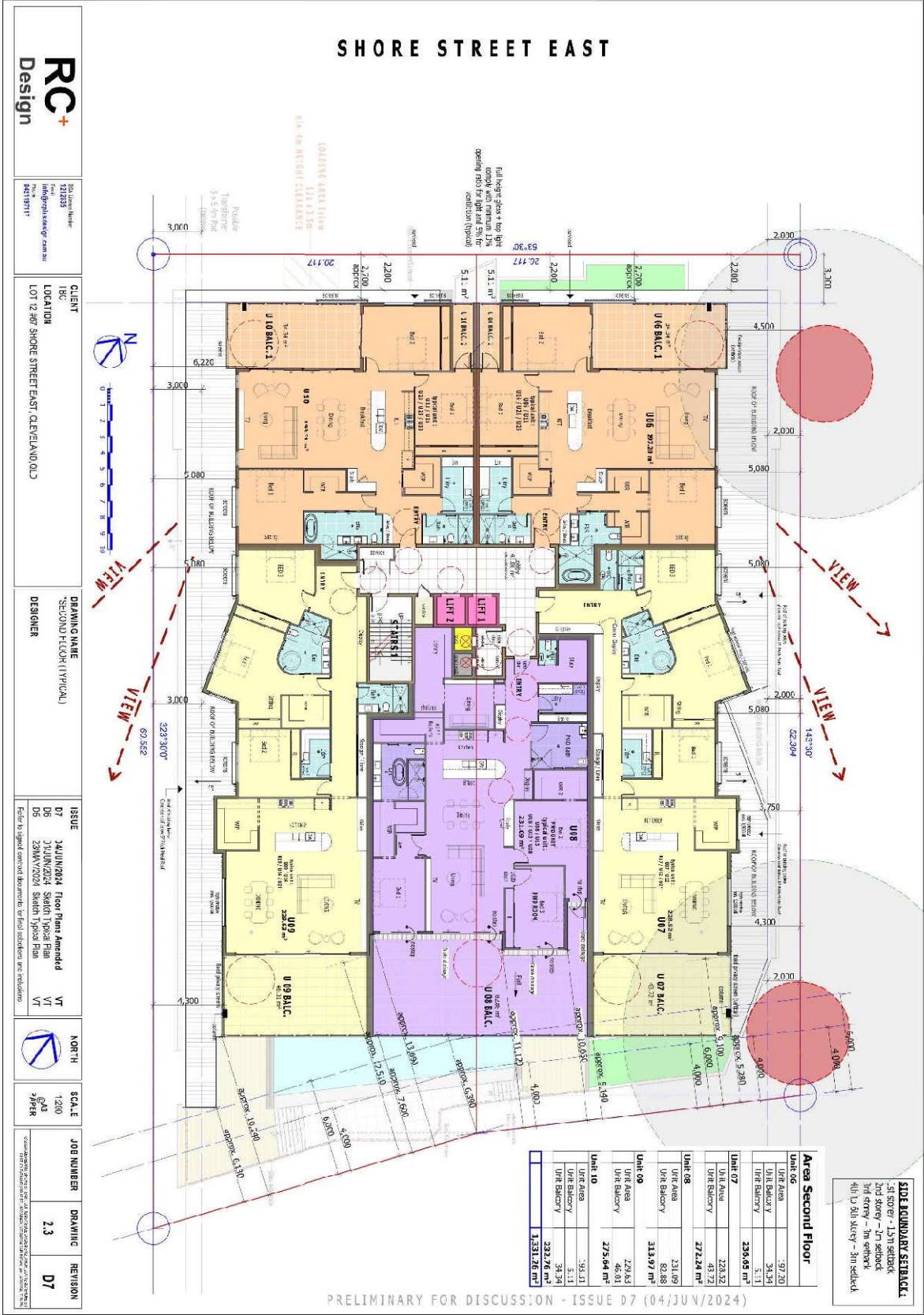
Stage	Tasks	Specific Outcomes
<b>Pre-construction Phase</b>		
Prepare and finalise Arboricultural Impact Assessments for submission to Council	Project Arborist to be appointed Review tree details in all approved Arboricultural reports following any new issue of plans	Submit Arboricultural reports including Arboricultural Impact Assessment for final Council Approval
Project Arborist to conduct Prestart Meeting with all representatives involved in construction	Prior to meeting: TPZ temporary protection/fencing installed <b>Arboricultural Report, TMP &amp; Council approval copies to be included in CMP</b> and made available to onsite crews	Prestart Certification and approvals in place & available onsite with CMP
<b>Commencement - Construction Phase</b>		
Initial Site Preparation	Project Arborist to supervise all tree work. <b>Construction crew or others are not to remove any part of a tree.</b> Arborist prestart site inspection.	Compliance Certification of Arboricultural works for lodgement to Council  Arborist certification of TPZ measures.
Prestart Toolbox Meeting	All relevant onsite crews to be briefed by Project Arborist prior to commencement of <u>each</u> work phase. Project Arborist <u>must</u> be notified and onsite at all times when construction works are within or close to TPZ. Note: Onsite attendance of Project Arborist is a condition for issue of Arboricultural Site Audit Statement/s.	Arborist Site Audit Reporting system to be in place. Copies of Arboricultural Report to be retained onsite.  <u>Arboricultural Site Audit Statement/s will not be issued retrospectively</u>
<b>Construction Phase</b>		
Site Establishment	Project Arborist to monitor tree health during establishment phase including bulk earthworks, changes in hydrology etc.	Instigate remedial tree care measures if required
Construction work	Site Manager to liaise with and ensure Project Arborist is advised in time to allow them to be present for all work carried out within TPZ area including any work likely to affect identified tree/s. Any deviation/s from approved plans to be approved by Project Arborist. <b>Project Arborist to provide ongoing Site Audit Certification of all work within TPZ</b>	Any remedial tree works to be carried out by qualified arborists under supervision of Project Arborist.  Project Arborist is responsible for issue of Arborist Site Audit Reports.
Practical Completion	Project Arborist to carryout review of tree health and vigour and advise on TPZ fencing.	On Project Arborist approval, carryout removal of remaining temporary tree protection measures
<b>Post Construction Phase</b>		
Final Arborist inspection	Carryout tree health review and provide recommendations for required tree care.	Issue of final Arborist Site Audit Compliance Statement for inclusion in final DA documentation and sealing.

Plans







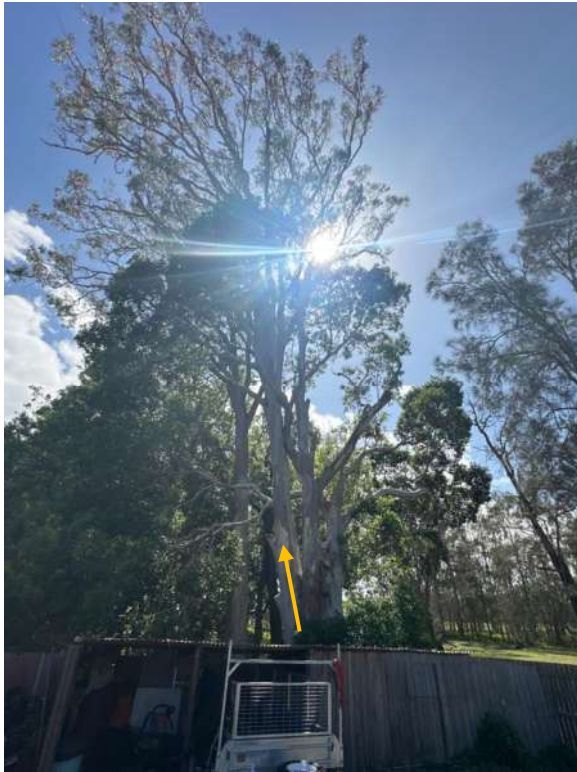




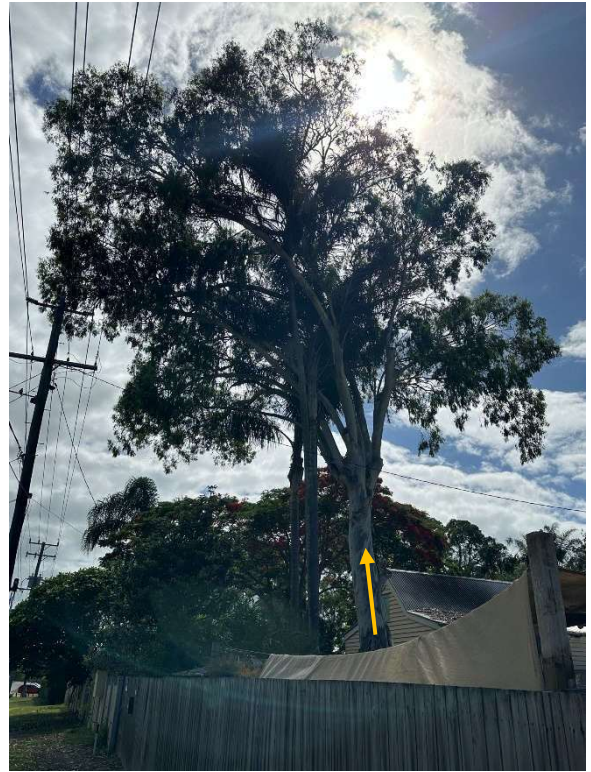




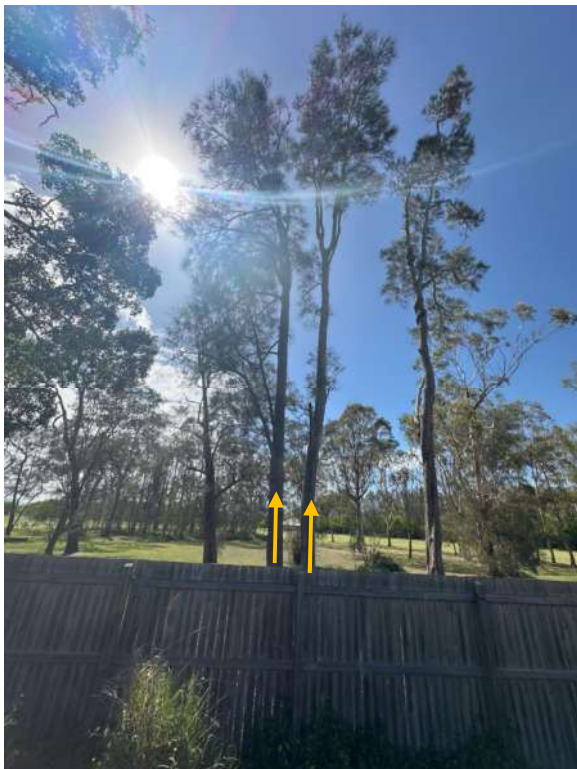
## Photos



Tree 1

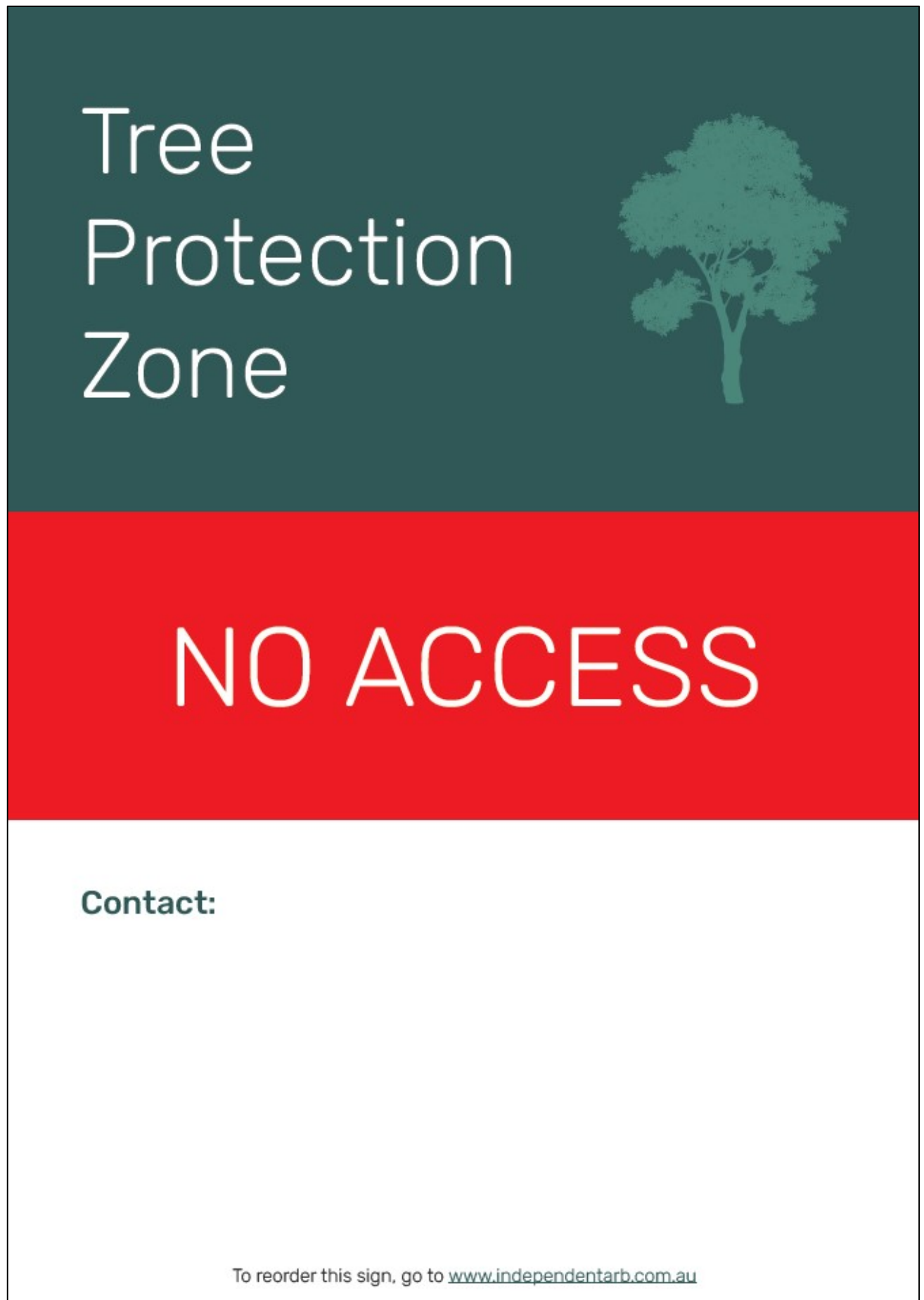


Tree 2



Tree 3

## Appendix 1: TPZ Fencing Signage





## Appendix 2: Explanation of Terminology

Definition	Process Description
<b>Removal</b>	Complete tree removal leaving stump as close as possible to ground level. Recommended process will include chipping of all foliage limbs and timber and reinstatement of work site. Recommendation typically based on tree being assessed as representing a health and safety concern [Dead, dying, structurally unsound, unstable, poor form]
<b>Remove and grind</b>	Complete tree removal to include grinding of stump to a depth of 75 millimetres unless otherwise specified. Recommended process will include chipping of all foliage limbs and timber and reinstatement of work site. Stump site will be cleaned of all grinding debris and sawdust and backfilled with premium topsoil free from weeds.
<b>Crown Clean (Deadwood)</b>	Removal of all major/significant deadwood and dead branches up to [and including] 30 millimetres in diameter in trees overhanging pedestrian or vehicular areas or removal of dead branches > 50mm diameter in canopy of trees located in parkland or similar area unless otherwise specified.
<b>Crown Clean (General pruning)</b>	Recommended pruning process will include removal of broken, crossing, rubbing, diseased, stressed or dying branches or limbs with poor attachment. Additional work process may include pruning to define leaders, balance the crown, reduce weight load, or clear the tree from obstructions. In summary, to rectify, as far as is possible, any structural defects and eliminate undesirable growth or deadwood.
<b>Crown Reduction (Canopy reduction)</b>	Recommended pruning process may include light and general pruning typically to encompass removal of up to 15% but no more than 20% of the leaf-bearing crown. By definition the unique shape and form of the tree will not be altered or compromised by the pruning process. Typically, the consulting arborist will nominate the reduction percentage [%] appropriate to species, condition and assessment.
<b>Crown Raising (Canopy lift)</b>	Pruning processes maybe involve the raising of the tree's lower canopy to a height specified in metres. Typically, the process is performed to provide for pedestrian and or vehicular clearance and unless otherwise specified the default parameters will be to provide 2 metres clearance from ground level or as specified by local or state government regulation. From time to time pruning requirements may be altered to accommodate various site-specific requirements as advised by the consulting arborist accordingly.
<b>Crown Restoration</b>	Pruning process will encompass crown restoration and remedial works where the tree has been previously lopped or otherwise damaged. Not feasible when tree has extensive decay and should only be considered when there is evidence of healthy re- growth. When performed correctly the process of remedial pruning will most likely take several years to complete.
<b>Hanger Limb / Unattached branch</b>	Pruning process may be restricted to the removal of any hanger/s or dangerous/dead/dying limbs and will typically involve the removal of a single limb. In some instances, removal of an individual limb may be necessary to accommodate an obstruction and the consulting arborist will advise accordingly.
<b>Directional Pruning</b>	Pruning process will be restricted to pruning canopy away from buildings/service wires/property boundary and will typically be performed to avoid future growth in these areas. Where appropriate future growth will be directed away from obstruction by selected pruning so as to encourage the development of the growth of new leaders.



<b>Habitat Pruning</b>	When pruning deadwood from trees, simple techniques and methods can be employed to achieve hazard reduction whilst leaving food and habitat for tree dwelling fauna. Long pieces of deadwood can be reduced in length to limit potential hazard but still retain food for the insects and microorganisms. Stubs that have been left by old pruning or previous branch failure can be retained, and with the use of a hole-saw or chainsaw they may also be bored out to create a nesting hollow for native birds or small mammals. Source: Mosman Council
<b>Deadwood</b>	Dead branches within canopy of tree <sup>59F</sup> . Deadwood is a naturally occurring feature of most tree species and comprises dead or decaying branches within the canopy of a tree. Deadwood may have habitat value and require removal only according to the considered risk of its location, i.e. high use pedestrian area or damage to adjacent infrastructure.
<b>Decay</b>	The process of degradation of woody tissues by micro-organisms <sup>61F</sup>
<b>Compaction</b>	Results from loads or stress forces applied to the soil as well as shear forces. Both foot traffic and vehicle traffic exert both forces on soils. Vehicle traffic may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). The degree of compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling and transporting also tend to lead to the breakdown of soil structure and thus to compaction. Vibration as a result of frequent traffic or adjacent construction activities will also compact soils <sup>55F</sup>
<b>Codominant Structure:</b>	Stems or trunks of about the same size originating from the same position from the main stem <sup>52F</sup> . When the stem bark ridge turns upward the union is strong; when the ridge turns inward the union is weak, a likely point of failure in storm or windy weather conditions or where increasing weight causes undue stress on the defective union <sup>53F</sup>

Source: AS4373-2003 Pruning of Amenity Trees & AS 4970-2009 Protection of Tree on Development Sites & Habitat Creation By Kieran O'Neill, Mosman Council.

## Appendix 3: Normal Function of a Tree

**Background Note:** The following diagrams and explanatory notes are useful to illustrate the structure of a tree in a normal growing environment. This information is taken from AS4970-2009 Protection of trees on development sites which has been released subsequently to AS4373-2007 Pruning of amenity trees.

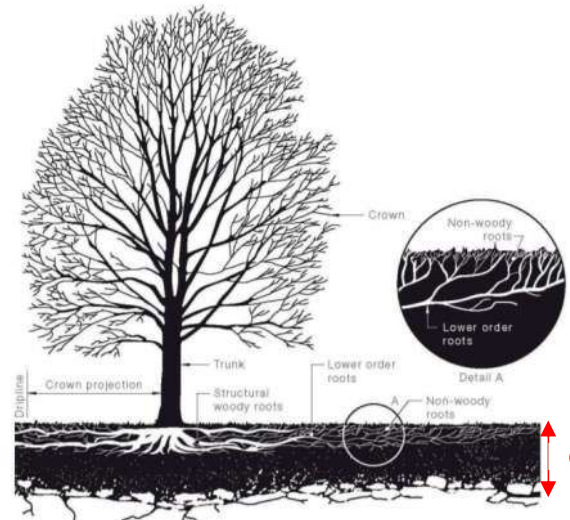


Figure 2: Structure of a tree in a normal growing environment

### Leaves

The main function of leaves is photosynthesis, that is, the production of sugars. The sugars produced by the leaves (and any other green tissue) are the source of chemical energy for all living cells in the entire plant and as such are essential for the normal functioning and survival of the tree. Anything that directly or indirectly damages the leaves will interfere with photosynthesis.

### Trunks and branches

Branches and trunks are composed of many tissues with specialized functions including the bark (protection), phloem (transport of sugars from the leaves), vascular cambium (growth of new transport tissues), sapwood (transport of water and nutrients from the roots), heartwood (strength and structural support) and rays (internal transport and storage of sugars). Damage to branches or trunks may allow infection by plant pathogens (disease causing organisms), disrupt the movement of vital materials and structurally weaken the tree.

### Roots

The main functions of roots include the uptake of water and nutrients, anchorage, storage of sugar reserves and the production of some plant hormones required by the shoots. For roots to function, they must be supplied with oxygen from the soil. The root system of trees consists of several 'types' of roots found in different parts of the soil and is generally much more extensive than commonly thought. The importance of roots is easily overlooked because they are not visible, that is 'out of sight, out of mind'. Damage to the root system is a common cause of tree decline and death and is the most common form of damage associated with development sites.

Root systems consist of three main parts:

1. The structural woody roots (anchorage, storage and transport);
2. Lower order roots (anchorage, storage and transport); and
3. Non-woody roots (absorption of water and nutrients, extension, synthesis of amino acids and growth regulators) (see Figure).

In addition to lateral root spread being underestimated, root depth in trees has also been grossly exaggerated. Deep root systems or taproots are the exception rather than the rule. Most roots of most trees are found in the very top of the soil. The vast majority of these roots are small non-woody absorbing roots which grow upward into the very surface layers of the soil and leaf litter. This delicate, non-woody system, because of its proximity to the surface, is very vulnerable to injury.”

#### **Explanatory Note: The importance of gas exchange in soils**

The fact that tree roots require oxygen to function is often misunderstood. Accessibility to available oxygen and water within the soil structure is dependent on the integrity of soil structure within their surrounds; when soils are compacted there is little space between soil aggregates with soil volume and total pore space, especially macropore space diminished. In turn, good soil oxygenation and gas exchange (Lonsdale) levels allow for successful function of tree roots. Oxygen levels in soils will typically decrease as soil depth increases and /or soils are heavily compacted.

Macropore is the term used to describe the relatively large space between soil particles that is usually air filled and allows for water movement and root penetration. Micropore is the term used to describe the space between soil particles that is relatively small and likely to be water filled.

Compaction results from loads or stress forces applied to the soil as well as shear forces. When soil within the root zone of a plant, including a tree, is compacted through either pedestrian or vehicular traffic, or by the heavy weight of stored materials or machinery, the ability of water and oxygen to penetrate the soil around the roots of living plants is compromised. Whilst tree roots are typically found in the top 600mm of the soil horizon, vehicle traffic, in particular may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). (Refer Tree Function Note above).

The degree of soil compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling and transporting also tend to lead to the breakdown of soil structure and thus to soil compaction. Vibration, as a result of frequent traffic or adjacent construction activities, will also cause compaction of soil.

Contrary to the commonly held myth that all trees have tap roots, tree roots are typically located within the top 600mm of soil. Just as leaves perform the vital function of photosynthesis, tree roots are vital for the primary functions of anchorage, storage, absorption and conduction. Larger tree roots fulfil the main functions of anchorage, storage and conduction and smaller more fibrous tree roots, which grow primarily at the end of the main woody roots, fulfil a vital role in absorbing oxygen, essential mineral elements and moisture from the soil, often through a symbiotic relationship with soil borne fungi referred to as Mycorrhizae; the extent of root loss has the potential to jeopardise any or all of these main functions and most importantly may compromise the structural integrity of an established tree and its associated potential OH&S risk of failure occurring; any OH&S risk of potential failure in a high use area such as public roads, is noteworthy for all the wrong reasons and should be of major concern and avoided at all times. (Refer Appendix 2, Tree Function Note).

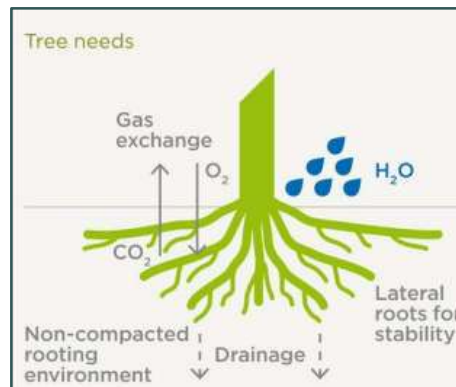


Figure 3: Gas exchange in woody tissues: the diffusion of gases into and out of a particular region (Jaluzot)

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# Company Details

## Independent Arboricultural Services

Independent Arboricultural Services, incorporated in May 2007, offers a completely independent arborist consulting and reporting service. Its directors and associated consultants bring extensive arboricultural knowledge gained over many years to this company. All consulting staff hold AQF Level 5 (Diploma of Arboriculture). Specialised advice when required, such as provision of survey mapping or engineering advice and certification is sourced from reputable professional providers according to site requirements as per Australian Standard 4970-2009.

## Statement of Goal

To deliver continual improvement through the use of world's best arboricultural practices, supported by ongoing education and exposure to leading industry experts and research throughout the world.

## Mission Statement

To provide timely, relevant and actionable consulting advice and practice based on the latest available and best scientific arboricultural knowledge.

## Environmental Statement

Independent Arboricultural Services supports long term environmental sustainability sustainable sourced paper and ensuring all inks cartridges are recycled where possible.

Independent Arboricultural Services actively seeks to maintain a positive carbon footprint status and to that end is committed to protecting and preserving the environment, continuing to carry out tree planting, transplanting and replacement planting where practical, having planted in excess of 4000 trees in the first 2 years after its inception in May 2007 alone. Arboricultural recommendations involving the removal of tree/s will include replanting at a minimum ratio of 2 trees for any tree removed where possible. All arboricultural recommendations are made in accordance with world's best arboricultural practice and within the Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 – Protection of trees on development sites so as to ensure optimal outcomes for all living trees.

Independent Arboricultural Services acknowledges the benefits of healthy trees with good vigour and vitality and actively promotes better understanding in the general community of the contribution that trees make to reducing greenhouse gasses, the contribution of trees to better water retention and the prevention of soil erosion, the ability of trees to provide protection to infrastructure by diffusing strong winds in weather events and the contribution of trees to general liveability within the urban environment.

It is an acknowledged fact that air temperature beneath a tree canopy can be in excess of 5° Celsius lower than the surrounding ambient air temperature thereby reducing reliance on greenhouse gas producing air conditioners and coal fired power sources.