Abel Ecology

Arboricultural Impact Assessment (AIA)

for

Tamworth Hospital - Dean Street, Tamworth NSW 2340
Lot 1, DP 1181268

Proposed extension to existing building

Prepared for:	Tom Kelly of Capital Insight on behalf Health Infrastructure NSW
Report No:	AE25-2760-REP-ISS 2
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Disclaimer

No tree is entirely without hazard potential. No responsibility is accepted for any damage or injury that may be caused by any trees on the site. All measures outlined should minimise damage inflicted on the trees if carefully implemented.

This report does not provide an assessment of risk of harm posed from tree hazards. Information may be provided about the structure, function, defects or tree pests and/or diseases, vitality, condition and life expectancy. However, no assessment of targets, frequency of use by potential targets or guidance of risk of harm is included in this report.

This report is an arboricultural impact assessment; it is not a risk assessment.

No internal examination of any kind has been undertaken on any tree described in this report, unless expressly stated. On occasions, a mallet may be used as an auditory guide to assist in determining the presence of internal hollows.

Document History

Report	Version	Prepared by	Technical Review by	Proofread by	Submission	
					Method	Date
Report	Draft A	Andy Araya		Janelle Merry	Dropbox	22 November 2024
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List of Abbreviations

DBH	Diameter at breast height (~1.4 metres)
DAB	Diameter at base/root junction
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment
LGA	Local Government Area
APZ	Asset Protection Zone
IPA	Inner Protection Area

Note regarding maps in this report

The diagrams/site maps used in this report have been supplied by and are used with the permission of Health Infrastructure.

With regard to maps provided by the Land Information Centre, Topographic maps used with the permission of © Land and Property Information, NSW.

Glossary

Explanation of Tree assessment terminology and rationale:

Amenity - Trees with recreational, functional, environmental, ecological, social, health or aesthetic value rather than for production purposes (Standards Australia 2007).

A desirable or useful feature or facility of a building or place; the pleasantness or attractiveness of a place (Google Dictionary 2017). An assessment of amenity value is to some extent subjective and qualitative, however it also includes Arboricultural assessments of structure and health of the tree.

Arborist - A person with training to AQF Level 3 in Arboriculture, or above, or equivalent recognized and relevant experience that enables the person to perform the tasks required by the Australian Standards for Arboricultural practice (AS4373-2007 Pruning of amenity trees and AS4970-2009 Protection of trees on development sites).

Australian Qualification Framework (AQF) - A national framework for all educational and training purposes in Australia.

Codominant stems - Stems or trunks of about the same size originating from the same position from the main stem.

Condition - An evaluation of the structural status of the tree including defects that may affect the useful life of an otherwise healthy specimen. Such influencing factors include cavities and decay, weak unions between scaffolds (major branches) or trunks and faults of form or habit.

Coppiced - Cutting a trunk close to ground level in order to stimulate the production of multiple new stems (epicormic shoots).

DBH (Diameter at breast height) –A standard Arboricultural measurement used to calculate the Tree Protection Zone (TPZ), taken at 1.4 metres from the ground.

Epicormic Growth - The production of epicormic growth from dormant buds is a response to stress, fire and damage, including poor pruning methods. 'Epi's' can occur on branches, stems and from the rhizome base of the tree. Arising from the cambium (actively growing bark region) they are often weakly attached. Epicormic shoots arising from rhizomes is an adaptive strategy in many Australian native plants including Eucalypts and plants in the Proteacea family, occurring commonly after fire, damage or drought.

Mycorrhizae/Rhizosphere - Mycorrhizae are fungi that grow in symbiotic association with tree roots (especially the fine root hairs) and are attributed with increasing the uptake of nutrients, particularly phosphorus, and reducing infection from soil borne pathogens. They greatly increase the surface area of a tree's root system. Mycorrhizae require aerobic soil conditions and are reduced in number by compaction, waterlogging and overuse of soil fertilisers. Forest litter or similar mulch provides ideal conditions for the proliferation of Mycorrhizae. Rhizosphere is a term describing the peripheral area of a tree's root system where this symbiotic association most commonly occurs.

Remedial (restorative) pruning - Removing damaged, diseased or lopped branches, taking the cut back to undamaged tissue, in order to induce the production of shoots from latent or adventitious buds, from which a new crown will be established.

STAG – A dead tree, that often remains standing as a large deadwood. Additionally, STAGS often form hollows and provide habitat for local fauna.

Stem - Organ supporting the branches, leaves, flowers and fruit, and connecting the upper parts of the tree to the root system; may also be referred to as 'the trunk'.

Visual Tree Assessment (VTA) - using external characteristics as indicators of the internal conditions and structural stability of a tree. It is described by Mattheck and Breloer (1994), the first step of the method is to visually examine a tree to find external symptoms of internal defects. It is generally used in some form by Arborists in Australia for tree assessment.

A full VTA is comprised of three steps. This report does not undertake a full VTA. Only the first step, a visual inspection is described in this report. No internal examination was be undertaken. On occasions, a mallet may be used as an auditory guide for the presence of internal hollows. The assessment described in this report is ground based assessment. No climbing of any tree was done as part of an assessment.

Vitality - Indicates the energy reserves of the tree and is determined by the observed crown colour and density, the percentage of dead/dying branches and epicormic growth, and the tree's response to wounding, disease and decay pathogens. Poor vitality compromises the tree's ability to initiate internal defence systems (including compartmentalisation of damage or decay) is reduced and it can also become predisposed to attack by insects and pathogens. Often used synonymously in Arboricultural writing with 'vigour' or 'health'.

Tree Hazard Potential - An assessment of the risks associated with retaining a tree in its existing or proposed surroundings. Factors to consider are the growth characteristics of the species, tree vitality, condition and the frequency and type of potential targets. The impact the proposed works can have on any individual tree can only be assumed from general principals about trees.

This report does not provide an assessment of risk of harm posed from tree hazards. Information may be provided about the structure, function, defects or tree pests and/or diseases, vitality, condition and life expectancy. However, no assessment of targets, frequency of use by potential targets or guidance of risk of harm is included in this report.

Tree Protection Zone (TPZ) – Based on the DBH measurement of the tree. It specifies an area around the tree to protect the upper parts as well as the underground root system from impacts of development works. Specifications for TPZ may include maintenance actions such as application of mulch and irrigation.

Executive summary

Abel Ecology carried out a tree assessment survey at Tamworth Hospital (Lot 1, DP 1181268) (Figure 1) on behalf of Health Infrastructure (the applicant), to assess the likely impacts of the proposal on trees on the site, and to address issues pertaining to tree protection.

The proposal is to extend the existing hospital building (Figure 2 and Figure 3).

The area proposed for development was landscaped as part of the major hospital redevelopment which was completed in 2016. The landscaped vegetation consists of a mix of exotic species and Australian natives from across the country. The trees present within the proposal area are semi-mature due to their relatively recent planting. Many plants show indications of stress (epicormic growth, poor form/structure, pests and disease).

Of the twenty-two (22) trees surveyed, twelve (12) trees are identified for removal due to the impact from the proposed construction. Health Infrastructure has a policy of replacement/offsetting of trees removed at a ratio of better than 1:1.

This report does not authorise tree removal on the site or on neighbouring properties.

Australian Standards 'AS4970 Protection of trees on development' notes in Table 1 that a preliminary development design can be undertaken. During this stage, the following action is described: *"Design modifications to minimize impact to trees."*

This AIA addresses the development submission stage described in Table 1 of AS4970. A matter for consideration at the submission stage is: *"Identify trees for retention through comprehensive arboricultural impact assessment of proposed construction."*

The following recommendations apply:

Tree replacement

As per Health Infrastructure's policy, at least thirteen (13) replacement trees are to be installed within the hospital lot to offset the removal of the twelve (12) trees from the proposed construction.

Tree Protection

a) Show tree locations and protective fencing on all construction plans used on site.

b) Engage a Project Arborist to ensure and certify that tree protection measures such as tree protection fencing and ground protection (mulch) are satisfactorily implemented and to provide advice as applicable. The arborist will inspect the site after tree protection measures are in place and before any construction/excavation works are conducted. The arborist will then attend the site at least once within every six months during construction, and once upon completion of demobilisation.

c) Construct tree protection fences at a minimum radius distance(s) measuring the TPZ from the centre of the tree, prior to construction to prevent unnecessary root damage. Construct tree protection fences using chain wire mesh panels to a height of 1.8 metres high. Fences are to be held in place with secure footing (Figure 7).

d) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 3 and Appendix 4).

Root Management

a) Apply mulch 100-150 mm deep with a radius of at least 2 metres, (or to the edge of the calculated tree protection zone where possible) around retained trees prior to construction to stimulate growth of absorbing roots. For trees that will be located beneath fill, apply mulch on top of fill soils.

b) Re-apply mulch annually to compensate for root loss.

c) Advice must be sought from a suitably skilled and experienced Project Arborist wherever roots over 40 mm diameter are encountered during excavation near trees to be retained. The tearing of roots of retained trees must be avoided and root pruning undertaken as directed by the nominated arborist.

d) Cleanly cut any roots with a thickness of 2 cm or more encountered during excavation to reduce damage to roots from tearing, splitting and cracking.

e) Route any potential trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

f) If trenching excavation is to occur within the TPZ of trees to be retained, engage hydraulic methods utilising a Vacuum Truck and trained operator to minimise damage to roots. These works are also to be conducted with the supervision of the Project Arborist

g) Route all trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

Certification by an Arborist

a) An AQF5 Arborist must inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The AQF5 Arborist must then provide compliance documentation to be retained on the project file records. Tree protection compliance is to be checked before any tree related or earthworks occur on the site. Tree protection measure must be reviewed when development design changes occur and at construction hold points as outlined in *AS4970-2009 – Protection of Trees on Development Sites*, Table 1. The hold points occur at the start of various construction phases which includes – Site Establishment, Construction work, Implement Hard and Soft Landscape Works and Practical Completion.

Post-development Landscape Plantings

a) As part of any landscape planting establishment program, all soil areas and plots for proposed plantings are to be de-compacted and amended with organic matter. Decompaction and the addition of organic matter must be undertaken to 30 – 60 cm in depth. The soil decompaction area and the related soil volume must be sufficient to support the expected mature size of the proposed street trees. Additional guidance can be provided by a AQF level 5 Arborist/Horticulturalist.

b) A tree maintenance program is to be created by an AQF5 (or above) Horticulturalist/Aboriculturalist and implemented for the landscape plantings to ensure establishment and increase survivability.

c) Use locally native species to replace removed trees. Suggested species, below, are adapted to local climate conditions and are likely to have a long span of usefulness for the site while providing a net ecological benefit. Other locally native species may be used if desired, providing that they are appropriate for the long-term use of the site. (see recommendation of the Prescribed Ecological Assessment Report (PEAR) – (AE25- 2759-PEAR-ISS 2)

1. Introduction

1.1. Scope

A survey of the proposed development site at Tamworth Hospital (Dean Street, Tamworth NSW 2340 – Lot 1 DP 1181268) ('the site' – Figure 2) was undertaken on 30th October 2024.

The objective of this survey was to assess the trees on the site and prepare a report that addresses issues pertaining to the proposal and tree management.

This report will provide a description of individual trees and assess the anticipated impact of the development to the trees on the site.

Introductory information is provided in Section 1. Methods are provided in Sections 2, 8 and the Appendices.

This report includes both a:

1. Preliminary Arboricultural Report (pre-DA); and
2. Arboricultural Impact Assessment (for DA)

The Australian Standard (AS 4970-2009) Protection of trees on development sites describes five stages in planning (Section 2.3 of AS 4970-2009). Each stage from Section 2.3 is listed below. The relationship between sections from this report and the Australian Standard are provided below.

AS 4970-2009 Section 2.3.1 Site Survey – When required - Section 3 and Appendix 1 of this report

AS 4970-2009 Section 2.3.2 Preliminary tree assessment and *AS 4970-2009 Section 2.3.3 Preliminary arboricultural report* – Section 4 and Appendix 2 of this report

AS 4970-2009 Section 2.3.4 Development design and review– Section 0 and 6 of this report

AS 4970-2009 Section 2.3.5 Arboricultural impact assessment – Sections 0 and 6; and Appendix 3, Appendix 4 and Appendix 5 of this report

The preparation of this report has been guided by the Australian Standard (AS 4970-2009), local council legislation and related policies as well as the scope of works discussed with the client.

1.2. Information and Documentation Provided

Abel Ecology has been provided the following documents from the client:

- Earthworks cut and fill Detailed Design Schematic (Figure 4 - WCP-ACR-DRW-CIV-TAM-01A-0000008[F])
- Proposal diagram (Figure 3- EOL-ACG-TAM-DWG-AR-200003[B])

1.3. Associated reporting

This report should be read in conjunction with the following reports:

- Site Prescribed Ecological Assessment Report (PEAR) – Abel Ecology, AE25- 2759-PEAR-ISS 2
- Site Bushfire Report (BAL) - Abel Ecology, AE25-REP-2758-ISS 1

2. Method

Tree assessments were undertaken by Abel Ecology on 30th October 2024.

The definition of a 'Tree' varies across LGAs. The document, *Australian Standard AS 4970-2009. Protection of trees on development sites* provides a useful definition:

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

The vitality and condition of trees were assessed from ground level using a modified VTA (Visual Tree Assessment) method (Mattheck & Breleor, 1994). No internal investigations of the tree were undertaken. On occasions a nylon hammer may be used for sounding to test if hollows may be present. Tree heights were determined by visual estimation. Trees were not tagged due to their small size, but their locations were plotted as per Section 2.1.

The Tree Protection Zone (TPZ) of each tree was determined using the formula "TPZ = d.b.h. x 12", and Structural Root Zone (SRZ) was calculated using the formula "SRZ radius = (Base Diameter X 50) 0.42 x 0.64". Formulae used to calculate TPZs and SRZs are provided in the Australian Standard for Protection of Trees On Development Sites AS4970-2009 (Standards Australia, 2010).

The term 'health' in this document is used synonymously with other words such as 'vigour 'and 'vitality'.

The term 'structure' is synonymous with the word 'condition'.

Tree numbers and locations are shown in Figure 6. Trees are individually described in Appendix 2.

2.1. Plotted Tree Locations

Tree locations were recorded using GPS data collected on site and then input on georeferenced maps using Geographic Information Systems program (QGIS). Inherit margins of error of GPS units and the density of obstructions at various locations on Site may result in variations of recorded tree locations and true tree locations on site. As such it is recommended that for more accurate location data, a surveyor should plot tagged trees on site.

2.2. Limitations

DBH and DAB may be estimated for trees when access is difficult. The access difficulties may be due to proximity to structures, materials, hazardous fauna and flora, overgrown vegetation or located on neighbouring properties. When an estimate is recorded the abbreviation “est” is included in the table.

Some trees could not be identified to species level due to a lack of identifiable features (buds, flowers, fruit) at the time of survey.

No soil, root or other below ground investigations were done as part of this assessment.

No aerial inspections were undertaken as part of this assessment.

3. Site Survey

3.1. Site description

For the purposes of this report the site is the area shown in Figure 1 at Tamworth Hospital (Dean Street, Tamworth NSW 2340 – Lot 1 DP 1181268).

The site is approximately 0.15 ha in size and the elevation is approximately 400 m above sea level.

The site is mostly flat with a gentle slope southward to the main hospital building

The proposal area (Figure 3) is characterised by a mix of exotic dominated lawn space, landscaped vegetation/gardens and lightly gravelled pathways (Figure 2). The planted vegetation contains exotic and native species sourced from around the country. The planted trees are semi-mature. This area of planted vegetation could not be attributed to any ecological community.

No portion of the site is mapped on the Biodiversity Values map.

An access road borders the area to the north. Contained courtyards with minor landscaping and a sheltered pathway run along the main hospital building.

3.2. The proposal

The proposal is to extend the main hospital building (Figure 2 and Figure 3)

The Asset Protection Zone for this site is addressed in the Bushfire Report (Abel Ecology, AE24 2758 BAL)

3.3. Site Plans

Figure 3 below shows the proposed construction diagram.

4. Observations

4.1. Assessed Trees

Data for **twenty-two (22) trees** assessed at the time of the survey is condensed in Table 1 below and further outlined in Appendix 2.

No hollows or nests were observed in the assessed trees.

The trees on site are a mixture of planted Australian natives and exotics not consistent with any ecological community.

Species identified within and adjacent to the site include the following (Table 1):

Table 1. Tree species identified

Species name	Common name	Count
Acacia cultriformis	Knife-leaved Wattle	4
Acacia decora	Western Silver Wattle	1
Eucalyptus erythrocorys	Red-capped Gum	1
Eucalyptus leucoxylon subsp. leucoxylon	Yellow Gum	3
Eucalyptus spp.	-	4
Eucalyptus spp. (E.rugosa/E.leptocalyx/E.cooperiana ?)	-	1
Geijera parviflora	Wilga	2
Lagerstoemia indica	Crepe Myrtle	3
Morus nigra	Black Mulberry	1
Pistacia chinensis	Chinese Pistachio	2
	Total	22

5. Arboricultural impact assessment

5.1. Tree Retention

The proposal indicates the retention of **ten (10)** trees within the property:

10, 11, 12, 13, 14, 15, 16, 18, 19, 20.

5.2. Tree removal

The proposal indicates the removal of **twelve (12)** trees (Figure 6). The following trees occur within the proposal footprint and have been marked for removal due to their proximity to the proposed construction:

1, 2, 3, 4, 5, 6, 7, 8, 9, 17, 21, 22.

Table 2. Trees to Retain/Remove

Tree Number	Retain/ Remove	Comment
1	Remove	Greater than 10% encroachment to TPZ from construction
2	Remove	Greater than 10% encroachment to TPZ from construction
3	Remove	Greater than 10% encroachment to TPZ from construction
4	Remove	Greater than 10% encroachment to TPZ from construction
5	Remove	Greater than 10% encroachment to TPZ from construction
6	Remove	Greater than 10% encroachment to TPZ from construction
7	Remove	Greater than 10% encroachment to TPZ from construction
8	Remove	Greater than 10% encroachment to TPZ from construction
9	Remove	Greater than 10% encroachment to TPZ from construction
10	Retain	Not impacted by construction. Tree protection required.
11	Retain	Not impacted by construction. Tree protection required.
12	Retain	Not impacted by construction. Tree protection required.
13	Retain	Not impacted by construction. Tree protection required.
14	Retain	Not impacted by construction. Tree protection required.
15	Retain	Not impacted by construction. Tree protection required.
16	Retain	Not impacted by construction. Tree protection required.

Tree Number	Retain/ Remove	Comment
17	Remove	Greater than 10% encroachment to TPZ from construction
18	Retain	Not impacted by construction. Tree protection required.
19	Retain	Not impacted by construction. Tree protection required.
20	Retain	Not impacted by construction. Tree protection required.
21	Remove	Greater than 10% encroachment to TPZ from construction
22	Remove	Greater than 10% encroachment to TPZ from construction

5.3. Direct impacts

5.3.1. Impact of proposal on retained trees

The Australian Standard 4970-2009 specifies that an encroachment into the TPZ of 10% of the total area is allowable (see Appendix 5). We recommend that tree protection fencing be installed (Figure 6) at minimum of the TPZ radius distance where possible. The following (Table 3Table 4) indicates the trees to be retained and the protection measures required to be employed.

Table 3. Trees for Retention and Protection

Tree no.	Retain	Comments
16	Yes	Due to proximity to construction, this tree requires TPZ/SRZ protection measures (fencing/mulch-soil compaction).
10-15, 18,19,20	Yes	Tree protection fencing is to be erected to isolate this area of retained trees from construction works.

5.3.2. Services

Services and excavated trenching is to be routed outside the tree protection zones. Where this is not achievable underboring may be an acceptable method after consultation with an arborist.

6. Discussion

The definition of a 'Tree' varies across LGAs. The document, *Australian Standard AS 4970-2009. Protection of trees on development sites* provides a useful definition:

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

Retained trees are to have tree protection measures in place prior to construction works taking place (Refer Appendix 3 and Appendix 4).

Trees to be retained are not impacted by the proposal and will require tree protection measures. Retained trees fall within the IPA, and therefore, are to be maintained to IPA conditions (NSW RFS, 2019).

Trees to be removed will be adversely impacted by the development (greater than 10% encroachment of TPZ) and are identified in Table 2 and displayed in Figure 6.

The establishment of generous protection areas and maintenance of stringent site controls will be essential in preventing damage during construction. Landscaping must also accommodate existing roots and provide favourable conditions for normal root function.

In order to create an APZ consistent with the requirements of Inner Protection Area (IPA) conditions, tree canopy cover must be reduced to a maximum of 15% within the APZ (NSW RFS, 2019).

Roots cannot grow without oxygen, and they cannot survive in compacted soils. Any activity that buries or cuts roots such as a soil stockpile or service trench will result in death of a corresponding portion of the canopy (*Perry, 1982*). It follows, then, that a large soil stockpile near the base of the tree will remove oxygen for a significant proportion of the root system, and thus impact the live crown.

Section 3.3.3 of the Australian Standard for tree protection (*Standards Australia, 2010*) says the following with regard to encroaching in TPZs by more than 10%:

> 3.3.3 Major encroachment
>
> If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ (see Clause 3.3.5), the Project Arborist must demonstrate that the tree(s) would remain viable. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. This may require root investigation by non-destructive methods and consideration of relevant factors listed in Clause 3.3.4.

*Levinsson (*2015) suggests effective management may be more valuable to tree survival than beginning with a vigorous specimen. In the context of trees on or adjacent to development sites, effective management is simply a matter of adequate protection, mulching, and regular irrigation, as this satisfies the most commonly limiting factors for tree growth (Harris et al., 2004; Mauseth, 2009). Additionally, wood chip and leaf litter mulches are

effective and cost-efficient methods for stimulating new root growth and improving soil quality in compacted urban soils (Scharenbroch, & Watson, 2014).

Mycorrhizae are fungi that grow in symbiotic association with tree roots (especially the fine root hairs) and are attributed with increasing the uptake of nutrients, particularly phosphorus, and reducing infection from soil borne pathogens. They greatly increase the surface area of a tree's root system. Mycorrhizae are reduced in number by compaction, waterlogging and overuse of soil fertilisers, as they require aerobic soil conditions, that is, they need oxygen. Forest litter or similar mulch provides ideal conditions for the proliferation of Mycorrhizae (*Harris et al., 2004*).

Adequately insulated soils allow small absorbing roots to grow in the upper 150 mm of soil, whereas exposed soils are prone to become hot enough that roots are restricted to greater depths because absorbing roots cannot survive in the upper layer of soil (*Harris et al., 2004*).

Roots cannot grow without oxygen, and they cannot survive in compacted soils. Any activity that buries or cuts roots such as a soil stockpile or service trench will result in death of a corresponding portion of the canopy (*Perry, 1982*). The vast majority of roots are found within the top metre of soil, though this is highly dependent on the soil type. Roots systems are shallow in poorly aerated clay soils, deep in well-aerated sandy soils, and widespread in desert environments, all according to the availability of oxygen, water, and soil nutrients (*Dobson, 1995*).

7. Recommendations

The following recommendations apply:

Tree replacement

As per Health Infrastructure's policy, at least thirteen (13) replacement trees are to be installed within the hospital lot to offset the removal of the twelve (12) trees from the proposed construction.

Tree Protection

a) Show tree locations and protective fencing on all construction plans used on site.

b) Engage a Project Arborist to ensure and certify that tree protection measures such as tree protection fencing and ground protection (mulch) are satisfactorily implemented and to provide advice as applicable. The arborist will inspect the site after tree protection measures are in place and before any construction/excavation works are conducted. The arborist will then attend the site at least once within every six months during construction, and once upon completion of demobilisation.

c) Construct tree protection fences at a minimum radius distance(s) measuring the TPZ from the centre of the tree, prior to construction to prevent unnecessary root damage. Construct tree protection fences using chain wire mesh panels to a height of 1.8 metres high. Fences are to be held in place with secure footing (Figure 7).

d) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 3 and Appendix 4).

Root Management

a) Apply mulch 100-150 mm deep with a radius of at least 2 metres, (or to the edge of the calculated tree protection zone where possible) around retained trees prior to construction to stimulate growth of absorbing roots. For trees that will be located beneath fill, apply mulch on top of fill soils.

b) Re-apply mulch annually to compensate for root loss.

c) Advice must be sought from a suitably skilled and experienced Project Arborist wherever roots over 40 mm diameter are encountered during excavation near trees to be retained. The tearing of roots of retained trees must be avoided and root pruning undertaken as directed by the nominated arborist

d) Cleanly cut any roots with a thickness of 2 cm or more encountered during excavation to reduce damage to roots from tearing, splitting and cracking.

e) Route any potential trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

f) If trenching excavation is to occur within the TPZ of trees to be retained, hydraulic methods utilising a Vacuum Truck and trained operator to minimise damage to roots. These works are also to be conducted with the supervision of the Project Arborist

a) Route all trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

Certification by an arborist

a) An AQF5 Arborist much inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The AQF5 Arborist must then provide compliance documentation to be retained on the project file records. Tree protection compliance is to be checked before any tree related or earthworks occur on the site. Tree protection measure must be reviewed when development design changes occur and at construction hold points as outlined in AS4970-2009 – Protection of Trees on Development Sites, Table 1. The hold points occur at the start of various construction phases which includes – Site Establishment, Construction work, Implement Hard and Soft Landscape Works and Practical Completion.

Fauna Management

a) A hollow clearance survey should be undertaken by an appropriately experienced ecologist prior to tree removal works. This is to ensure the appropriate management/relocation of existing protected fauna located at the Site, under Environmental Protection and Conservation Act (1999) and Biodiversity and Conservation Act (2016) before the commencement of any high disturbance.

Post-development Landscape Plantings

a) As part of any landscape planting establishment program, all soil areas and plots for proposed plantings are to be de-compacted and amended with organic matter. Decompaction and the addition of organic matter must be undertaken to 30 – 60 cm in depth. The soil decompaction area and the related soil volume must be sufficient to support the expected mature size of the proposed street trees. Additional guidance can be provided by a AQF level 5 arborist/horticulturalist.

b) A tree maintenance program is to be created by an AQF5 (or above) Horticulturalist/Aboriculturalist and implemented for the landscape plantings to ensure establishment and increase survivability.

c) Advanced stock (>300 mm pot size) must not be planted within nominated tree protection areas so as to avoid disrupting the critical root zone of protected trees.

d) Use locally native species to replace removed trees. Suggested species, below, are adapted to local climate conditions and are likely to have a long span of usefulness for the site while providing a net ecological benefit. Other locally native species may be used if desired, providing that they are appropriate for the long-term use of the site (see recommendation of the PEAR Abel Ecology, AE25- 2759-PEAR-ISS @).

8. References

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Appendix 1. Figures

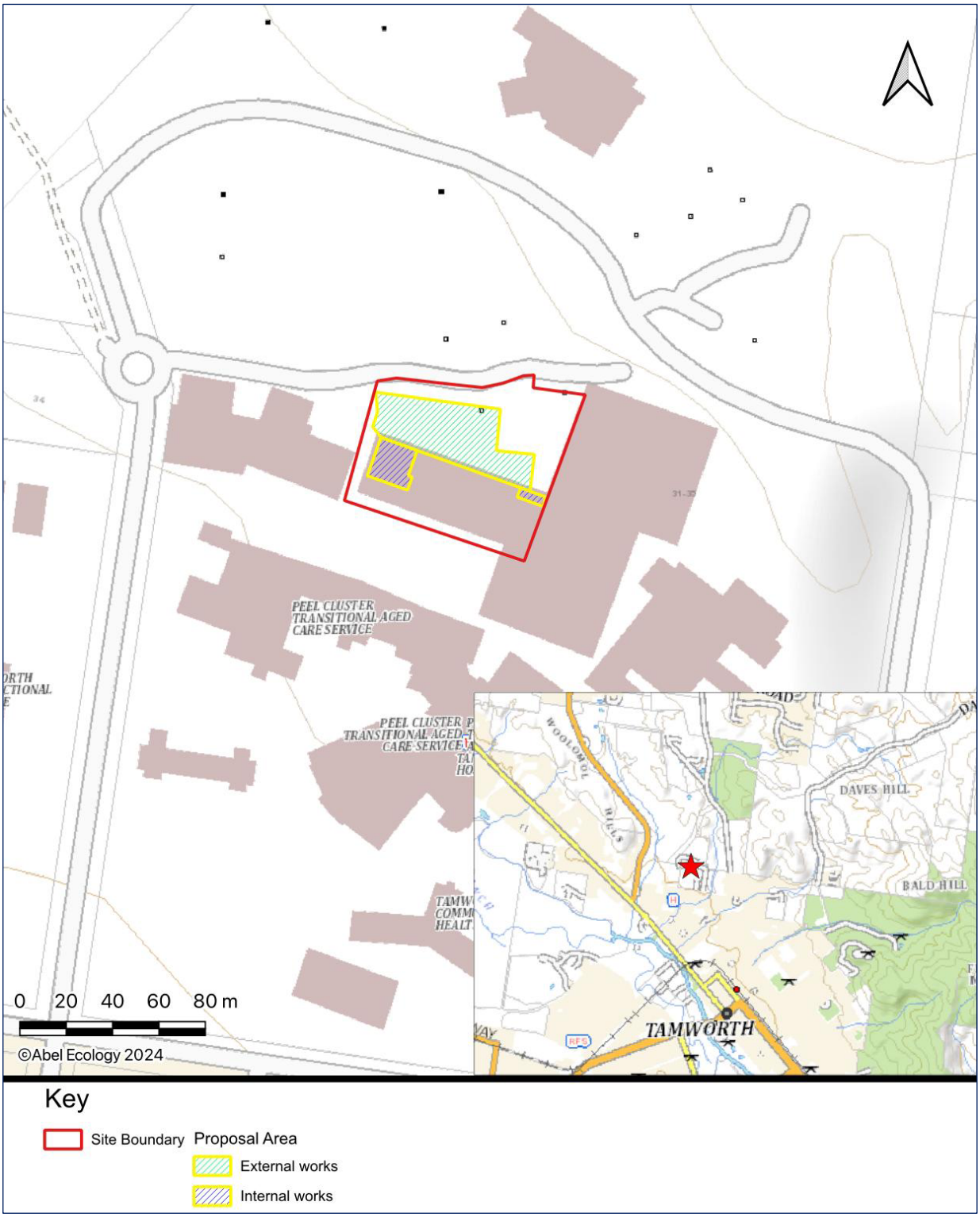


Figure 1. Locality map of 'The Site'

Figure 2. Aerial view of the site

Source: Nearmap

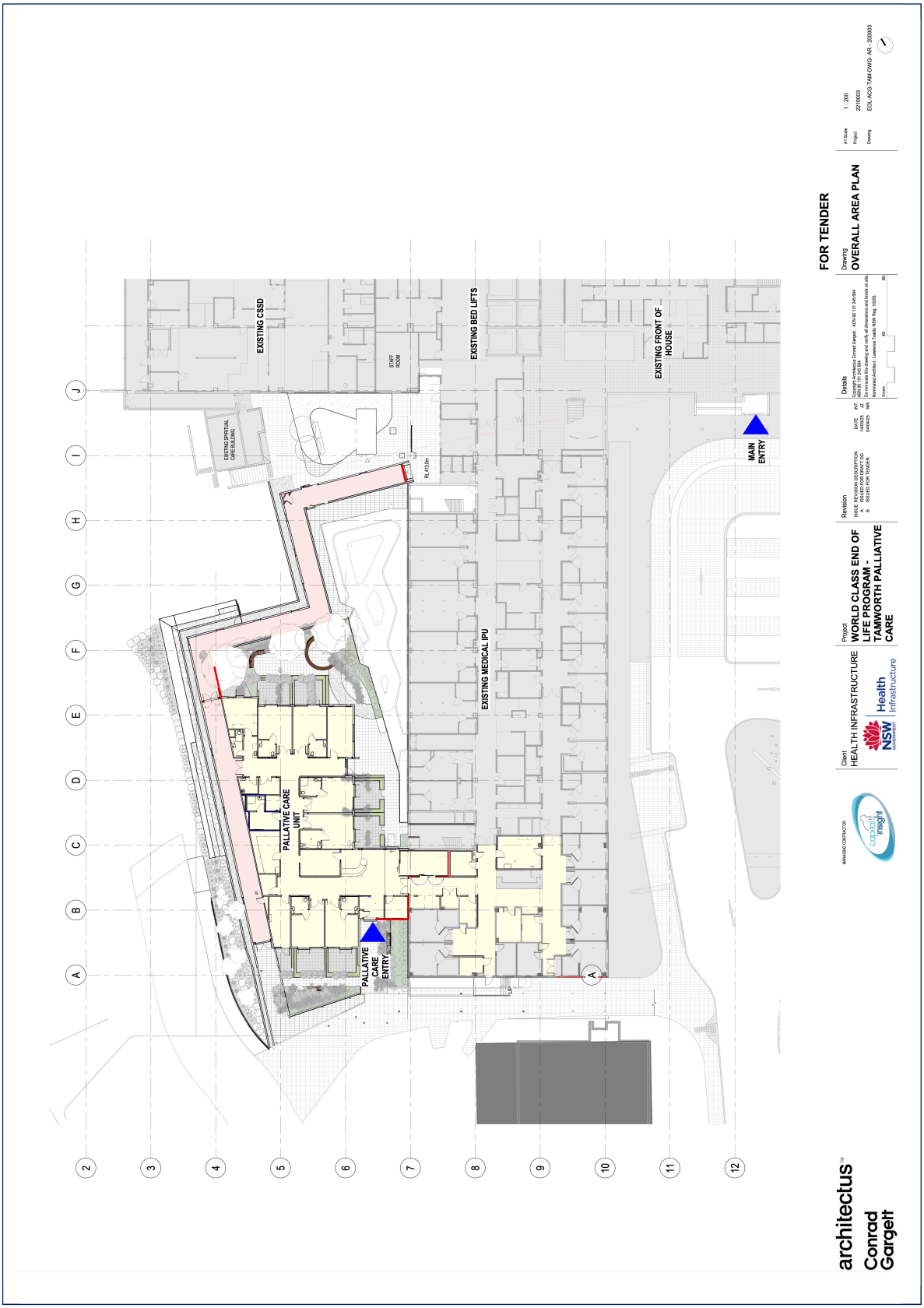


Figure 3. Proposal Diagram

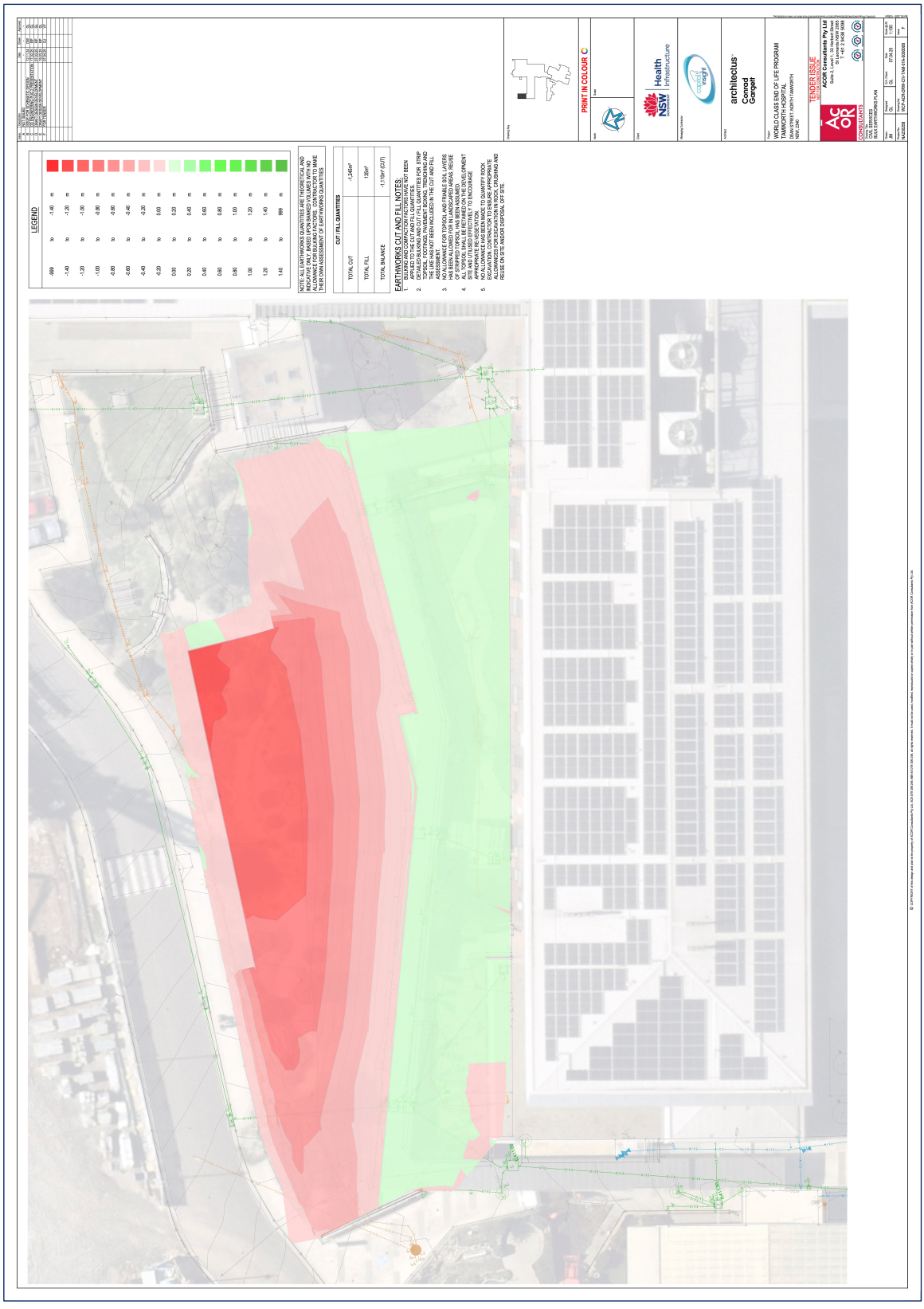


Figure 4. Bulk earthworks – Cut and Fill

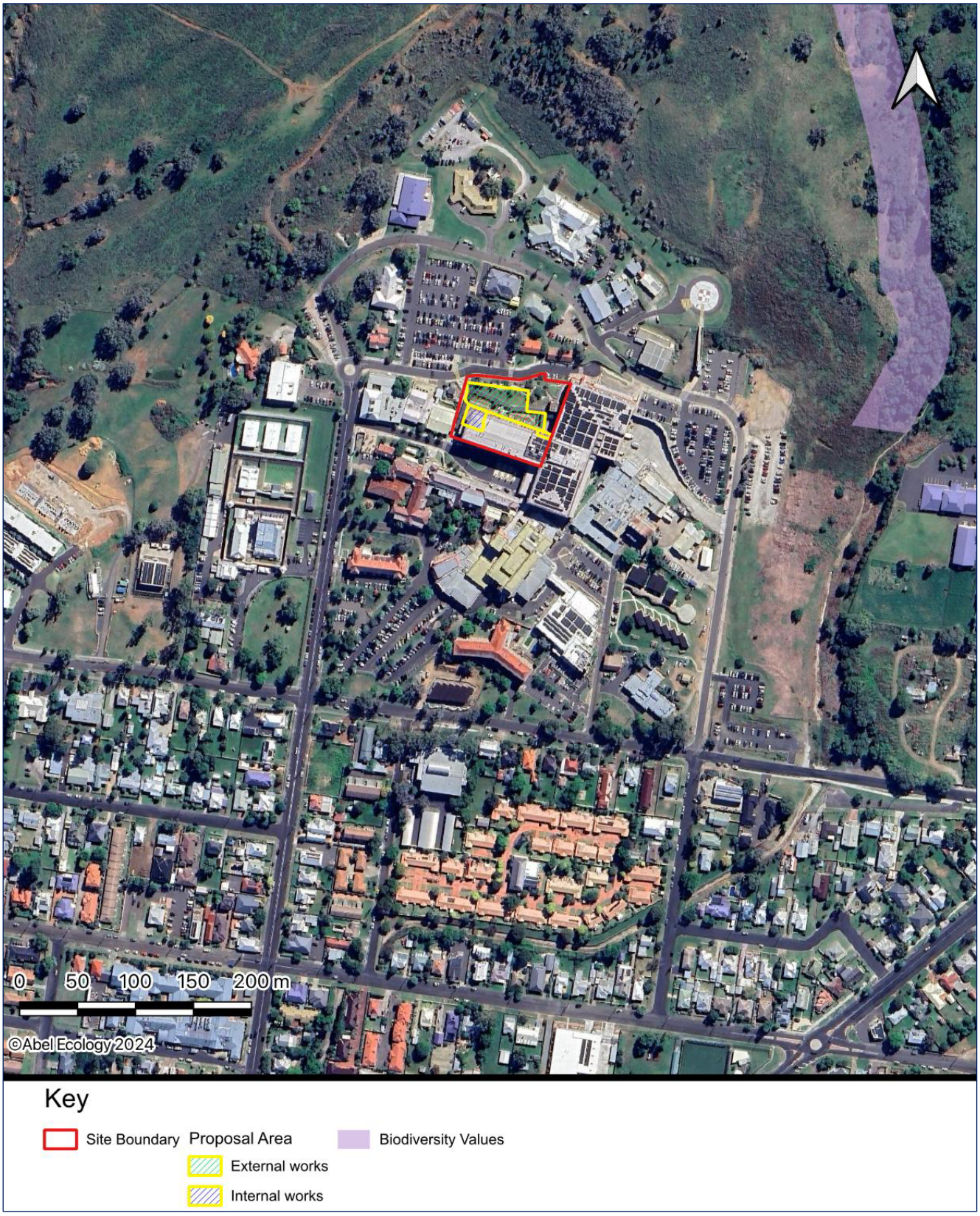
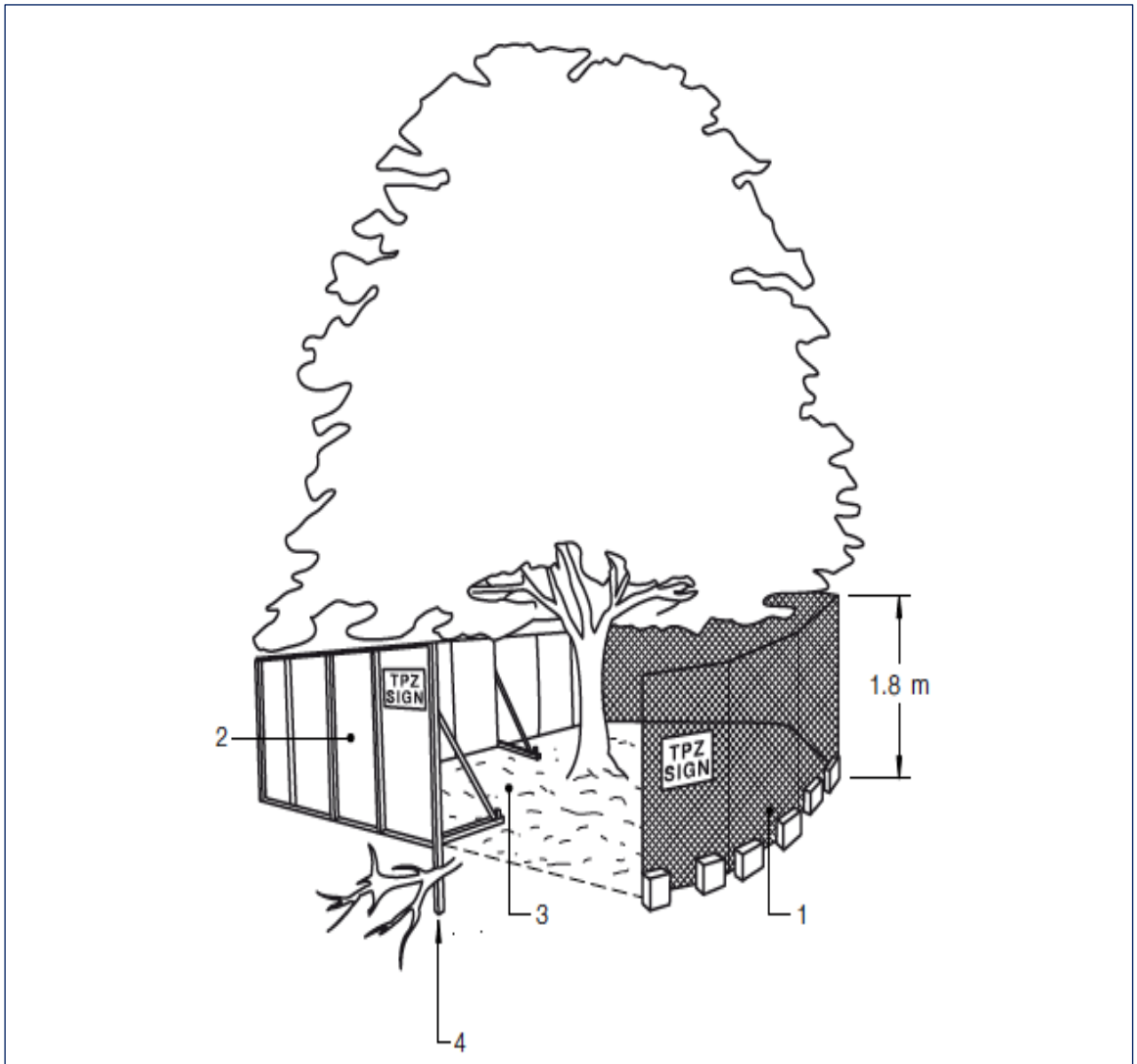


Figure 5. Biodiversity Values Map

Figure 6. Tree retention plan



LEGEND:

1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.

2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.

3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.

4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.

Figure 7. Protective fencing (Extract from Section 3 of AS 4970-2009)

Source: Standards Australia (2010) *Protection of trees on development sites* (AS 4970-2009 – incorporating Amendment No. 1).

Appendix 2. Tree data table

The following tree schedule (Table 4) describes the numbered trees shown in (Figure 6).

Table 4. Tree Data and Comments

Tree No.	*Species*	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Comments
01	*Acacia cultriformis*	15	14	2.00	1.50	Senescent in middle
02	*Acacia cultriformis*	22	11	2.00	1.75	
03	*Eucalyptus leucoxylon subsp. leucoxylon*	34	14, 12, 10	2.52	2.10	Codominant mallee form spreading
04	*Geijera parviflora*	18	15	2.00	1.61	
05	*Acacia cultriformis*	9	8, 4, 3, 3	2.00	1.50	4 codominant base
06	*Eucalyptus spp. (E.rugosa/E.leptocalyx/ E.cooperiana?)*	29	12	2.00	1.97	Caterpillars, pruned back, epicormic canopy
07	*Eucalyptus leucoxylon subsp. leucoxylon*	13	6, 6	2.00	1.50	Caterpillars, large fruit, broad opercilum, codominant from base
08	*Morus nigra*	38	8, 8, 7	2.00	2.20	Codominant from base
09	*Eucalyptus leucoxylon subsp. leucoxylon*	14	14	2.00	1.50	Codominant from base, scale
10	*Acacia decora*	18	18	2.16	1.61	Die back west side
11	*Eucalyptus erythrocorys*	9	9	2.00	1.50	
12	*Geijera parviflora*	17	17	2.04	1.57	Spreading from low
13	*Acacia cultriformis*	31	11, 6, 5	2.00	2.02	
14	*Eucalyptus spp.*	11	6	2.00	1.50	Bark smooth patchy
15	*Eucalyptus spp.*	9	6	2.00	1.50	Die back top
16	*Eucalyptus spp.*	12	7	2.00	1.50	Caterpillars
17	*Eucalyptus spp.*	25	25	3.00	1.85	Coppiced from base, Covered in scale and caterpillars
18	*Lagerstoemia indica*	14	7, 6	2.00	1.50	
19	*Lagerstoemia indica*	13	9	2.00	1.50	
20	*Lagerstoemia indica*	17	11	2.00	1.57	
21	*Pistacia chinensis*	20	18	2.16	1.68	Senescent in middle
22	*Pistacia chinensis*	20	18	2.16	1.68	

Table 5. Tree Canopy and Height Data

Tree No.	*Species*	Canopy Spread (m)				Tree Height Estimate (m)
		North	South	East	West	
01	*Acacia cultriformis*	1	2	1.5	2	< 3
02	*Acacia cultriformis*	2	2	2	2	3 - 5
03	*Eucalyptus leucoxylon subsp. leucoxylon*	5	3	3	3	3 - 5
04	*Geijera parviflora*	1	1	1	1	3 - 5
05	*Acacia cultriformis*	1	1	1	1	< 3
06	*Eucalyptus spp. (E.rugosa/E.leptocalyx/E.cooperiana?)*	1	1	1	1	3 - 5
07	*Eucalyptus leucoxylon subsp. leucoxylon*	1	1	1	1	< 3
08	*Morus nigra*	2	2	2	2	3 - 5
09	*Eucalyptus leucoxylon subsp. leucoxylon*	1	1	1	1	< 3
10	*Acacia decora*	2	1	2	1	3 - 5
11	*Eucalyptus erythrocorys*	2	0	1	1	< 3
12	*Geijera parviflora*	2	2	2	2	3 - 5
13	*Acacia cultriformis*	2	2	2	2	3 - 5
14	*Eucalyptus spp.*	1	1	1	1	< 3
15	*Eucalyptus spp.*	0.5	0.5	5	0.5	< 3
16	*Eucalyptus spp.*	1	1	1	1	< 3
17	*Eucalyptus spp.*	0.5	0.5	5	0.5	< 3
18	*Lagerstoemia indica*	2	2	2	2	3 - 5
19	*Lagerstoemia indica*	2	2	2	2	3 - 5
20	*Lagerstoemia indica*	2	2	2	2	3 - 5
21	*Pistacia chinensis*	2	2	2	2	3 - 5
22	*Pistacia chinensis*	2	2	2	2	3 - 5

Table 6. Tree Health and Retention Values

Tree No.	Species	Health	Structure	Age Class
01	*Acacia cultriformis*	Poor	Fair	Semi-mature
02	*Acacia cultriformis*	Good	Good	Semi-mature
03	*Eucalyptus leucoxylon subsp. leucoxylon*	Good	Fair	Semi-mature
04	*Geijera parviflora*	Good	Good	Semi-mature
05	*Acacia cultriformis*	Good	Fair	Semi-mature
06	*Eucalyptus spp. (E.rugosa/E.leptocalyx/E.cooperiana?)*	Poor	Fair	Semi-mature
07	*Eucalyptus leucoxylon subsp. leucoxylon*	Good	Fair	Semi-mature
08	*Morus nigra*	Good	Fair	Semi-mature
09	*Eucalyptus leucoxylon subsp. leucoxylon*	Fair	Fair	Semi-mature
10	*Acacia decora*	Poor	Fair	Semi-mature
11	*Eucalyptus erythrocorys*	Poor	Poor	Semi-mature
12	*Geijera parviflora*	Good	Good	Semi-mature
13	*Acacia cultriformis*	Good	Good	Semi-mature
14	*Eucalyptus spp.*	Good	Good	Juvenile
15	*Eucalyptus spp.*	Poor	Fair	Juvenile
16	*Eucalyptus spp.*	Good	Good	Juvenile
17	*Eucalyptus spp.*	Good	Fair	Juvenile
18	*Lagerstoemia indica*	Good	Good	Mature
19	*Lagerstoemia indica*	Good	Good	Mature
20	*Lagerstoemia indica*	Good	Good	Mature
21	*Pistacia chinensis*	Good	Good	Mature
22	*Pistacia chinensis*	Good	Good	Mature

Appendix 3. Tree protection guidelines

A Pre-construction/Demolition phase

The following methods are to be implemented to minimise potential damage to retained trees, e.g. from soil compaction and site activity. Trees are to be protected at all stages of the development, and growing conditions are to be improved within the Tree Protection Zone (TPZ). These guidelines are consistent with AS4970-2009 Protection of trees on development sites.

A 1. All site workers are to be aware of relevant tree protection requirements. Nominated trees will be removed or transplanted as per the tree protection plan. An arborist is to supervise tree removal, pruning and transplanting and certify the completed works.

A 2. All trees not nominated for retention are to be removed prior to any construction activity. Approved tree pruning and removal operations near retained trees are to be carried out in a way that avoids soil compaction and damage to canopy, trunk or roots. Works are to be supervised by an arborist or the person responsible for site management.

A 3. Stumps are to be ground, not dozed or dug out, if in the vicinity of retained trees. Machinery (other than stump machines) is to be kept beyond the nominated protection zones of retained trees during all operations.

A 4. Tree protection fencing is to be in place before the introduction of machinery or other materials to the site and before commencement of works. Fencing is to be located to at least the canopy dripline, be of sturdy construction and retained in-situ during works unless altered by the Project Arborist. All site activities are excluded from this zone. Refer to Appendix 2 for specific minimum setback distances. AS4687 specifies applicable fencing requirements.

A 5. The TPZ is to be mulched using material compatible with *'AS4454-2003 Composts, soil conditioners and mulches'*, e.g. decomposed leaf litter, and maintained at 50-100 mm depth. Some areas, e.g. turf, may not require mulch. Temporary irrigation may be required. Weeds are to be removed and controlled.

A 6. Pruning is to be undertaken by suitably qualified, skilled and insured people to comply with *AS4373-2007, Australian Standard: Pruning of Amenity Trees*. Initial pruning provides adequate clearances and general crown maintenance. Flexible branches are to be tied back, not pruned.

B Construction phase (Maintain tree protection fencing)

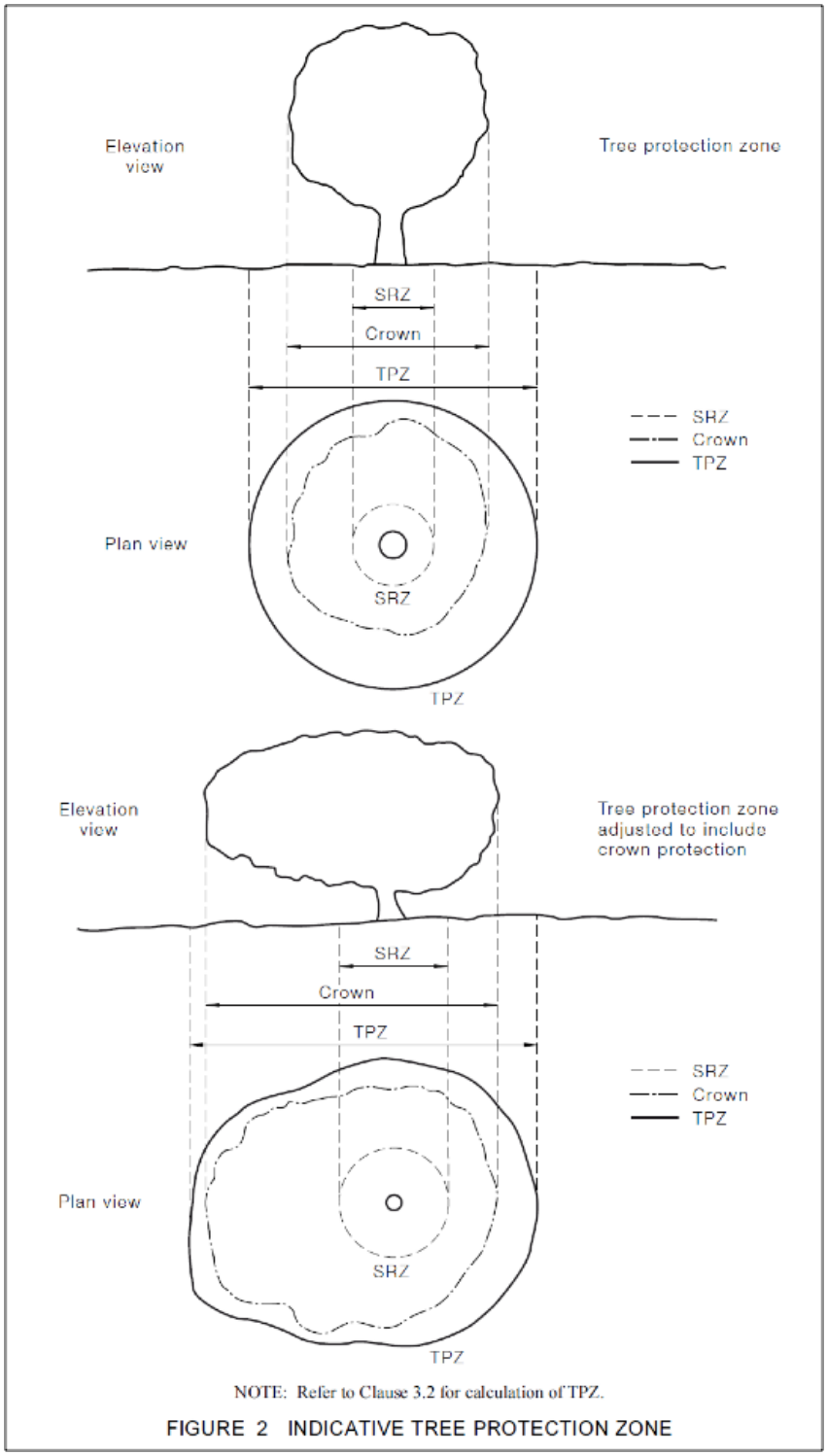
B 1. Where access is required within a TPZ, temporary ground protection measures will be required (e.g. metal plates, rumble boards or exterior-grade ply over aggregate) capable of supporting the required load without deflection. Trunk protection may be required, e.g. battens wrapped around the trunk to a height of 2 metres.

B 2. Material stockpiles or dumps, parking, excavation, site sheds, preparation of chemicals, fires, wash down areas or similar are to be located clear of TPZs. Areas designated for such requirements are not to divert drainage water into tree protection areas.

B 3. Machine trenching is to be excluded from the TPZ of retained trees. Any required root excavation inside a TPZ is to be done by hand and intact roots >40 mm in diameter are to be retained. Services are to be installed 100 mm clear of such roots. Damaged roots **must** be cut cleanly with sharp implements (backhoe blades and similar are excluded), with no root dressings or paints. Trenches are to be backfilled promptly to minimise soil desiccation. Underbore if no suitable alternative location is possible. All works within the TPZ are to be supervised by an arborist.

Appendix 4. Tree protection zone and structural root zone

Extract from Section 3 of AS 4970-2009



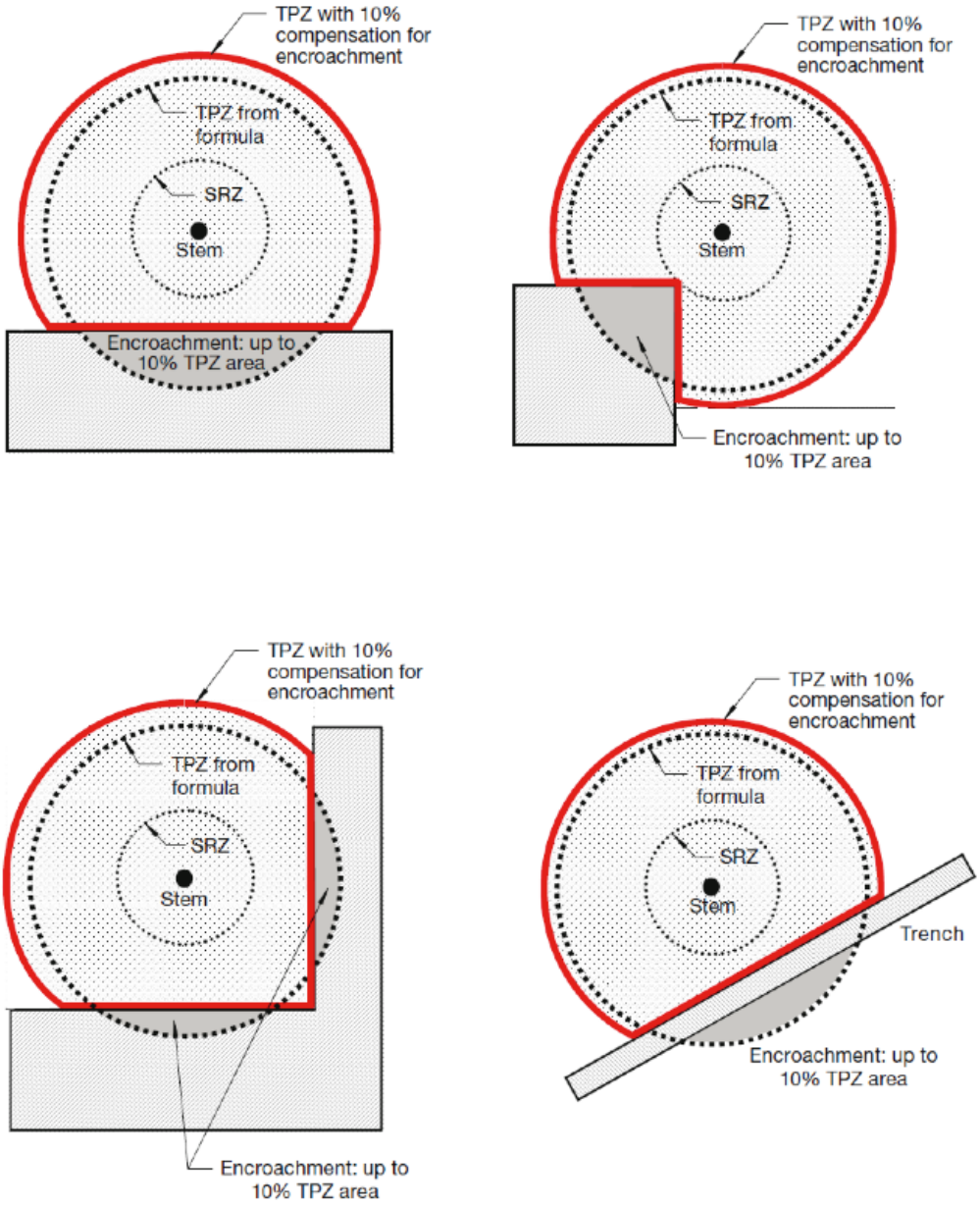
NOTE: Refer to Clause 3.2 for calculation of TPZ.

FIGURE 2 INDICATIVE TREE PROTECTION ZONE

Appendix 5. Encroachment into tree protection zones

Extract from Appendix D of AS 4970-2009

Encroachment into the tree protection zone (TPZ) is sometimes unavoidable. Figure D1 provides examples of TPZ encroachment by area, to assist in reducing the impact of such incursions.



NOTE: Less than 10% TPZ area and outside SRZ. Any loss of TPZ compensated for elsewhere.

FIGURE D1 EXAMPLES OF MINOR ENCROACHMENT INTO TPZ

Appendix 6. IACA Significance of a Tree, Assessment Rating System (STARS)© (IACA)©

IACA Significance of a Tree, Assessment Rating System (STARS)© (IACA 2010)©

In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High*, *Medium* and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined. An example of its use in an Arboricultural report is shown as Appendix A.

Tree Significance - Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vigour;
- The tree has a form typical for the species;
- 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;
- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils significant Tree Register;
- 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;
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values;
- 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.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour;
- The tree has form typical or atypical of the species;
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,
- The tree provides a fair contribution to the visual character and amenity of the local area,
- 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*.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour;
- The tree has form atypical of the species;
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings,
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area,
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen,
- 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,
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

Hazardous/Irreversible Decline

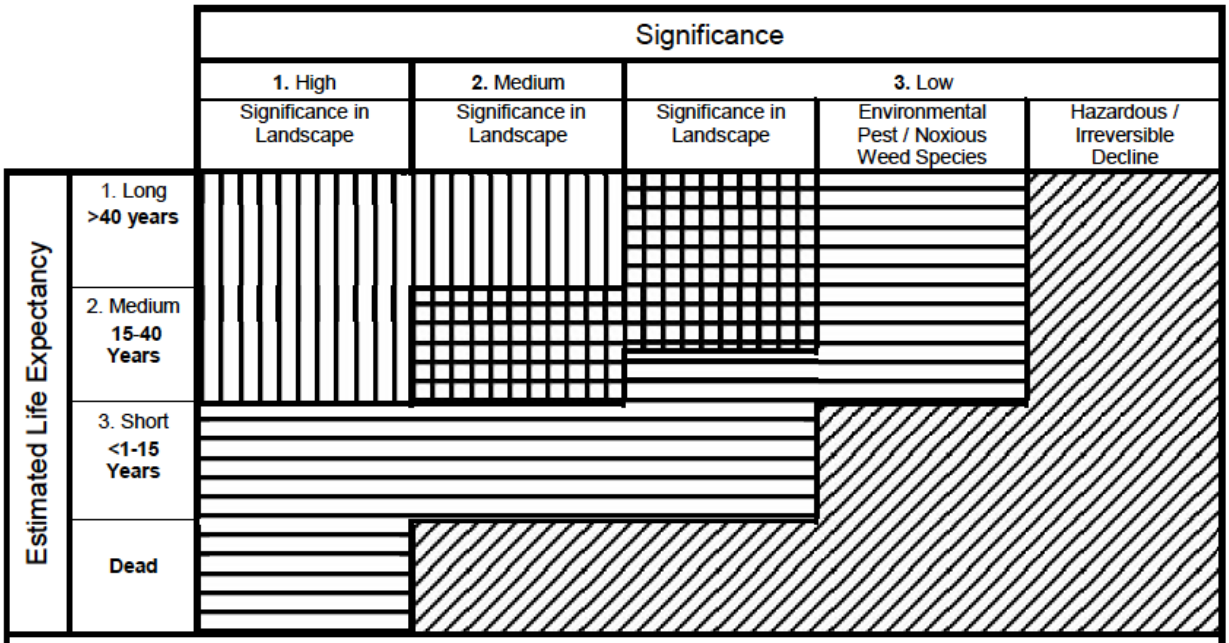
- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g. hedge.

IACA 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturists, www.iaca.org.au

Table 1.0 Tree Retention Value - Priority Matrix.



Legend for Matrix Assessment

INSTITUTE OF AUSTRALIAN CONSULTING ARBORICULTURISTS

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 e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.

Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.

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.

Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

USE OF THIS DOCUMENT AND REFERENCING

The IACA Significance of a Tree, Assessment Rating System (STARS) is free to use, but only in its entirety and must be cited as follows:

IACA, 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturists, Australia, www.iaca.org.au

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Footprint Green Pty Ltd 2001, *Footprint Green Tree Significance & Retention Value Matrix*, Avalon, NSW Australia, www.footprintgreen.com.au

IACA 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturists, www.iaca.org.au

Appendix 7. Company Profile

Abel Ecology has been in the flora and fauna consulting business since 1991, starting in the Sydney Region, and progressively more state wide in New South Wales since 1998, and now also in Victoria. During this time extensive expertise has been gained with regard to Master Planning, Environmental Impact assessments including flora and fauna, bushfire reports, Vegetation Management Plans, Management of threatened species, Review of Environmental Factors, Species Impact Statements and as Expert Witness in the Land and Environment Court. We have done consultancy work for industrial and commercial developments, golf courses, civil engineering projects, tourist developments as well as residential and rural projects. This process has also generated many connections with relevant government departments and city councils in NSW. Our team consists of eight scientists and four administrative staff, plus casual assistants as required.

Licences

NPWS s132C Scientific licence number is SL100780.

NPWS GIS data licence number is CON95034.

NSW Dept of Primary Industries Secretary's Animal Care and Ethics Committee Approval: 18/575.

NSW Dept of Primary Industries Animal Research Authority. Accreditation No: 84207.

The Consultancy team

Dr Danny Wotherspoon

BSc, DipEd, MA, PhD, Grad Dip Bushfire Protection,
MECA NSW, MEPLA, MNELA, MESA, MEIANZ, White card.

Danny has practised as an ecological and bushfire consultant since 1991.

He is a consulting ecologist to private developers, State Government agencies and various City Councils on a regular basis, for development applications, government projects, and as expert witness in the NSW Land and Environment Court.

Danny's PhD researched fragmented vegetation and fauna habitat use. He has special expertise in fauna habitat use. Danny has presented invited papers at international conferences since 2001 in Australia, China, South Africa, Sri Lanka and Israel on his PhD and other research, including golf course habitat management. Danny's scientific papers have been published in both international and Australian academic journals.

Mark Mackinnon

B Env. Sci. (Hons); Grad. Dip. in Bushfire Protection.
Accredited Practitioner Level 3 - Bushfire Planning & Design (BPAD); Accreditation number 36395.
MEIANZ, White Card.

Mark is a passionate and enthusiastic scientist who thrives in the field of natural resource management. He has experience in threatened species, fire ecology, bushfire management, pest plant and animals, and landscape restoration. In particular he specialises in ornithology and bushfire management. Mark has several specialized field-based skills including simple and complex tree climbing, working at heights, general firefighter departmental fire accreditation, venomous snake and reptile handling, immunization to handle bat species, and an A - class bird banding licence with mist-net endorsement. Mark is also skilled in GIS mapping, first-aid and four -wheel-driving.

Mark Sherring

BM, MAABR, Cert. Hort., Cert. Bush Regen, Cert. Rural Ops, White Card.
Member of the Australian Association of Bush Regenerators.

Mark has extensive knowledge and experience of plant species in New South Wales. He has built up his expert knowledge on NSW native plant species over the many years that he has practiced as a Botanist. He is regularly asked to contribute to the extensive (ongoing) flora surveys of the Sydney Basin and Blue Mountains carried out by the Royal Botanic Gardens, Sydney. Mark has extensive field survey experience, having worked for over ten years in various plant-related roles. His role in Abel Ecology is to provide expert advice on flora and on the full range of flora management issues encountered, and in the design and management of environmental monitoring projects.

Nicholas Tong

BSc (Biology), MPhil (Ecology), Cert. III CLM
BAM Accredited Assessor (BAAS22012),
MECA NSW, Snr First Aid, White card.

Nicholas is an experienced ecologist with expertise in fauna, plant species identification, vegetation assessment and ecological restoration. In the last six years, he has been a consulting ecologist to private developers and large corporations, for a variety of projecting including State Significant Developments. Nick has extensive field work experience in Sydney, the Blue Mountains and Central West NSW. His Master's project investigated the impacts of exotic predators on herpetofauna in the arid zone. His role at Abel Ecology is to provide expert advice on fauna and the application of the Biodiversity Offset Scheme.

Andy Araya

Botanist/Ecologist
B Env. Sci. MTeach (Env., Marine, Agr., Bio., Chem.), Dip. Marine Operations
First Aid Cert. White Card. ACDC Chemical Licence, NSW Boating Licence, Marine Radio Licence, Security Licence, Chainsaw Licence.

Andy has over 15 year's experience as a bush regeneration supervisor working across a number of environments throughout NSW and QLD from EEC of the Cumberland Plain, riparian and wetland areas, sand dunes and rainforests, to the higher elevations of the Blue Mountains National Park. Managing teams of up to 10 staff in remote areas as well as urban environments has allowed Andy to hone his skills of communication and native species identification. Andy's additional experience as a builder in the building and construction industry gives him a solid understanding of the considerations and legal requirements clients face in mitigating environmental and personal harm.

Emily Barbaro

Ecologist
BA, MPublishing, Grad. Cert. EnvSc, MEScM (enrolled).

Emily has completed a Graduate Certificate in Environmental Science and a Masters of Environmental Science and Management. During her degree, Emily also completed the Volunteer Botanical Training Program at the Australian National Herbarium, Centre for Australian National Biodiversity Research and CSIRO. The Program included both botanical and general herbarium tasks, such as archiving plant specimens, plant identification, and assistance with taxonomic research projects. Emily has previously worked as a Bush Regenerator and has been volunteering with Bushcare for Blue Mountains City Council for the last three years. She is passionate about continuing to learn more about her local Blue Mountains flora and fauna.

Erin Parker

Ecologist

B Biodiversity and Conservation, Macquarie University.

Erin has completed a Bachelor of Biodiversity and Conservation at Macquarie University. Erin has previously worked as a bush regeneration team member while completing her degree. There she was able to develop plant ID skills and understanding of the procedures of weed management and restoration. Erin has also taken part in a casual position assisting with threatened species surveys in the Central West of NSW. This involved various tasks including tree hollow surveys for Glossy Black Cockatoos, preparation for reptile surveys, spotlighting, harp trapping surveys of microbats, and Koala SAT plot surveys. Erin is passionate about furthering her knowledge on native Australian flora and fauna, their ecology and impacts.

Callista Harris

Technical Officer

BPlan (Hons)

First Aid Cert., White Card, Work Safely at Heights, Chainsaw Licence, Operate Elevating Work Platform (scissor lift), High Risk Work Licence - Boom-Type Elevating Work Platform (WP) (over 11 metres), Cert. Venomous Snake Handling, Damage Mitigation Permit - Protected Animals.

Callista has 9 years' experience as an urban planner. She has a strong knowledge of NSW environmental legislation and has secured approvals for a wide range of developments, including housing developments, industrial developments, solar farms, and infrastructure. She has recently changed careers and has gained valuable on the ground experience working as a fauna spotter catcher, ecologist, and botanist on various projects.

Dr Stephanie Clark

Specialist Consultant

B Sc (Hons), PhD

Stephanie has over 30 years experience in the collection, identification and taxonomy of marine, estuarine, freshwater and terrestrial molluscs. She has conducted numerous targeted surveys for endangered and threatened species (particularly land and freshwater molluscs) in both Australia and the United States. She is particularly interested in the systematics, taxonomy, morphology (external and internal), population and conservation genetics and conservation of molluscs particularly terrestrial (especially the Helicoidea) and freshwater (especially the Hydrobiidae and related families) groups.