Technical Manual

Newcastle Urban Forest

(updated February 2018)

Urban Forest Technical Manual
prepared by Newcastle City Council

Enquiries:
For information about this manual, contact:
Customer Enquiry Centre
Newcastle City Council
Phone: 02 4974 2000

Endorsed by:			
Name:	Ken Liddell	**Name:**	Peter Chrystal
Position	Director Infrastructure	**Position**	Director Planning and Regulatory
Signature:		**Signature:**	
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Published by:
Newcastle City Council
282 King Street, Newcastle
Phone: 02 4974 2000
(main switchboard)
Post: PO Box 489
Newcastle 2300 Australia
Fax: 02 4974 2222
E-mail: mail@ncc.nsw.gov.au
Web: www.newcastle.nsw.gov.au

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Newcastle Urban Forest Technical Manual
Part A Private Trees

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The urban forest is the collection of trees, shrubs, and other vegetation types, on both public and privately owned land within the Newcastle Local Government Area. The urban forest and associated tree canopy across Newcastle provides a range of benefits for the community. Some of these benefits include shade, microclimate regulation, air quality, sense of wellbeing, diverse flora and fauna, storm water management and interception. The liveability of the city is greatly improved by having a sustainable tree canopy and green spaces.

In May 2008, Council adopted the Newcastle Urban Forest Policy and Urban Forest Background Paper in recognising the importance of the urban forest. The goals of the Urban Forest Policy include sustaining and maximising the Newcastle urban forest on an intergenerational basis. In June 2013, Council adopted the Newcastle 2030 Community Strategic Plan which is the community's long term vision for the city. The Community Strategic Plan identifies that over the next 20 years the Newcastle community wants a greater connection with nature, with a greener more enriching environment where the urban forest is maintained and connected.

This Technical Manual contributes to Newcastle's urban forest by providing guidance on the management of trees (including shrubs) on both public and private land within the Newcastle Local Government Area. The Manual is an accompaniment to the Newcastle Development Control Plan Section 5.03 Vegetation Management. It is separated into three parts based on the land on which the tree is located and the type of vegetation present:

- Part A provides guidance on the management of trees and shrubs located on private land.
- Part B provides guidance on the management of trees and shrubs located on public land.
- Part C provides guidance on the management of native vegetation communities on private land

Use the Part that relates to the land on which the tree, shrub or other vegetation is located, regardless of the proposed activity.

Urban Forest Technical Manual
Part A Private Trees

Table of Contents

1.0 Introduction

Part A of the Urban Forest Technical Manual is to be used for all activities relating to trees on private land. Private trees are trees located on land that is not managed by Council, and includes all private residential land and land managed by other government agencies.

To sustain canopy cover across the local government area, Council requires the appropriate management of private trees to maximise the useful life of the trees and that suitable replacement planting is undertaken when trees are removed.

Where development is undertaken it is preferred that healthy trees are retained and protected by appropriate design and construction methods. Where the retention of trees is not possible, then adequate space is to be made available on the site for new tree planting.

1.1 How to use this manual

Part A of this Manual is presented in 12 sections:

Section 1.0 Introduction - outlines when this part of the Manual is to be used.

Section 2.0 Pruning - outlines when pruning does / or does not require approval and provides the pruning specification.

Section 3.0 Tree and shrub removal not associated with development - provides the process to be followed for tree removal on private land that is not associated with a development application. Outlines when tree assessment tests are required, and details what is required to undertake each of the five tree assessment tests on private land.

Section 4.0 Tree removal on private land associated with development - provides the process to be followed for tree removal on private land associated with a development application. Outlines what is to be submitted with the development application where trees may be impacted.

Section 5.0 Greenfield sites - outlines what is to be considered during the design of a subdivision.

Section 6.0 Arborist reports and qualifications - sets out the level of qualification required for reporting on private trees.

Section 7.0 Protection measures - provides specific detail on tree protection in relation to any works undertaken as part of private development.

Section 8.0 Designing for new trees - details the process and considerations for incorporating new trees into the design of subdivisions or other large scale developments. This advice also assists residents in planting trees on their property.

Section 9.0 Tree species selection and supply - details the ordering and supply of tree stock in accordance with NATSPEC.

Section 10.0 Tree planting - provides extensive detail on best practice planting techniques and requirements for subdivisions and large commercial developments. This advice also assists residents in planting trees on their property.

Section 11.0 Biosecurity - identifies the biosecurity requirements to be implemented for tree maintenance activity.

Section 12.0 Callaghan Campus - provides details for tree management on Callaghan Campus (University of Newcastle).

2.0 Pruning

2.1 Pruning requiring a permit

A permit for pruning of tree(s) or shrub(s) on private land is required from Council when:

- the tree or shrub being pruned is a heritage listed item, that is or forms part of an Aboriginal object or is within a place of Aboriginal significance.

For pruning of a tree/shrub that is a heritage listed item, forms part of an Aboriginal object or is within a place of Aboriginal significance the following information must be submitted to Council:

- a completed *Notification - Heritage Minor Works or Maintenance* form obtainable from Council's website www.newcastle.nsw.gov.au/Council/Forms-Publications/Forms/DA-Heritage-Notification-Form , and
- a *Tree Pruning Specification* form (see **Appendix 5**) completed by an arborist with minimum Level AQF 3 qualification.

Note 1: The pruning of vegetation in a threatened ecological community or a threatened plant species listed under the *Biodiversity Conservation Act 2016* requires a licence under that Act. For further information see the Office of Environment and Heritage website. A permit application is also required from Council, refer Part C of this manual.

Note 2: The pruning of marine vegetation under the *Fisheries Management Act 1994* requires a permit under that Act. For further information see the Department of Primary Industries website.

Note 3: A permit from Council is required prior to clearing or pruning any other native vegetation including understorey plants, groundcovers and plants occurring in a wetland and is less than the biodiversity offsets scheme threshold identified under the *Biodiversity Conservation Act 2016*. Refer to Part C of this manual.

Note 4: Pruning of public trees and shrubs can only be undertaken by Council. Refer to Part B of this manual.

2.2 Pruning that does not require a permit

A permit from Council is not required for the pruning of tree(s) or shrub(s) on private land in the following circumstances:

- Pruning with a pruning specification (section 2.2.1)
- Pruning without a pruning specification (section 2.2.2).

2.2.1 Pruning with a pruning specification

A permit is not required to prune declared vegetation (trees and shrubs) where the following criteria are met:

(a) landowners consent has been obtained; and

(b) for a tree or shrub greater than 5m in height:

(i) the pruning is undertaken in accordance with the *AS4373 -2007*, and

(ii) a pruning specification (**Appendix 5**) is completed by a suitably qualified arborist, and

(iii) the pruning specification is retained by the landowner for a period of two years.

2.2.2 Pruning without a pruning specification

A permit is not required to prune declared vegetation (trees and shrubs) and a pruning specification is not required where the following criteria are met:

(a) for pruning of individual branches from a tree or shrub that overhangs a dwelling, formal path or driveway:

(i) the pruning is to remove branches that are within 1m of the dwelling, formal path or driveway, and

(ii) the pruning does not alter the overall shape or structure of the tree, and

(iii) the branches removed are less than 100mm in diameter at the final cut, and

(iv) the final cut is at a branch collar or appropriate growth point (refer to Section 2.3), or

(b) the height of the shrub/s is less than 5m, and

(i) it is maintained without reducing the height, or

(ii) is pruned for the purposes of hedging, topiary, clearing of driveways or formal pathways, or similar.

2.3 Australian standard and pruning specification

All tree pruning is to be undertaken in accordance with the Australian Standard *AS 4373-2007 Pruning of Amenity Trees* (*AS 4373 - 2007*). This standard provides guidance on tree pruning and encourages pruning practices and procedures that reduce the risk of hazard development including branch failure, pathogen infection and premature tree death.

AS 4373-2007 requires that pruning specifications are prepared by a person with a minimum level in arboriculture of AQF 3 (refer to **Table 1**). *AS 4373-2007* also requires pruning should be carried out by a suitably qualified person with experience in arboriculture (minimum AQF level 2) and in accordance with relevant WHS guidelines. **Table 1** outlines the Australian Qualifications Framework for arboriculture.

Table 1 - Australian Qualifications Framework (AQF)

AQF*	Indicative employment level
Level 2	**Tree Worker**
Level 3	**Trade Arborist**
Level 4	**Supervising Arborist/Coordinator**
Level 5	**Consulting Arborist**
Level 8	**Municipal Tree Manager/ Urban Forest Management**

***** The Australian Qualifications Framework is a national framework for education and training qualifications. It provides national recognition of competency based training on endorsed competency standards, assessed in accordance with assessment guidelines.

The following steps outline what is required for tree pruning to be in accordance with *AS 4373-2007*:

1. A thorough inspection of the tree is to be carried out by an arborist competent in arboricultural assessment (minimum AQF level 3).

2. The arborist will determine if pruning is required and the pruning requirements will be specified in a tree pruning specification (see **Appendix 5**).

3. The specified pruning will not adversely affect the tree.

4. All applicable planning, heritage and protected species legislation will have been considered in the context of the proposed pruning.

5. The specified pruning is to be carried out by a person qualified and experienced in arboriculture (minimum AQF level 2).

6. The person undertaking the pruning must do so in accordance with the specification that addresses the following pruning types from *AS 4373-2007*:

    - all pruning cuts are to be at a suitable branch collar or appropriate growth point, and
    - for dead wood pruning, the minimum diameter and location of branches removed must be specified, and/or
    - for crown thinning, the total percentage of crown to be removed and the maximum diameter and location of branches to be removed must be specified, and/or
    - for selective pruning, the branches to be removed must be specified, and/or
    - for reduction pruning, the extent of crown or limb reduction must be specified, and/or
    - for crown lifting, the clearances to be achieved and the maximum diameter and location of branches to be removed must be specified, and/or
    - for remedial pruning the initial and subsequent pruning events will be precisely detailed and the pruning specified as a last resort, and/or
    - for pruning palm trees the disinfection of tools must be specified to reduce the risk of spreading palm disease, for example Palm Wilt see **Appendix 1**.

Note 1: Tree topping and lopping are not forms or classes of pruning in *AS 4373-2007*.

Note 2: Safe Work NSW Amenity Tree Industry Code of Practice applies to all commercial tree work including tree pruning.

3.0 Tree and shrub removal not associated with development

This section outlines the processes to be followed when tree or shrub removal is being undertaken, and the removal is not associated with other development (eg. building a residential dwelling), including:

- tree and shrub removal (not associated with other development) that requires development consent
- removal of a heritage listed tree
- tree or shrub removal that does not require a permit
- tree or shrub removal that requires a permit in accordance with Section 5.03.04 of Council's *Development Control Plan 2012*.

If the tree or shrub removal is associated with other development see section 4.0 of this Manual.

Note: Tree removal on private land in relation to bushfire 10/50 rules are not to be submitted to Council. Refer to the Rural Fire Service website.

3.1 Tree removal on private land that requires development consent

The following trees/vegetation requires development consent from Council prior to removal:

(a) a tree that is listed as a heritage item unless removal is of a minor nature (refer to Section 3.2)

(b) a tree that forms part of an Aboriginal object or is within a place of Aboriginal significance unless removal is of a minor nature (refer to Section 3.2)

A development application is to be lodged with Council. Forms can be obtained from Council's website: www.newcastle.nsw.gov.au/Development/Application-Guide/Development-Application-Process or phone (02) 4974 2000.

3.2 Removal of a heritage listed tree

3.2.1 Heritage listed tree

A heritage listed tree or shrub, including trees or shrubs that form part of an Aboriginal object or is within a place of Aboriginal significance, may potentially be removed if Council considers the works to be of a minor nature or will not adversely affect heritage significance. To make application to Council for determination of the works to the heritage listed tree or shrub as being minor or not adverse to heritage significance the following information must be submitted:

(a) a completed *Notification - Heritage Minor Works or Maintenance* form obtainable from Council's website: www.newcastle.nsw.gov.au/Council/Forms-Publications/Forms/DA-Heritage-Notification-Form, and

(b) an arborist report prepared in accordance with **Appendix 7** (qualification minimum AQF 5).

3.3 Tree and Shrub removal on private land that does not require a permit

A permit (*Application for Tree Removal* form) is not required from Council to remove a tree or shrub on private land in the following circumstances

1. The tree or shrub poses an immediate risk to life or property due to a demonstrated sudden change to its structure as a result of severe storm or wind events. Landowners consent is required to be obtained and the *Report Storm Damage Tree Removal* form in **Appendix 6** must be completed by the person carrying out the removal. The report must be retained by the resident for at least 2 years.

   Clear and relevant photos are required to support the removal of the tree under this section. The photos are to show:

   - the tree in context, showing relationship to dwellings, other trees or structures, and
   - clear images of the damaged sections of the tree, and

- clear images to demonstrate the sudden change to the trees structure, and that it poses an immediate risk to life or property as a result of severe storm or wind events.

If the storm damaged private tree is a heritage listed item, then Council is to be notified by supplying the complete*d Report Storm Damage Tree Removal* form in **Appendix 6**. The completed form and relevant photos are to be forwarded to Council within 5 working days of the tree removal.

Note: Trees or shrubs on public land cannot be removed in these circumstances. If a public tree or shrub appears to be damaged by a storm then this must be referred to Council who will carry out the required works.

2. The tree is dying or dead (refer to Glossary), and
   - is not required as the habitat of native animals, and
   - is not a heritage listed item (refer to Section 3.2.1 for requirements for heritage listed trees), and
   - is not part of a native vegetation community, and
   - an arborist (minimum AQF 3) has confirmed in writing (see **Appendix 11** *Dead or Dying Tree Removal Form)* that the tree meets the definition of dead or dying, and
   - the landowners consent has been obtained in writing.

   Clear and relevant photos are required to support the removal of the tree under this section. The photos are to show:
   - the tree in context, showing relationship to dwellings, other trees or structures, and
   - clear images of the tree that clearly show the tree is dead or dying, and
   - the land owner is to retain the completed Dead or Dying Tree Removal Form and all relevant photos for a period of 2 years.

3. The tree is less than 3m in height or with a circumference at breast height (1.4m above ground level) less than 450mm for a single trunk tree, or less than 300mm for each trunk of a multi-trunk tree (see **Figure 1**), and is not part of a native vegetation community.

4. The shrub is less than 5m in height and is not part of a native vegetation community.

5. The tree or shrub is located within 3m of the wall of an existing principal building (excluding carports, garages, pergolas, fences, retaining walls and the like) on the land where it is situated or on adjacent privately owned land (where the land owners consent for the works has been obtained).

Note 1: The 3m distance is measured from the closest point of the trunk to the footings of the building (see **Figure 2**).

Note 2: It is preferable that a replacement tree is planted on the same lot as the removed tree where space is available, and that this planting is outside the 3m buffer to the principal building.

Note 3: This clause does not apply to trees or shrubs on land managed by a public authority including Council, this clause only applies to trees on privately owned land.

6. The tree or shrub is native vegetation previously planted for agriculture, agroforestry, forestry, horticulture or woodlot purposes.

Note 1: The removal of vegetation in a threatened ecological community or a threatened plant species listed under the *Biodiversity Conservation Act 2016* requires a licence under that Act. For further information see the Office of Environment and Heritage website. A permit application is also required from Council refer Part C of this manual.

Note 2: The removal of marine vegetation under the *Fisheries Management Act 1994* requires a permit under that Act. For further information see the Department of Primary Industries website.

Note 3: A permit from Council is required prior to clearing (removal) any other native vegetation including understorey plants, groundcovers and plants occurring in a wetland and is less than the biodiversity offsets scheme threshold identified under the *Biodiversity Conservation Act 2016*. Refer to Part C of this manual.

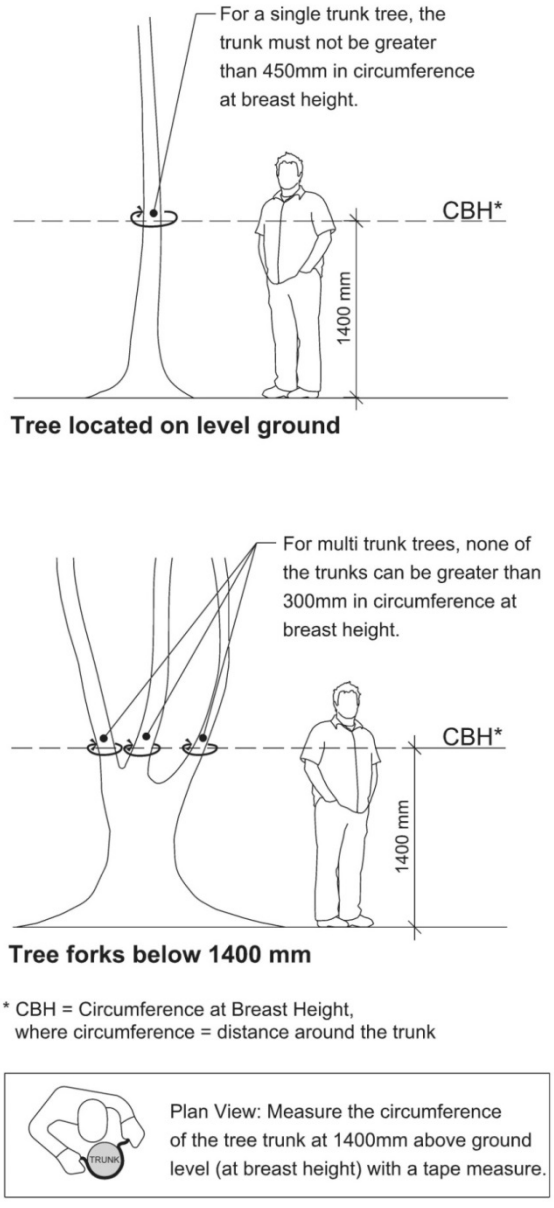


Figure 1 - Single and multi-trunk trees

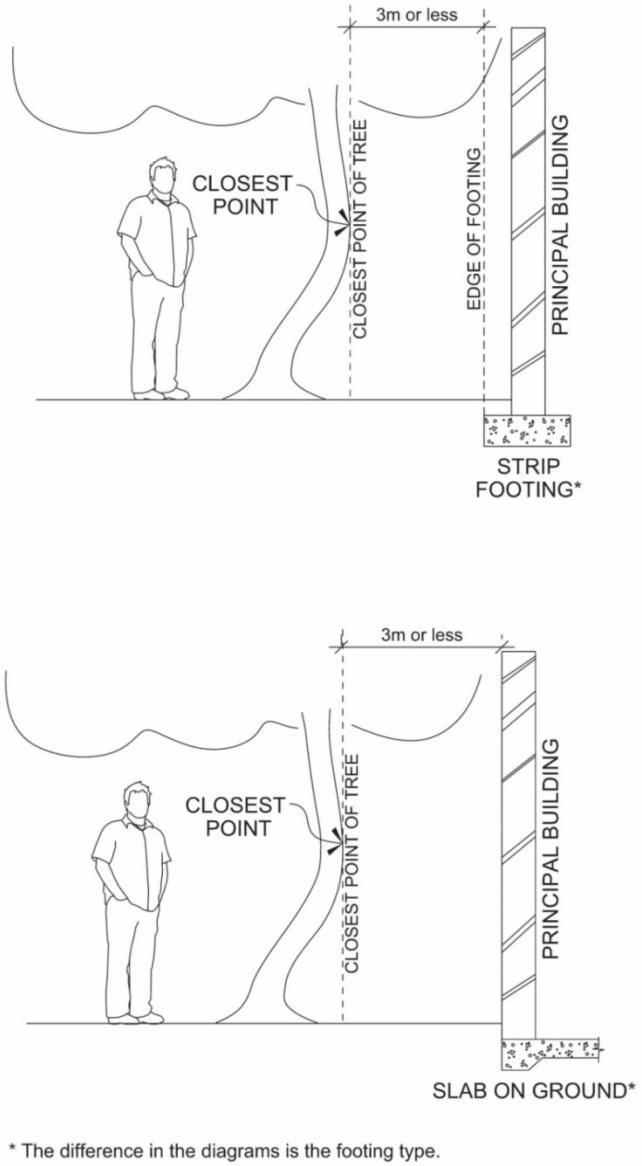


Figure 2 - Tree located within 3 metres of principal building

3.4 Tree and shrub removal on private land requiring a permit

A permit is required from Council to remove trees (or shrubs greater than 5m in height) on private land as detailed in (a) to (c) below:

(a) a tree that is required to be retained or planted as a condition of a permit, complying development certificate or development consent, or

(b) a tree that was planted as a replacement tree, or

(c) any other tree/shrub that is not listed in sections 3.1, 3.2 or 3.3 above.

Note: All trees and shrubs within Council's road reserve are declared vegetation and the maintenance or removal of these trees is undertaken by Council.

The removal of trees as a permit is separated into two distinct processes. These two processes are:

1. A permit *Application for Tree Removal* form (no Arborist Report) of up to 3 trees and where replacement planting is to be undertaken (Section 3.4.1).

2. A permit *Application for Tree Removal* form (with Arborist Report) for removal of more than 3 trees, OR where no replacement planting is to be undertaken (Section 3.4.2).

3.4.1 Application for removal of up to three (3) trees and where replacement planting is to be undertaken

This process is used where it is proposed to remove up to three (3) trees, and plant a minimum of one new tree. Additional replacement trees are encouraged where space permits. The replacement plantings should be species that are suitable to the site and the available space. The planting of an appropriate size tree for the space minimises the likelihood of future interaction with built structures and maximises the life of the tree (refer to Section 10).

An arborist report (including the tree assessment tests) is not required for this permit for tree removal process.

A permit application for removal of up to three (3) trees, and replant with a minimum of one new tree, is to include the following:

(a) a completed *Permit Application for Tree Removal* form, and

(b) a site map which identifies the location of the tree(s) to be removed and the location of replacement plantings in relation to the principal building and other ancillary structures, and

(c) the botanical and common name of the replacement tree species.

Note 1: Where the removal of up to three trees does not include the replacement planting of at least one tree, then section 3.4.2 below applies.

Note 2: Council does not assess the appropriateness of the proposed planting location or nominated species.

3.4.2 Application for removal of more than three (3) trees or where no replacement planting is to be undertaken

This process is used where it is proposed to remove more than three (3) trees, OR where no replacement planting is to be undertaken.

Where more than three (3) trees are to be removed the replanting of replacement trees is encouraged, provided adequate space permits. The replacement plantings should be species that are suitable to the site and available space. The planting of an appropriate size tree for the space minimises the likelihood of future interaction with built structures and maximises the life of the tree (refer to Section 10).

The circumstances where no replacement tree/shrub planting is acceptable may include:

- small courtyard areas such as town house or terrace houses
- the only space available to plant is in the narrow areas between houses along the property boundary
- the offsets from all of the existing structures and associated hard stand areas, results in a space that is inadequate to support the tree/shrub at maturity without significant damage.

Where it is proposed to remove more than three (3) trees, or where no replacement tree planting is proposed, and where the trees are not part of a native vegetation community, a *Permit Application for Tree Removal* is to include the following:

(a) a completed *Permit Application for Tree Removal* form, and

(b) an *Arborist Report Permit Application* completed by a suitably qualified arborist (AQF5) (refer to **Appendix 7**) that

- demonstrates that at least one of the tree assessment tests under section 3.4.4 has been met, and
- is prepared in accordance with section 6.0.

(c) A site map which identifies:

- the location of the tree(s) to be removed, and
- location of replacement plantings (where proposed) in relation to the principal building, other ancillary structures (eg. carport/garage/garden shed) and hardstand areas, and

(d) The botanical and common name of the replacement tree species.

Note 1: Council does not assess the appropriateness of any proposed planting location or nominated species.

Note 2: The removal of vegetation in a threatened ecological community or a threatened plant species listed under the *Biodiversity Conservation Act 2016* requires a licence under that Act. For further information see the Office of Environment and Heritage website. A permit application is also required from Council refer Part C of this manual.

Note 3: The removal of marine vegetation under the *Fisheries Management Act 1994* requires a permit under that Act. For further information see the Department of Primary Industries website.

Note 4: A permit from Council is required prior to clearing (removal) any other native vegetation including understorey plants, groundcovers and any plants occurring in a wetland and that is less than the biodiversity offsets scheme threshold identified under the *Biodiversity Conservation Act 2016*. Refer to Part C of this manual.

Note 5: For tree removal within a native vegetation community refer to Part C of this manual.

3.4.3 Designing for new tree planting

Where it is proposed to undertake replacement plantings, refer to Section 8.0 for information on designing for new tree planting.

3.4.4 Tree assessment tests

The tree assessment tests are required for permit applications where it is proposed to remove more than three (3) trees, or where no replacement planting is to be undertaken.

The purpose of the tree assessment tests for permit applications is to ensure that tree removal is only undertaken where necessary. This is achieved by ensuring existing private trees are only removed where it is demonstrated that no practical alternative is available, and that this has been fully investigated and documented.

Private tree removal requires one or more of the following tests to be met to support a permit application for tree removal.

3.4.4.1 The unacceptable risk test

The objective of this test is to determine if the private tree poses an unacceptable risk that cannot be appropriately managed by arboricultural treatment, fencing, signage or other risk management measures.

The following is to be provided by a suitably qualified arborist:

- a documented tree inspection, and
- a detailed tree risk assessment in accordance with industry best practice tree condition assessment methodology, and
- supporting evidence, which is to include clear and relevant photographs of the tree(s), any hazards, targets, and demonstrate the risk, and
- a review of options for managing risk other than by tree removal, and
- a summary of the risk abatement options and implications.

3.4.4.2 The diseased condition test

The objective of this test is to determine if the private tree is in a diseased condition that cannot be corrected by appropriate arboricultural treatment.

The following is to be provided by a suitably qualified arborist:

- an inspection of the tree and formal identification of the disease, and
- an assessment of the impact of the disease on tree health and/or structural condition, and
- supporting evidence, which is to include clear and relevant photographs of the tree(s), any visible signs of disease, and
- a review of options for managing the disease other than by tree removal, and
- a summary of the options and implications.

Where the trees structural integrity is at risk, a formal risk assessment is to be conducted using industry best practice tree condition assessment methodology.

3.4.4.3 The property damage test *within 12 months of assessment*

The test is to determine if public or private property are being significantly affected by the presence/location or growth of a private tree, and it is shown that tree removal is the only reasonable means to avoid further impact.

Council uses this test where private trees are interacting with infrastructure.

The purpose of this test is to assess the degree of impact a tree is having on built assets (including utility services, footpaths, driveways, retaining walls and buildings) and to demonstrate whether removal is the only reasonable option to avoid further conflict, within the short term, ie. 12 months.

The following is to be undertaken:

- A suitably qualified arborist is to:
  - review the condition and proximity of all existing and previously removed trees that are relative to the part of the built asset that is, or is likely to be damaged within 12 months, and
  - assess the likely future growth and development characteristics of the tree(s), and

- undertake investigations to demonstrate that the tree(s) are interacting where existing damage is claimed or evident, and
- provide supporting evidence, which is to include clear and relevant photographs of the tree(s), damage, root interaction and relationship of this to nearby trees, and
- consider appropriate options, other than tree removal, for managing the interaction between tree(s) and built asset, and
- provide a final review of options and their feasibility for managing the interaction between tree(s) and built asset.

3.4.4.4 The suppressed growth test

The objective of this test is to determine if the tree is part of a group of trees in which the spacing prevents each of the trees in the group from attaining its desired full potential.

The following is to be provided by a suitably qualified arborist:

- an assessment of all trees in a group, and
- a report that:
  - demonstrates why the tree(s) in question would be the most beneficial tree(s) to remove, and
  - a site plan and clear photographic details to indicate exactly which tree(s) are to be removed, and
  - the method to be used and precautions to be adopted to protect remaining trees.

Note 1: This test does not apply to a traditional avenue planting of evenly spaced trees, or trees that are typically understorey plants.

Note 2: Caution should be exercised in removing trees from a mature/established group as changes in wind exposure could increase the likelihood of failure.

3.4.4.5 The public infrastructure works test

This test can only be applied by Council. The test is applied when Council is undertaking infrastructure works on public land that impact on an adjacent private tree. The information will be provided in accordance with Council's requirements and address the matters below.

The objective of the test is to determine if a private tree is likely to be significantly injured or damaged as a result of public infrastructure work, and it is demonstrated to be impractical to relocate or reconfigure those works to avoid such injury.

Significant injury or damage is defined as resulting in:

- tree death, or
- the tree posing an unacceptable risk, or
- a reduction in the remaining service life of the tree to an unacceptable timeframe.

The likelihood of significant injury must be confirmed in a report prepared by a suitably qualified Council approved consulting arborist who must:

- conduct a tree inspection, and
- undertake a detailed assessment of the impact of the proposed works on the health and structure of the tree to determine if significant injury or damage will occur, and
- provide a summary to the public infrastructure designer.

The public infrastructure designer must:

- document all reasonable design alternatives to retain healthy trees, and
- discuss the likely impacts of the options with the arborist, and
- liaise with the tree owner where there are no design options that can retain the tree/s, and
- where the owner agrees with the removal, complete a *Permit Application for Tree Removal*, and obtain the owner's signature, and
- submit the form to City Greening Services, note the receipt of the permit and removal of the tree on appropriate plans.
- Council arranges removal of the tree(s) and a new tree(s) is provided to the owner for planting on their own land.

Note: Private trees that are within 5m of the boundary **must** be considered when designing and installing public infrastructure. Failure to consider this can result in creation of a foreseeable risk.

4.0 Tree removal on private land associated with development

This section applies to tree removal associated with single lot development (eg. construction of a residential dwelling on a single lot). The process for greenfield development is outlined in Section 5.0.

Council requires new developments to consider incorporation of retainable private trees into the design of the development. Where this is not possible, suitable replacement planting should be undertaken. An assessment of both public and private trees is required for a proposed development.

Public trees within 5m of a proposed development must be shown on the submitted site plan, and will be assessed by Council in accordance with the Part B, Section 2 of this manual.

Where the development affects private trees located on the lot, or where the trunk of a private tree is located within 5m of the development footprint, the following information is to be submitted with the development application:

(a) A report (see Section 6.0) from a consulting arborist (AQF5) that:

(i) includes an assessment of each trees health and structure, and

(ii) incorporates a tree retention value assessment in accordance with Section 4.1, and

Note: Tree retention value assessments are not required for development that has a total footprint greater than 2ha. Assessment requirements for sites of this size are incorporated into the greenfield site controls of Section 5.

(iii) includes evidence to substantiate any claims made about tree condition. Evidence may include clear and relevant photographs of the tree(s) and any other relevant factors, and

(iv) defines tree protection zone offsets and protection requirements in accordance with Section 7.0, and

(v) provides a summary of trees to be retained and removed, and

(vi) must be provided to the designer who is to consider and document design options to retain suitable trees (see Section 4.2).

Note: Development and development footprint includes any ancillary works or associated excavation such as driveways, utility trenches, stockpiling of materials or soil, wash out areas and vehicle movements.

(b) Where it is demonstrated that the development design cannot retain trees, a landscape concept plan for the site is to be prepared. The plan is to identify suitable locations and species for compensatory tree planting within the site (see Section 4.3).

(c) Where the proposed development will impact on more than 1000m^2 of bushland, or where the development will impact on trees or bushland within a riparian corridor, a flora and fauna assessment must be prepared by a suitably qualified consultant. An arborist report is not required for these areas.

4.1 Determining tree retention value

Note: This Process is not required for Public Trees, or private land tree complying development certificate applications.

Tree Retention Value is derived from a weighted combination of tree sustainability and landscape significance using the matrix in **Table 3**. This assessment is required to identify which trees are retainable with the resulting information used to guide the site analysis and site planning stages. The following three steps are to be undertaken in assessing tree retention value.

Step 1 - Assess tree sustainability

The health, condition and longevity of a tree increases or diminishes depending on its quality, intactness and state of maturity.

A measure of sustainability is an estimate of the relative length of time a tree can provide amenity and other benefits. For the purposes of this test, sustainability is to use the following classifications:

- Greater than 40 years
- From 15 to 40 years
- From 5 to 15 years
- Less than 5 years
- Dead or hazardous.

To assess tree sustainability, the heads of consideration in **Figure 3** are to be assessed by the arborist to determine the relevant classification.

Sustainability must only be assessed by a person with a minimum qualification of AQF 5.

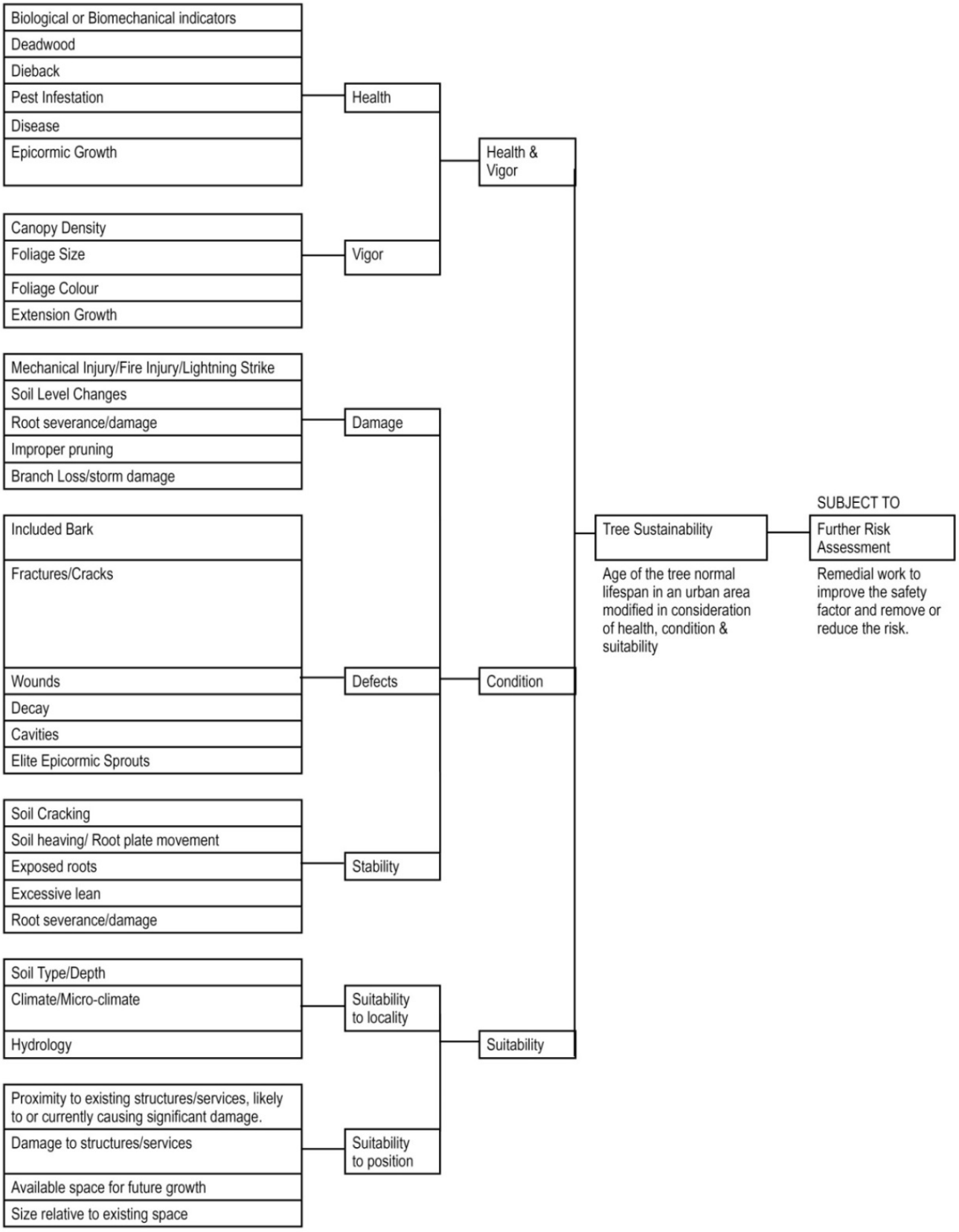


Figure 3 - Tree Sustainability Heads of Consideration

Step 2 - Assess landscape significance

Make a considered evaluation of each tree's landscape significance, having regard for its environmental, heritage and amenity values.

The level of landscape significance is determined using the following criteria in **Table 2**.

Table 2 - Criteria for assessment of landscape significance

1. SIGNIFICANT
The tree is listed as a heritage Item under the *Newcastle Local Environment Plan (LEP) 2012* with a local, state or national level of significance, or
The tree forms part of the curtilage of a heritage item (building /structure/artefact/place of significance) as listed in *Newcastle LEP 2012* and has a known or documented association with that item, or
Aboriginal cultural artefact, evidence by identifiable markings or other documentary evidence, or
The tree is a commemorative planting relating to an important historical event, or
The tree is listed as a threatened plant species or is a key indicator species of a threatened ecological community under the *Biodiversity Conservation Act 2016* or the *Environmental Protection and Biodiversity Conservation Act 1999*, or
The tree is an endemic species, representative of the original vegetation of the area and is known as an important food, shelter or nesting tree for endangered or threatened fauna species, or
A remnant tree in existence prior to development of the local area, or
The tree has a very large live crown size (greater than 200m²) with normal to dense foliage cover, is visually prominent in the landscape, exhibits good form and habit typical of the species and makes a significant contribution to the amenity and visual character of the area by creating a sense of place or creating a sense of identity, or
The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.
2. VERY HIGH
The tree has a strong historical association with a heritage item (building, structure, artefact, garden, etc) within or adjacent the property and/or exemplifies a particular style or era of landscape design associated with the original development of the site, or
The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a key wildlife corridor or has known wildlife habitat value; or is uncommon in cultivation, and
Visible from surrounding properties, the street or other thoroughfares (including waterways), and
The tree has a very large live crown size (exceeding 200m²); a crown density exceeding 70% Crown Cover (normal-dense), good form and branching habit, good representative of the species or is aesthetically distinctive and makes a positive contribution to the visual character and amenity of the area.

3. HIGH
The tree has a suspected historical association with a heritage item or landscape supported by anecdotal evidence or based on knowledge of similar sites, tree age, etc, or
The tree is a locally-indigenous species and representative of the original vegetation of the area, and The tree is beneficial for native wildlife, or
The tree has a large live crown size (exceeding 100m²), and The tree is a good representative of the species in terms of its form and branching habit with minor deviations from normal (e.g. crown distortion/suppression) with a crown density of at least 70% Crown Cover (normal), and The subject tree is visible from surrounding properties and makes a fair/neutral contribution to the amenity of the property/visual character of the area.
4. MODERATE
The tree has a medium live crown size (exceeding 40m²), and The tree is a fair representative of the species, exhibiting fair form and habit, moderate distortion or suppression with a crown density of more than 50% Crown Cover (thinning to normal), and The tree makes a fair contribution to the visual character and amenity of the area, and The tree is visible from surrounding properties. Not visually prominent – view may be partially obscured by other vegetation or built forms, or
The tree has no known or suspected historical value or association.
5. LOW
The tree has a small live crown size(less than 40m²) and can be replaced within the short term with new tree planting, or
The tree is a poor representative of the species, poor form and habit with significant distortion or canopy suppression, with a crown density of less than 50% Crown Cover (sparse), and The tree is not visible from surrounding properties (obscured by other trees or built forms) and makes a negligible contribution to the amenity of the property/surrounding properties, or detracts from the visual character of the area.
6. VERY LOW
The tree is listed as an undesirable species as listed in Part A, Table 7 of this Technical Manual; and
The tree does not meet any of the above criteria and has no heritage importance or value, no known or suspected historical association.
7. INSIGNIFICANT
The tree is an undesirable species as listed in Part A, Table 7 of this Technical Manual.

The material in **Table 2** has been adapted with permission of the author, Andrew Morton, Earthscape Horticultural Services. Sydney, Australia.

* Crown Size expressed in (m^2) is calculated by $\pi \times r^2$
r = the average distance to canopy dripline. To work out the average distance to the canopy line add (+) the radial distance of the canopy at four (4) cardinal points and divide (÷) by four (4).

Step 3 - Determine Tree Retention Value

After determination of the tree sustainability and significance in the landscape the matrix in **Table 3** is used to evaluate the tree retention value.

Table 3 - Tree retention values assessment methodology

	Landscape Significance Reading						
Tree Sustainability	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Greater than 40 years	**High Retention Value**						
15 to 40 years			**Moderate**				
5 to 15 years				**Low**			
Less than 5 years					**Very Low Retention Value**		
Dead or hazardous							

Modified by A. Morton from: Couston, Mark and Howden, Melanie (2001) Tree Retention Values Table Footprint Green Pty Ltd, Sydney Australia.

4.2 Explore alternative design options

Alternative design options are to be considered where removal of trees of moderate or high value (as determined in accordance with Section 4.1) is proposed. The information in the arborist report (including tree condition, tree protection offsets, and tree retainability assessment) is to form the basis for determining suitable development design options.

Alternative design considerations could include:

- relocating and/or minimising driveway crossover widths to retain existing trees
- altering development footprint
- altering hard surface design
- utilising permeable pavement
- move footpath alignment, or location
- ramp or bridge over tree roots, or use elevated walkways
- install footpath on surface without excavation and reduced batter
- move above or below ground utilities (eg. powerlines, water, gas) away from trees
- avoid level changes near trees.

4.3 Compensatory planting

Where it has been demonstrated it is not reasonable to retain a tree of moderate to significant value compensatory planting on private land will be required. A guide to compensatory planting rates for trees of moderate or high value is provided in **Table 4**.

Table 4 - A guide to compensatory planting on the development site

	Total area of crown projection to be removed[1]	Number of standard trees[2] to be planted
1	Up to 20m^2	1 standard tree
2	21 m^2 – 40m^2	2 standard trees
3	41 m^2 - 60m^2	3 standard trees
4	61 m^2- 80m^2	4 standard trees
5	81 m^2-100m^2	5 standard trees

Note 1: Crown Projection (m2) = average canopy radius x π

Note 2: A standard tree is a minimum 45L container volume, a minimum crown projection at maturity of 20m^2 and of a desirable species.

Compensatory planting is to be located on the development site. The required compensatory planting is to be achieved by designing for planting of new trees in accordance with **Table 4** above.

Where it is demonstrated compensatory planting cannot be carried out in accordance with the above table, incorporating smaller trees into the landscape area will be required. Trees of different sizes and species can be planted to suit the site.

The compensatory planting locations and species are to be shown on the landscape concept plans. The landscape plan is to indicate opportunities for canopy cover, biodiversity and occupant amenity.

Note 1: Public land is not to be used for compensatory planting.

Note 2: Where space permits, the preferred planting location is within the front of the property. The planting location should take into account services and other infrastructure. Planting should be offset a minimum 1.5m from the front property boundary.

When determining appropriate compensatory tree planting, consideration must be given to:

- physical constraints of the site, eg. adequate space for the tree at maturity including clearances required for driveways and other utilities
- site soil conditions and microclimate
- growth habits of the proposed species, eg. crown shape and characteristics
- implications for neighbouring properties.

4.4 Designing for new trees

When designing for new trees on a single lot development the information in Section 8.0 is to be incorporated into the development application documentation.

4.5 Tree protection

Where tree protection is required on a single lot development, the information in Section 7 is to be incorporated into the tree protection plan and any relevant development conditions.

5.0 Greenfield sites

Greenfield sites are undeveloped land that has been identified, through land use zoning, as having potential for future urban, commercial or industrial development. It is generally found on the fringes of existing developed areas and may contain a large amount of existing vegetation.

For the purpose of this technical manual greenfield sites are defined as land parcels greater than 2ha in area.

A development application for the development of a greenfield site is to include:

(a) A detailed site plan and report that identifies:

  (i) vegetation to be retained, and defines tree protection zone offsets and protection requirements in accordance with Section 7, and

  (ii) defined asset protection zones and relationship to vegetation to be retained, and

  (iii) the location of habitat trees (to be retained and removed), and

  (iv) a separate plan layer identifying locations of proposed street and park tree plantings, and nominated species selected in accordance with Council's Street Tree Selection Manual 2016.

(b) A flora and fauna assessment prepared by a suitably qualified and experienced ecological consultant where the development will impact on1000m^2 or more of bushland, or where the development will impact on trees or bushland within a riparian corridor.

(c) A report from a consulting arborist (AQF 5) where individual trees are to be retained on residential zoned lots or public land that:

  (i) includes a Tree Impact Assessment (see **Table 5**), which assesses the condition of the trees, determines the impacts from clearing of adjacent vegetation, and identifies trees suitable for retention, and

  (ii) identifies individual trees along fringes of bushland that are compromised by the development works and require removal, and

  (iii) defines tree protection zone offsets and protection requirements in accordance with section 7, and

  (iv) is prepared in accordance with section 6.0.

Note: Arborist's reports do not need to assess bushland, other than as outlined in clause 5.0(c).

5.1 Retention of vegetation

5.1.1 Benefits of vegetation retention

The retention and provision of vegetation on greenfield sites provides a range of significant benefits, including:

- valuable recreational, educational and scientific resources
- protection of habitats for native flora and fauna
- protection of wildlife corridors
- natural stabilisation of the soil surface

- retention of aesthetic values
- protection of scenic values and visual identity.

5.1.2 Percentage of site as bushland

Greenfield sites with a total site area greater than 2ha are to have a minimum of 25% of the site area preserved for the retention or provision of native bushland. Trees on residential lots are excluded from the 25% vegetation calculation.

Priority for native bushland retention should be given to the communities of highest ecological value as identified in the flora and fauna report.

Land set aside for stormwater detention basins, roads, and other infrastructure associated with the development will not be included in the calculations of the area set aside for native bushland.

If the site is generally devoid of native vegetation or contains degraded lands, the development is to include the restoration of at least 25% of the site area to native bushland. Species selection is to be consistent with the endemic vegetation of the area.

Provision of a single canopy layer does not satisfy Council's requirements. Canopy, sub-canopy, shrub and groundcover layers are required to ensure coverage of the site to satisfy Council's requirements (see **Figure 4**). Areas to be retained or improved for indigenous vegetation are to be shown on landscape plans submitted for development application approval.

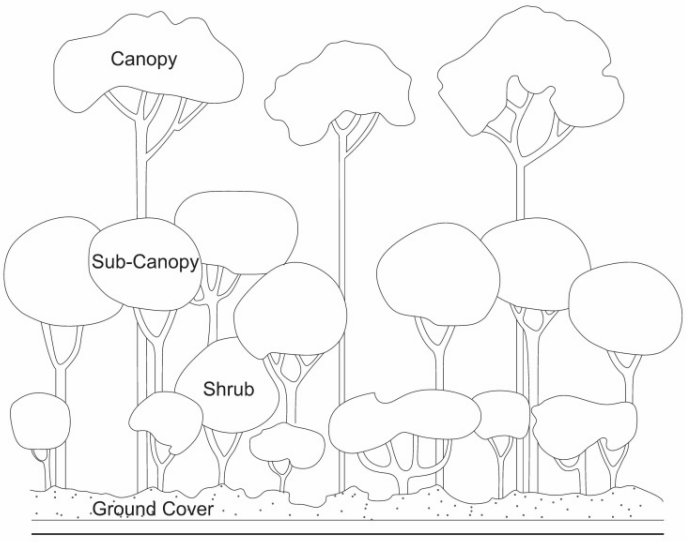


Figure 4 - Example of vegetation cover required

6.0 Arborist reports and qualifications

Arborist reports, specifications and tree protection plans are to be prepared by an arborist with the minimum qualifications and experience as detailed in **Table 5** below.

Table 5 - Arborist qualifications for preparation of reports and specifications

Task	Minimum Qualification	Recommended Practical Experience
Unacceptable Risk Assessment Test	AQF 5 in Horticulture (Arboriculture)	Assessing, quantifying and reporting hazard and risk in trees. Application of resistance drilling technology and other methodologies for non-destructive assessment and measurement of decay in trees.
Diseased Condition Assessment Test	AQF 5 in Horticulture (Arboriculture)	Assessing, reporting on disease in trees. Diagnosis and assessment of tree disease Application of appropriate methodologies for non-destructive testing of disease in trees.
Property damage Assessment Test	AQF 5 in Horticulture (Arboriculture)	Assessing and reporting the implications of interactions between trees and structures.
Suppressed Growth Assessment Test	AQF 5 in Horticulture (Arboriculture)	Sound knowledge of tree species and tree biology. Experience in assessment or management of multi-storey vegetation
Public Infrastructure Works Test (used by Council only)	AQF 5 in Horticulture (Arboriculture)	Assessing, quantifying and reporting the potential impacts of infrastructure designs and construction activities on trees. Extensive knowledge of urban trees and soils. Practical knowledge of tree root mapping and root plate assessment methodologies.
Prepare an *Arborist Report to support Tree Removal Application Form* (***Appendix 7***)	AQF 5 in Horticulture (Arboriculture)	Assessing tree/s, reviewing options to retain trees and experience as detailed in The Tree Assessment Tests listed above, relevant to the circumstance.
Prepare a *Dead or Dying Tree Removal form* (***Appendix 11***)	AQF 3 in Horticulture (Arboriculture)	Assessing tree/s. Sound knowledge of tree species and tree biology/physiology. Demonstrated ability to provide clear and relevant evidence to support the claim of dead or dying.
Prepare a *Storm Damage Tree Removal form* (***Appendix 6***)	AQF 3 in Horticulture (Arboriculture)	Assessing tree/s. Sound knowledge of tree species and tree biology. Demonstrated ability to provide clear and relevant evidence to support the claim of storm damage.
Complete *NATSPEC tree stock inspection form* (***Appendix 8***)	AQF 4 in Horticulture (Arboriculture)	Demonstrated experience in assessing tree stock against NATSPEC Landscape Trees (or Australian Standard). Thorough understanding of NATSPEC requirements and heads of consideration. Experience in tree planting and maintenance.

Task	Minimum Qualification	Recommended Practical Experience
Tree retention value assessment	AQF 5 in Horticulture (Arboriculture)	Assessing the retention value of trees in relation to large and small scale development.
Tree impact assessment or Tree Survey	AQF 5 in Horticulture (Arboriculture)	Assessing, quantifying and reporting the potential impacts of development designs and activities on trees. Extensive knowledge of urban soils and soil practices. Practical knowledge of tree root mapping and root plate assessment methodologies.
Specify tree pruning to AS 4373 –2007	AQF 3 in Horticulture (Arboriculture)	Assessing and specifying tree pruning to meet the Australian Standard and other best practice methodologies.
Write a Tree Protection Plan	AQF 4 in Horticulture (Arboriculture)	Assessing, quantifying and reporting the likely impact of development on trees and identifying practical measures for harm minimisation.
Tree amenity valuation	AQF 5 in Horticulture (Arboriculture)	Assessing the amenity value of trees using best management practice methodologies.

Arborist reports must use clear and precise language and consider the following:

1. Be guided by theoretical and factual scientific concepts.

2. Be objective and disclose any pecuniary or non-pecuniary interests.

3. State findings grounded on observations and discuss the connective significance of those observations.

4. Provide suitable evidence, including clear relevant photographs, and references to support claims/recommendations.

5. Provide the relevant detail of the tree assessment test where required.

6. Include the information contained in **Table 6** in addition to any other requirement.

Table 6 - Contents of an arborist report

Arborist	Full name
	Business name and ABN
	Business address
	Qualification and AQF Level, certificate number and date of award
	Business telephone and email address
The site and the brief	The full address of the site
	The full name and address of the client
	Dates of all site visits
	The project brief as provided by the client
	A table of contents including list of photographs
	A clear site plan showing relevant site details accurately plotting existing tree locations and actual crown spread
	A relevant site description including a summary of soil and drainage conditions
	A table listing each tree by number, common and scientific name, DBH, estimated height, age class, health, vigour and structure
	A summary of trees proposed to be removed and the reasons for removal

7.0 Protection measures

The purpose of this section is to ensure that appropriate tree protection measures are documented and implemented to prevent damage to all trees on Council managed land. The Australian Standard *AS4970-2009 Protection of trees on development sites* applies for trees on both private and public land, and contains information required to determine the tree protection zone and prepare a tree protection plan.

The tree protection zone (TPZ) is the distance specified within documentation and construction plans that is to be protected during all phases of any works. The TPZ is calculated as 12 x trunk diameter at breast height (DBH) which is measured at 1.4m above ground level. The trunk diameter (DBH) of multi stemmed trees is calculated using Council's online calculator to achieve a single stem figure www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

The following information is supplied as a summary of the key elements of *AS 4970 - 2009* and is to be read in conjunction with that standard. The information provided below applies to the protection of tree/s on public land.

7.1 Trees and development applications

Australian Standard *AS4970-2009 Protection of trees on development sites* requires the preparation of a tree protection plan. Arborist reports submitted as part of a development application are required to include a tree protection plan and tree protection requirements for public trees will be included as part of conditions of consent. This is to ensure that any public tree retained within 5m of the property boundary is adequately protected during the demolition and construction phase of development. A final tree protection plan for public trees is to be submitted to and approved by Council prior to issue of a Construction Certificate.

Inspections are to be undertaken by the Certifying Authority to ensure the tree protection measures are installed and maintained in accordance with the approved tree protection plan. Tree protection measures are to be implemented prior to the commencement of construction and remain in place until construction is complete.

7.2 Preparing a tree protection plan

Tree protection plans are to be prepared by an arborist with minimum qualification level of AQF 4.

Tree protection plans are to be prepared in accordance with *AS 4970-2009* and the information detailed in the following sections. In some circumstances the tree protections zone may require modification, for example trees on road verges. All modifications should be determined prior to construction or, where issues arise on-site, by a suitably qualified arborist who will document the modification and reasons why.

7.3 Tree protection zone (TPZ) fencing

All retained trees will require tree protection fencing to be established prior to any tree removal works, demolition, earthworks, or construction works. The tree protection fencing is to be installed in accordance with the approved tree protection plan.

The site supervisor is responsible for the implementation of tree protection zone fencing. The site supervisor must also ensure the fencing is maintained at the required distance from the tree, and kept secure to exclude access until completion of works and rehabilitation of the site has occurred.

7.3.1 Fencing types

The type of tree protection fencing to be used is to be specified within the tree protection plan, and is to meet the requirements and intent of the *AS 4970–2009*. The fence is to be stable and robust so as to withstand weather events and accidental impact, and is to have signage stating Tree Protection Zone No entry (see **Figures 5 & 6**).

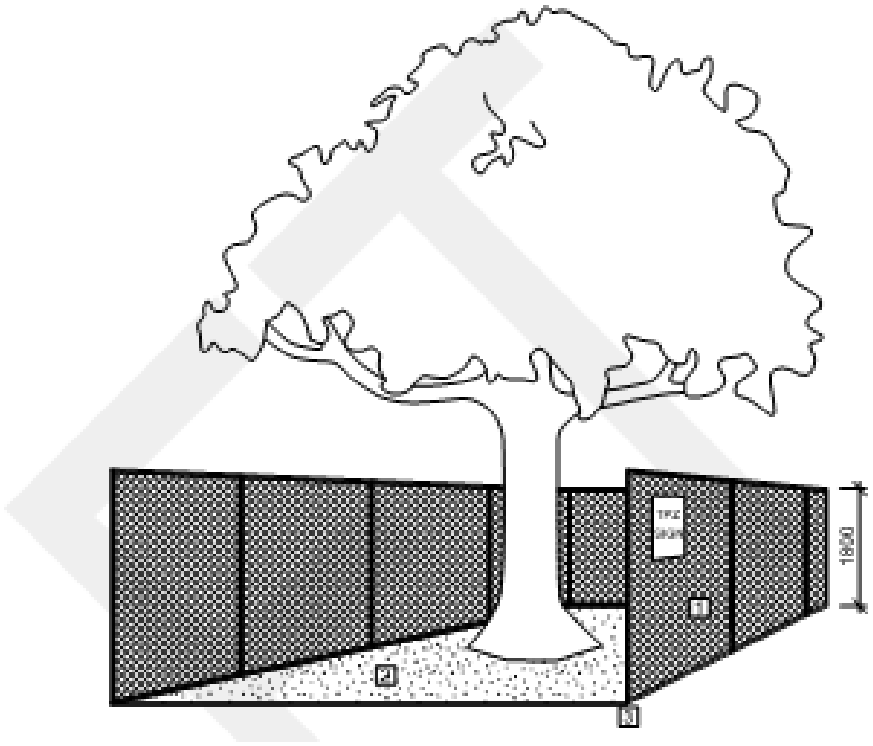


Figure 5 - Generic Tree Protection Fencing

Figure 6 - Tree Protection Fence Sign

7.3.2 Tree protection fencing for public footways

For trees situated within a road verge, only the area between the footpath and road shall be enclosed with the required tree protection fencing for a 3m distance each side of the tree to allow access to the property. Maintain pedestrian and roadway clearances for safe public use. **Figure 7a** and **7b** indicate typical treatment, however modifications may be required.

All works adjacent to the roadway require a Traffic Control Plan as per *AS 1742.3-2009 - Traffic control devices for works on roads*.

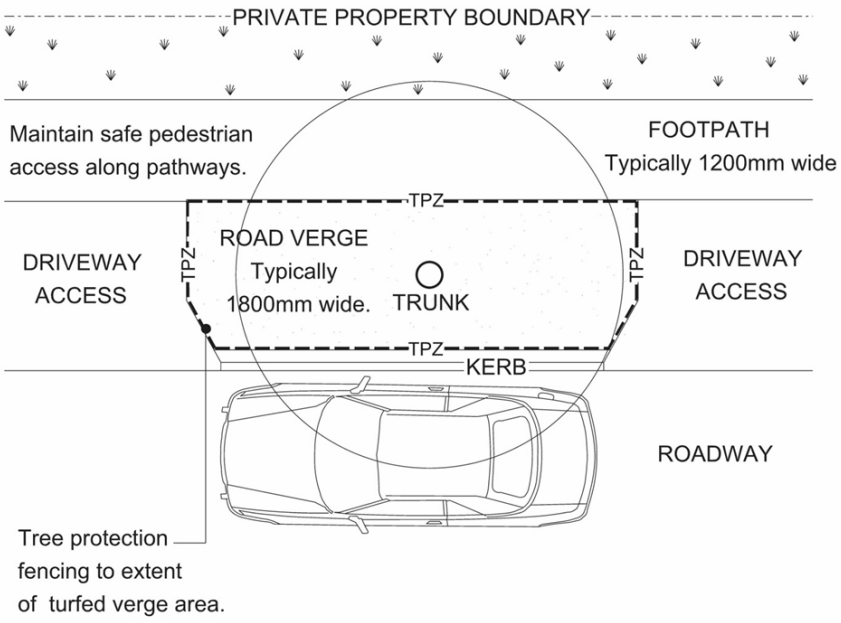


Figure 7a - Indicative tree protection on the road verge

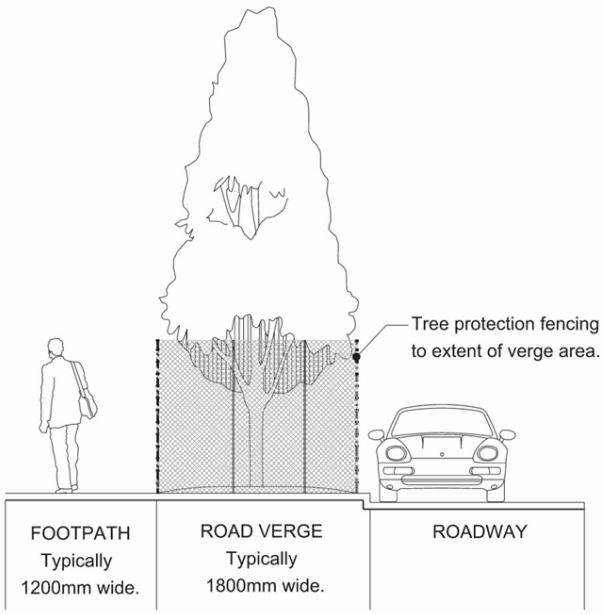


Figure 7b - Indicative tree protection on the road verge

7.3.4 Tree protection in limited space

Where construction works are required in limited space, then trunk, stem and ground protection are to be implemented in accordance with *AS 4970-2009* (See **Figure 8**). This may also occur where access to a site is within proximity of a tree(s).

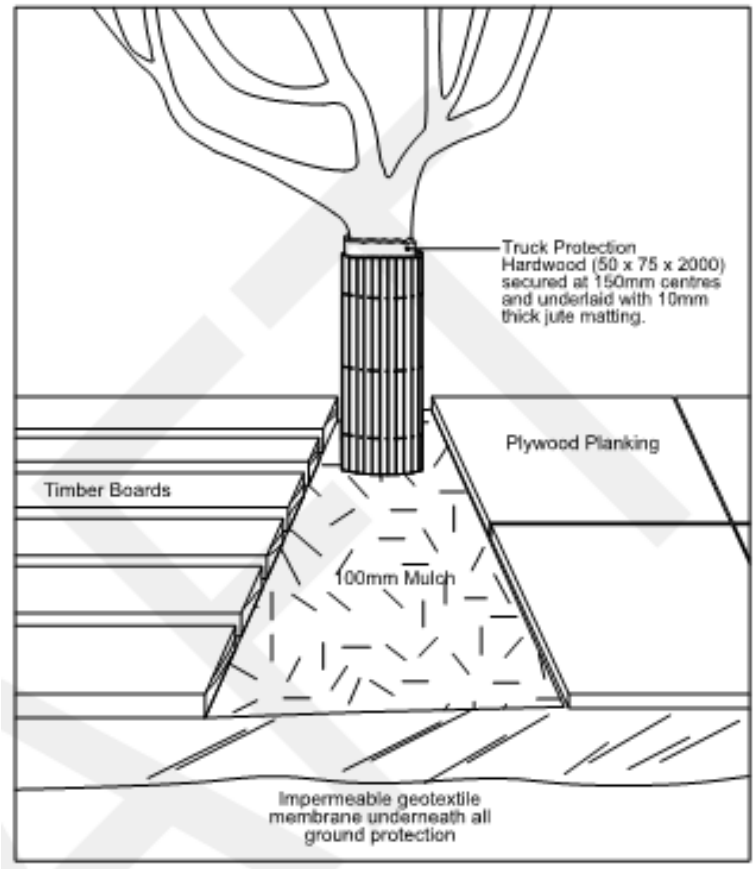


Figure 8 - Trunk and ground protection

7.3.5 Tree protection fencing in parks, reserves and bushland settings

Tree protection fencing is required for subdivision works, or works on private land that are adjacent to a park, reserve or bushland, where the works or associated ancillary activities are within the trees required tree protection zone.

The TPZ is calculated as 12 x trunk diameter at breast height (DBH) which is measured at 1.4m above ground level. The trunk diameter (DBH) of multi stemmed trees is calculated using Council's online calculator to achieve a single stem figure. See Council's website www.newcastle.nsw.gov.au/Living/Environment/Trees/Private-Trees/Online-Calculator.

The protection fence is to be stable and robust so as to withstand weather events and accidental impact, and is to have a signage stating Tree Protection Zone No entry (see **Figures 5 & 6**).

In some circumstances the density of planting can require access through the TPZ of trees (see **Figure 9**). Where this access is required ground protection is to be provided, which may include 200mm mulch, gravel and/or rumble boards (see **Figure 8**).

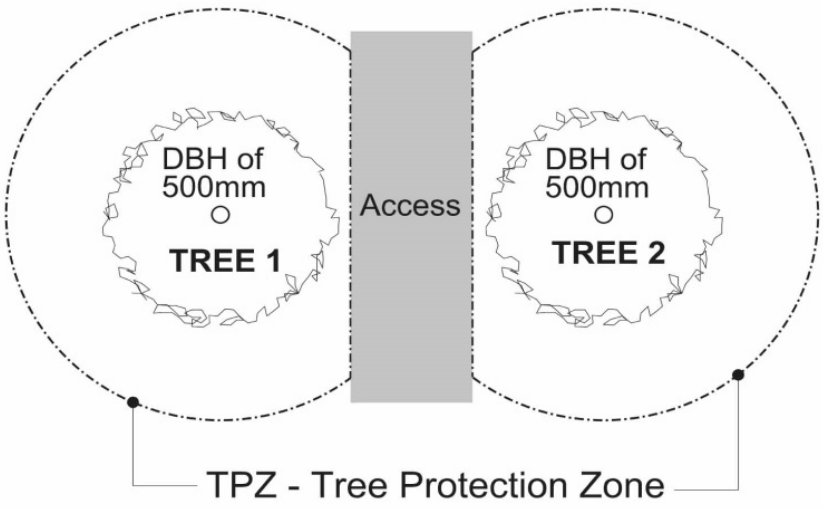


Figure 9 - Access between trees when space is limited

8.0 Designing for new trees

Assessment of the site early in the design phase provides an opportunity to ensure trees are appropriately incorporated into the proposed development. The following information is provided to inform tree planting on private land in subdivisions or other large scale developments, however the general principles and information is also applicable to residential planting. The design and implementation of tree planting on land that is, or will become, public managed land is to be undertaken in accordance with Part B, Section 5.2 of this manual.

When designing for new trees on private land the following should be considered:

1. Consider the context in which the planting is to occur (see Section 8.1).
2. Determine required soil volume and clearances from infrastructure (see Section 8.2).
3. Consider alternative designs for creating additional space (see Section 8.3).
4. Incorporate aeration and drainage into planting design (see Section 8.4).

8.1 Consideration of context

When designing new plantings consideration of the context of the planting area, particularly where structures, infrastructure or neighbouring properties may be impacted by tree root development or overshading, needs to be undertaken. The following sections detail the contextual factors that are to be considered as part of a design, or before undertaking tree planting.

8.1.1 Solar access

Solar access can be impacted by species selection and planting location. These impacts can include reduced sun or light entering the property, or increased cooling costs due to lack of shade. Solar access should be considered when selecting species and determining planting locations. The planting should also take into account the location of solar panels where they currently exist.

8.1.2 Bushfire hazard and asset protection

Prior to the selection of species or determining planting locations on bushfire prone land a review of potential impacts from bushfire is to be undertaken. Refer to Planning for Bushfire Protection 2006 (NSW Rural Fire Service) and the Bush Fire Protection section of Council's Development Control Plan.

8.2 Space required below ground and clearances from structures

8.2.1 Calculating mature tree soil volume

Trees require an adequate root system for tree stability, to maintain biological function and healthy growth. The amount of suitable soil that a tree has available will determine the amount of root system that the tree can develop and the amount of soil water and nutrients available to the tree. Tree roots are generally limited to the top 60cm of soil, with the majority located in the top 30cm, and form a broad root plate which can extend well beyond the canopy. In some cases tree roots may grow deeper in the soil, subject to oxygen levels, and are known as sinker roots. The overall stability of a tree is achieved through a combination of the shallow root plate and the sinker roots. See Council case book study on tree failure at the link below for further information and **Figure 10**.

Tree Failure Casebook History - Informing Tree Management in Newcastle - 2000-2011

Figure 10 - Tree root development

The generalized & unimpeded root system is broad and shallow (often only 200-300mm deep) with load bearing (structural) roots extending radially 2-4m with descending (sinker) roots below the trunk. Non-structural fine 'feeder' roots are wide-spreading often well beyond the edge of canopy (drip line).

Graphic source - The Morton Arboretum.

Soil volume required for root growth in soils is calculated as per the Cornell University formula which is widely accepted. The Cornell University formula requires the crown projection to be calculated first. Crown projection is the mature canopy spread for that particular species. Crown projection is to be calculated by a suitably qualified arborist.

- Crown projection (CP)(m^2) = π x r^2 π = 3.142 r = average radius(m)

Soil volume is then calculated by:

- Soil volume (SV)(m^3) = CP x 0.6

Example: A mature Tuckeroo with an average radius of 4m.

CP = π x 4^2
CP = $50m^2$
SV = $50m^2$ x 0.6
SV= $30m^3$

Note: The soil volume calculation does not include the percentage consumed by the inorganic fraction where gap graded soils (eg. structural soils) are used. Therefore, the total volume of a gap graded soil with high proportion of rock particles will be greater than for other options.

Once the soil volume has been calculated the area required to achieve this volume is to be determined based on a maximum soil depth of 60cm. Depth of soil below this may allow for some sinker roots but lower oxygen levels generally restrict fine root growth.

Using the example above the mature Tuckeroo requires a soil volume of $30m^3$. At 60cm deep the surface area required can be calculated as follows:

- Surface area (SA) (m^2) = Soil Volume/depth (m)
- SA = 30/0.6
- SA = $50m^2$

This cannot effectively be achieved in confined planting locations. Therefore, it is important to provide as much soil as possible in a given situation. Break out zones are generally ineffective as these often lead to interaction between tree roots and infrastructure. When designing new areas or full road rehabilitation, wider footways with an area clear of footpaths and utilities provide the best opportunity for increased soil volume. This results in faster establishment of canopy, healthy trees and reduced interaction with infrastructure.

The allocation of the required square metre area into width and length is to account for the development of the trees future radial structural root zone. Therefore, narrow planting beds are not suitable. See Council's online calculator or *AS4970-2009* to determine the radius of the structural root zone. www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

8.2.2 Clearances from structures and utilities

New tree planting areas are to be appropriately designed to provide clearance from utilities, hard stand areas and structures to avoid damage. Species should be selected and located to provide adequate clearance as the tree grows to maturity.

Prior to selecting a species and planting location the following should be undertaken:

- Locate all underground services through Dial Before You Dig.
- Identify where structures, paths and services are located in relation to each other to consider what space may be available for planting.

- Consider tree species that are suitable to the space.
- Review the potential for the chosen location and species to significantly impact neighbouring properties.

8.3 Consider alternative designs for creating additional space

There are a range of possible options for designing space for trees. The above ground design needs to consider the mature size of the tree in relation to the surrounding surface and proximity of buildings. The required soil volume below ground can be difficult to achieve given the competition for space with the various structures, utilities and hardstand areas required as part of the urban environment

The following list provides a number of options that can be used to incorporate new trees in the design of the development, and is to be used once the required space has been calculated (refer to Section 8.2.1). The following list is to be considered:

- locate pathways and structures away from the tree planting areas
- allocate a specific area for tree planting free of services and consolidate services wherever possible into common trenches
- create large planting pits or continuous trenches where space permits (Section 8.3.1)
- use improved planting soil below porous pavement located adjacent to trees Section 8.3.2)
- installation of structural cells or load bearing soils (Section 8.3.3)
- use of suspended slab pavements (Section 8.3.3)
- installation of root barriers (Section 8.3.4).

8.3.1 Large planting pits or continuous trenches

Large pits or continuous trenches provide the greatest opportunity for trees to quickly establish. This is due to the volume of feeder roots and associated Mycorrhizal fungi that can be established, which significantly increase soil and nutrient uptake.

Trenches or pits should be a minimum 3m wide and to a depth of 600mm, with the existing soil either improved or replaced with suitable planting soil. The trench or pit is to be free draining or drainage must be installed. While the tree may look small for the size of the planting pit or trench when installed, it will quickly develop into a larger canopy within a few years.

8.3.2 Improved planting soil below porous pavement

A suitable soil specification and installation method for use under porous paving can be found at **Appendix 2a** and **Appendix 2b**. This soil consists of a rapidly draining bedding layer for the paving, which sits over a horticultural soil.

The soil specification can also be used for general planting and can be installed under footpath pavement to increase the area for root growth. This approach can extend the life of both the tree and built assets. The added use of flexible joint products (such as Trip stop) further decreases the likelihood of interaction between trees and paths.

This specification and installation method is a cost effective way of providing underground space and improved water infiltration and gaseous exchange.

8.3.3 Installation of structural cells or load bearing soils

Load bearing soil systems allow for horticultural grade root space beneath a load bearing surface. The technologies include suspended slab pavement, structural cells and gap graded soils.

Suspended pavement designs involve the use of piers, eg. concrete pillars or other precast concrete supports, which bridge horticultural grade soil.

Structural cells or gap graded soils are placed beneath hard surfaces to improve the volume of soil available for root development. Each planting location is different and the soil volume required varies depending on site conditions and the mature size of the tree species planted.

It is recommended that structural cells are installed as per the manufacturer's specifications.

The soil to be used is to meet Council's specification as per Standard Drawings series 3000 www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings. The soil is to be tested by a NATA accredited soil laboratory and changes made to suit the specification and chosen species.

Gap graded soil (eg. Structural Soil®) should not be used within the structural root zone of the chosen species, often called the zone of rapid taper. This is to ensure the tree has the opportunity to develop larger structural roots. Where gap-graded soil is to be used the soil shall be equivalent to the specification for Benedict Sand and Gravel, SmartMix™3 40mm Structural Soil Mix Product Data Sheet. If sourced from an alternative supplier a sample of the filler soil and additives shall be tested for compliance by a NATA accredited laboratory and results submitted to Council for approval prior to installation. Install 20mm GMB20 base to a minimum depth of 150mm over the finished surface of the gap-graded soil in accordance with the specification provided.

Note: Refer to **Appendix 4** for Material Specification for Gap-graded Soil and GMB20 Base

8.3.4 Root barriers and deflectors

The installation of root barriers at the time of planting may assist tree roots to grow away from services, pavements and other structures. Root barriers should not be installed in such a manner as to restrict essential development of stabilising roots and fine roots required to sustain tree growth.

Tree root barriers are only suitable for use in certain situations and may fail because:

- they were not installed correctly including: poor jointing, inadequate depth or length for the circumstance, or
- the tree roots have bypassed the barrier either by going over, under, around or through the joints. This can be limited by ensuring only qualified persons using proven methods for installation of root barriers, and by embedding the top of the root barrier in concrete wherever possible.

Note 1: Tree root barriers/deflectors require periodic monitoring as roots deflected downwards may return to the surface if soil oxygen levels are not sufficient to support growth at depth.

Note 2: Root barriers should not be used to restrict roots so that the tree is prevented from developing a mechanically and biologically efficient root system to achieve maturity.

8.4 Additional requirements for design of new trees

The addition of aeration tubes and drainage can significantly improve the success of tree planting. The following information is to be considered within any design that is to incorporate new plantings. See also Council's Standard Drawings 3000 series www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings.

8.4.1 Drainage

Check drainage through infiltration rate testing prior to selection of tree species. This can be provided for by either:

- geotechnical advice obtained by sampling at the planting holes, or
- conduct falling head infiltration testing.

8.4.2 Subsoil/subsurface drainage

One or more of these options may be considered to ensure planting holes are free draining:

- Ag-pipe: install slotted, flexible 100mm PVC pipe and fittings minimum to *AS 2439.1-2007* (*Perforated plastics drainage and effluent pipe and fittings*). Install 5-7mm drainage gravel filter material around ag-pipe.
- Line flushing points: provide flushing inlets and approved surface covers to permit flushing of subsoil drainage lines.
- Auger drain holes: install a minimum of six drain holes to the bottom perimeter of the planting pit. Drain holes are to be 10cm in diameter, 60cm deep and filled with sand or fine gravel.

8.4.3 Aeration tubes

Aeration tubes may be installed when trees are being planted to maximise gaseous exchange at depth for root growth.

Install slotted agricultural pipe within the planting hole ensuring that it has access to the atmosphere at both ends.

Note that:

- the pipe is to be set at the base of the root ball
- the pipe inlets are to be flush or slightly proud (25mm maximum) of the final surface levels
- the pipe ends should be wrapped with filter fabric to stop rubbish entering the pipe
- use a heavy duty slotted cap in busy public or vandalism prone areas. The pipe cap is to be visible from ground level and the slots are to occupy 50% of the caps surface area
- this pipe is for aeration only.

9.0 Tree species selection and supply

All tree species selections for planting on Council managed land are to be undertaken using the process defined in Council's *Street Tree Selection Manual 2016*.

The use of a species at any given location is subject to the plants individual requirements and site conditions. Procuring the specific species can be difficult either due to poor tree stock quality, or the plant no longer being available commercially. The critical factor is that the chosen tree species is suitable for the space and capable of growing into a mature healthy tree in the site conditions.

It is important that species considered an undesirable species or an environmental pest must not be used. The undesirable tree species list is not a list of trees that have to be removed from current locations. However, they are a list of species that will not be planted in the foreseeable future.

From an urban forestry perspective, all woody species have inherent value, even those species that have some negative characteristics. For example, although Camphor Laurel is listed as 'undesirable' as a replacement species, the mature trees still provide essential shade, stormwater capture, and filter air pollution. The urban forestry approach seeks to strategically manage 'undesirable' trees by discouraging the further planting of these species rather than wholesale removal.

Species deemed as undesirable for use as replacement plantings are listed in **Table 7**. These species are described as 'undesirable' due to one or more of the following:

- excessive or unmanageable seed dispersal
- poisonous leaves, fruit or flowers
- excessive or unmanageable root suckering
- garden escape
- readily self-propagating from pruning and other materials from gardens
- non-local native species that is becoming an environmental weed as determined by Council
- known irritant species in certain high use areas as determined by Council.

Table 7 - Undesirable replacement tree species in the Newcastle LGA

Scientific Name	Common Name	Notes/Exceptions	Principal Reason
Acacia baileyana	Cootamundra Wattle		Native species but may become an environmental weed outside its natural habitat range
Acacia salignus	Golden Wattle		Native species but may become an environmental weed outside its natural habitat range
Ailanthus altissima	Tree of Heaven		Invasive (seed)
Albizia lophantha	Cape Wattle		Invasive (seed)
Chamaecytisus palmensis	Tree Lucerne		Invasive (seed)
Chrysanthe moides spmonolifea	Bitou Bush		Invasive (seed)
Cinnamomum camphora	Camphor Laurel	Except where the tree height exceeds 10m or the trunk diameter at 1.4m above ground level exceeds 450mm	Invasive (seed)
Cotoneaster spp.	Cotoneaster	All species	Invasive (seed)
Erythrina x-sykesii	Coral Tree		Brittle structure and Invasive due to vegetative reproduction
Ficus elastica	Rubber Tree		Invasive roots
Gleditsia triacanthos	Honey Locust	Not grafted horticultural cultivars	Root suckering
Ligustrum spp.	Privet	All species	Invasive (seed)
Nerium oleander	Oleander		Toxicity
Pyracantha spp.	Firethorn	All species	Invasive (seed)
Robinia pseudoacacia	Black Locust	Not grafted horticultural cultivars	Root suckering
Salix spp.	Willow	All species	Invasive due to vegetative reproduction and root suckering
Schefflera actinophylla	Umbrella Tree		Invasive (seed)
Schinus terebinthifolius	Brazilian Mastic		Invasive (seed)
Syagrus romanzoffianum	Cocos Palm		Invasive (seed)

9.1 Supply of trees

Obtaining quality trees is an important step to achieving superior tree growth, extending the life of the tree and managing future risk.

NATSPEC Construction Information Guide: Specifying Trees – A guide to assessment of tree quality (2nd Edition by Ross Clark, 2003) provides industry recognised standards and specifications for tree supply.

See **Appendix 8** for further detail on how to assess tree stock in accordance with NATSPEC.

Council will only accept NATSPEC certified trees for planting as part of subdivisions or large commercial development (see Section 9.1.1).

Private residents are encouraged to plant using quality tree stock that meets the NATSPEC guide Specifying Trees.

9.1.1 Ordering and delivery of stock

The following steps should ensure that quality trees are available at the time of planting:

1. Prior to ordering, and on delivery to site, a suitably qualified person is to inspect a representative sample of each batch of trees to comply with NATSPEC.

   This must include:

   - above-ground assessment
   - below-ground assessment
   - complete a tree balance assessment
   - root growth characteristics assessment
   - written evidence provided to Council's relevant planner in accordance with NATSPEC prior to tree planting.

2. Prior to delivery of tree stock the nursery is to mark orientation of north on the side of the pot as grown. Trees are to be orientated in the same direction at planting.

3. Transport of tree stock is to be undertaken in a covered vehicle to avoid damage and stress to the plants. Safe loading and handling of stock is to be undertaken with trees slung by the root ball and not the trunk.

10.0 Tree planting

Successful tree planting depends on the ability of the tree to rapidly initiate root growth. Planting is best undertaken in autumn (March to April) when lower air temperatures greatly reduce the stress on the newly planted trees, and soil temperatures are the highest for the year to encourage root activity. Summer planting is not recommended due to high temperatures with potential extremes and increased resource requirements, eg. additional watering.

It is important to note that, the root ball of a new tree can only hold enough water for one day until the root system establishes in the surrounding soil.

The success and long-term objectives of any planting is achieved by:

- completing full assessment of the site, eg. soils, microclimate, drainage, and
- selecting species appropriate to the site and suitable to the space (see Section 9), and
- application of best practice site preparation, stock handling, and
- planting in accordance with best practice, and
- ensuring adequate establishment maintenance for the circumstance.

All planting undertaken as part of a subdivision or commercial development, is to be undertaken by a Landscape Contractors Association (LCA), or an Australian Institute of Landscape Designers and Managers (ALIDM) affiliated contractor or Arborist (minimum level AQF3), with demonstrated experience in the installation of soils, tree handling, planting and establishment of advanced trees.

10.1 Full assessment of the site

The following information is provided to assist with undertaking a full assessment of the site.

10.1.1 Soils

The properties of the growing media directly influence the growth of trees. Physical attributes of the soil affect the availability of water and the levels of oxygen in the soil while chemical attributes influence nutrient availability. Typically urban soils have been highly disturbed and/or compacted and require remediation. Soil testing will determine the type and extent of remediation required.

Trees should be planted into existing soils wherever possible. Improved soil meeting Council's specification should be used in situations where the existing site soil is deemed unsuitable for the intended use and cannot be appropriately remediated.

10.1.2 Soil testing general

Where soil testing is to be undertaken, the testing should incorporate samples taken from one or more of the proposed planting locations. The onsite testing is to include a soil texture test and pH test of both the top soil and subgrade soil to 600mm deep.

10.1.3 Soil testing - subdivisions and commercial developments

During design and planning for private subdivision or commercial developments where tree planting is to be undertaken, the following soil testing is required:

1. Geotechnical assessment (including infiltration rates) of the proposed planting holes is to be conducted at the same time as other geotechnical works.

2. Full physical and chemical tests are to be undertaken by a National Association of Testing Authorities (NATA) laboratory.

3. The above information is to be provided on a plan and in documentation that incorporates soil remediation measures where required.

10.2 Best practice site preparation and stock handling

10.2.1 Site preparation

Site preparation should be undertaken in accordance with the sections below.

10.2.2 Types of imported soil media

Imported soil media used for tree planting should be suitable for the species of tree to be planted. The soil should have sufficient water holding capacity and adequate coarse component to ensure root growth. The soil specification provided in **Appendix 2a** of this manual may assist as a guide.

10.2.3 Soil samples

Samples of the planting soil are to be tested prior to delivery for subdivision or large commercial development. The supplier is to undertake all necessary remediation measures recommended from the soil laboratory results.

For subdivision works a sample of proposed soil mix, including full soil analysis details, is to be retained and provided immediately on request to Council, or an Accredited Certifier, for approval prior to installation.

Soil delivered to site is to be covered where there is a risk of weed contamination.

10.2.4 Tree planting preparation

The key steps in site preparation are:

- Site investigation.
- Creation of the largest planting pit possible for the site. This may include under pavement zones for root growth.
- Removal of surface material, which may be hard stand, grass, or other vegetation such as weeds or compacted/contaminated soil. Only spraying grass can lead to increased maintenance and risk of tree health/death when trying to manage grass.
- Replacement or remediation of unsuitable soils.
- Installation of sub soil drainage to improve growing conditions.
- Watering of the soil as it is installed to remove voids and improve establishment rates.
- Application of mulch at the time of planting by hand or mulch blower.
- Installation of tree protection measures.

10.2.5 Broad acre planting preparation

Planting should occur within an entire bed rather than augured holes.

The key steps to achieving success of broad acre plantings are:

- Site investigations.
- Weed grass treatment and removal.
- Soil ripping both A and B horizon.

- Rotary hoeing (or similar) of the A horizon.
- Improve drainage where required.
- Application of mulch at the time of planting by hand or mulch blower.

10.2.6 Stock handling

Trees can easily be damaged during transportation and installation, which can affect tree health, structure and long term viability. Damage to tree trunks can effectively ring bark the trees, and crushing of root balls can reduce stability and limit root growth. The following is to be applied when transporting or installing trees:

- Thoroughly water the root ball of the container stock at least twelve (12) hours prior to planting.
- Ensure the root ball is moist when it arrives at site and maintain root ball moisture by using a moisture probe if planting is delayed. Do not over water.
- Larger trees must be slung and lifted by the root ball only. In some cases a support sling is required to assist with guiding the tree, but should take no weight.
- Plan and prepare where trees will be planted to avoid further lifting. Holes should be correct depth and base material levelled. Never use weight of any kind to push trees down into the holes, including buckets of machines or stamping with boots.
- The root ball of trees must never be dragged or pulled by any means, including machinery or ropes to vehicles.

10.3 Planting

10.3.1 Moving stock

Move larger trees to the dedicated planting hole by lifting or slinging under the root ball. Do not lift by the trunk or place slings around the trunk. In some cases, a support sling is required to assist with guiding the tree however this should take no weight. Smaller stock should be carried by the pot and not the trunk.

10.3.2 Tree planting

To avoid multiple lifts of the tree and potential damage ensure tree planting holes are of suitable depth and width for the size of root ball that is to be planted. The top of the root ball must finish at the predetermined height, eg. root ball to finish level with surrounding soil or just below to allow for mulch.

When the trees arrive on site:

- measure the rootball depth and width and adjust hole accordingly, and
- ensure base of the planting hole is level and at the correct height before tree is lowered into the hole.

10.3.3 Soil additives at planting

A soil conditioner such as Terracottem ® or approved equivalent to be used in all tree planting. The additive is to be applied in accordance with manufacturer's recommendations.

10.3.4 Consolidating backfill

The consolidation of backfill is to occur to ensure soil doesn't sink post planting. This assists with stabilising the tree and helps prevent any paved surface from deforming. The following process is to be used:

1. Water in the soil as the planting hole is being backfilled to remove air pockets.

2. Ensure backfill is not placed over the top of root ball.

Note: The bark layer is live tissue that is critical to the trees survival as this layer transports soil water and photosynthates. This tissue is extremely vulnerable in young trees and must be protected.

10.3.5 Soil watering berm

A berm of soil is to be built around the edge of the root ball to hold water. The berm is to be covered with mulch, but must not be made of mulch. The following steps are to be used:

1. Form a soil berm 60-80mm high at the outermost edge of the root ball.

2. Ensure edge of berm overlaps the outer edge of the root ball.

3. Apply mulch to the specified depth across the planting area and over the berm.

4. Gently fill inside of soil berm area with water at completion of each tree planting.

5. The soil berm is to be maintained intact for the duration of the tree establishment period.

10.3.6 Watering

Newly installed trees, including drought tolerant species, are dependent upon watering or irrigation until established, typically for two years. The use of irrigation systems can be problematic due to unreliable performance and can result in shallow root systems. Trees require watering to below the root ball depth to sustain and establish the root system and manual watering is to be undertaken.

The root ball of a new tree can only hold enough water for one day in summer and regular watering is critical to the establishment and survival of the tree. Conversely in winter the root ball may hold sufficient water for up to six days. Therefore, it is vital that the frequency and amount of water is determined by the time of year that planting occurs, and is subject to soil moisture tests using a soil moisture probe prior to and during watering in both the root ball and surrounding soil.

The best mechanism to achieve this is a water budget based on individual site conditions and species requirements. The water budget is to be provided as part of the planting documentation for subdivisions or commercial developments.

Watering of the new tree is to be focused on the root ball through the early establishment period. However, additional watering of the surrounding planting bed soil can slow the loss of water from the root ball. A proven method for rapid establishment and growth of new trees is contained within **Table 8** and **Figure 11**. While this may not be possible in broad acre plantings, it provides a guideline against which water budgets can be established.

Table 8 - Watering frequency by season

Season	*Frequency from planting*	*Amount*
Late Spring to early Autumn (includes Summer)	Daily first six weeks, Every second day for 3 weeks Every third day for 3 weeks Weekly or as required.	To field capacity
Autumn	Every second day for 3 weeks Every third day for 3 weeks Weekly or as required	To field capacity
Winter	Every third day for 3 weeks Weekly or as required	To field capacity
Spring	Every second day for 3 weeks Every third day for 3 weeks Weekly or as required	To field capacity

Figure 11 - Example of two magnolias planted at same time (2005) with different planting and maintenance approaches. Tree on left was watered using Table 8 above, the tree on the right was not (photo 2015).

10.3.7 Mulching

Trees are to be provided with a mulched bed at the base of the tree to prevent damage from mowing, pedestrian or vehicle movement.

The addition of **inorganic** mulch (eg. rock or gravel or recycled hardwood) benefits tree health by conserving soil moisture and reducing weed growth.

The use of **organic** coarse mulch derived from live composted material benefits tree health by conserving soil moisture, reducing weed growth, increasing soil organism activity, providing soil organic matter and plant growth nutrients.

The mulch should be retained at 75mm depth and should never exceed 100mm in depth. Mulch placed at greater than 100mm depth will limit gaseous exchange between the soil and the atmosphere reducing soil organism activity and suppressing root development. In addition, it will reduce water infiltration which further inhibits plant growth.

The supply of organic mulch should be in accordance with AS 4454–2003 Compost, soil conditioners and mulches.

The area covered with mulch is to be:

- the area cultivated for planting, or
- the extent of the dripline as the tree grows.

Correct installation of mulch will:

- result in mulch tapering down to zero at the base of new trees next to the trunk, or
- result in a mulch free gap of not less than 100mm and preferably 200mm clear from the trunk of maturing or mature trees, and
- ensure that buttress or other large surface roots are not covered.

Refer to **Figure 12** for correct mulching method diagram.

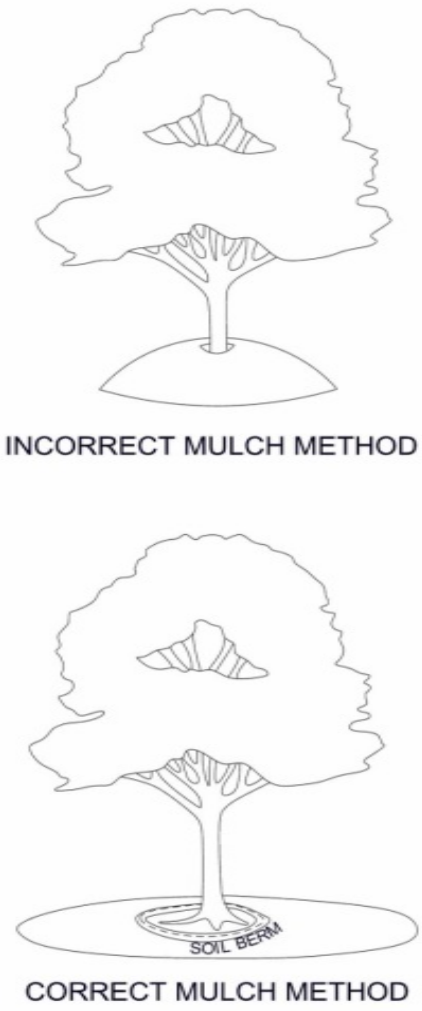


Figure 12 - Mulch diagram

10.3.8 Tree staking

Trees that conform to NATSPEC quality should not normally require staking. Some circumstances, eg. areas of high wind exposure, may require staking for protection during tree establishment. The staking is to be loose so as to not restrict trees, but must not damage tree trunks by rubbing.

10.3.9 Edging

Use edging to separate mulch areas from turf areas. Edging will aid in reducing turf growth into mulch areas and minimise maintenance. Edging should be installed below ground and higher than surrounding grass. However, install flush with the surrounding surface in pedestrian areas, where applicable, to avoid a trip hazard.

10.4 Establishment maintenance

The establishment maintenance period is essential to ensure the tree develops a healthy and mature canopy. Where works are undertaken for commercial or subdivision development, a bond or bank guarantee may potentially be required by Council to ensure quality tree establishment is completed. The following sections detail the requirements during the establishment maintenance period for all large subdivisions and commercial developments. The information below may also assist residents planting trees on their property.

10.4.1 Inspections

Inspections of all new tree plantings are to be scheduled to ensure that weeding, watering and mulch requirements are met in a timely manner. The schedule is to be prepared in advance and is to cover the 104 weeks intensive establishment maintenance period. The schedule needs to be flexible enough to allow for increased inspections during periods of low rainfall, or times of greatest grass and weed growth (eg. spring).

10.4.2 Practical completion report

A Practical Completion Report is required to be submitted to Council for all tree planting undertaken by large subdivisions and commercial development. Rejected works are to be rectified to the satisfaction of the Council. The following information is to be kept to support the practical completion report:

10.4.2.1 Log book record

The contractor undertaking the planting maintenance is to keep a log book of all works. The log book must be available on Council's request and include the time and date of visit, name of the person in charge of the site, the duration of site visit and works carried out. The following should be recorded:

- watering events including dates and amount
- non chemical weeding events and method used
- rubbish removal dates, amount and type
- fertiliser application dates, product specification and rate
- treatment of trees for insect pests and disease, include method, rate and date

- tree replacement date, species, root ball size, reason for replacement including failed, damaged or stolen trees
- reinstatement of mulch to required depths dates, mulch used, and volume
- formative pruning include dates and works undertaken. Pruning in accordance with *AS 4373-2007* (conducted at 102 weeks).

10.4.3 Establishment and maintenance works

10.4.3.1 Watering

Regular watering should occur during the establishment period in accordance with the predefined water budget (refer to Section 10.3.6).

10.4.3.2 Mulch replenishment

Ensure mulch is replenished as required to maintain cover and depth specified at time of planting (refer to Section 10.3.7).

10.4.3.3 Fertilising

Fertilising trees should not be necessary if appropriate soil conditions are provided or if the trees are in a load bearing structure. Fertilising may be required for trees that have been affected by disturbance, where a soil nutrient deficiency is affecting the performance of a tree, or where pest or disease is present. The tree should not be fertilised while stressed with application occurring once the stressor has been managed.

Benefits gained from the increase in stored resources may aid the tree to overcome the stress caused by future disturbances. Nutrient requirements should be based on a soil test by a registered soil laboratory.

10.4.3.4 Weed management

The use of chemicals to control weeds can be detrimental to trees, with many large tree species highly susceptible to even small amounts of chemical. Laboratory testing has shown that weed chemicals stay active when absorbed by mulch. It is vital to tree health to minimise the use of weed chemicals within the root zone or on mulch beds wherever possible.

During establishment maintenance ensure the tree planting pit and adjacent mulch areas are free of weeds for the entire period. Weed management should be undertaken by hand with inspection frequency to be increased where required to minimise weed establishment.

Where chemicals are used to manage weeds in large continuous mulch beds, or where the weeds have established, then the application must occur using only hand wands with hoods over the nozzle. The spray must not fan beyond the footprint of the weed. Broad spraying is not permitted.

10.4.3.5 Pest and disease management

Generally, insect populations can threaten tree health to the point of mortality. Notify Council of any pests and diseases found. Treatment of pests is generally undertaken by a licensed pest control operator.

There are a range of maintenance activities that can increase the risk of pest and disease attack in trees including:

- compaction of the soil within the dripline or root zone of the tree
- imported fill that may contain disease or pests
- roto-tilling, trenching or removing soil from the tree root area
- excessive or regular watering on or near the tree trunk
- planting water loving understory plants within the dripline
- use contaminated mulch, soil or plant stock.

The likelihood of pest and disease problems can be reduced by:

- using mulch that is free of weed species, harmful or foreign matter in accordance with *AS 4454-2012 Compost, soil conditioners and mulches*
- placing mulch well clear of plant stems
- regular watering to maintain field capacity
- use of certified growing media
- using certified plant material. Request certificate from Nursery supplier to certify disease free stock
- avoiding compaction
- avoiding chemical use
- aerating compacted soil.

Note: Refer to section 11.0 for common pests and diseases in the Newcastle LGA and **Appendix 1**.

11.0 Biosecurity

There is a risk to the tree population within any urban forest from a range of pests and diseases. It is critical that appropriate measures are put in place to ensure that any pest or disease is not introduced or spread within the Newcastle LGA.

Any tree maintenance activities (including propagation, planting, mulching, pruning or removal works) are to ensure that the requirements of **Appendix 1**: *Disease and Insect Pest Management Protocols Newcastle LGA* are included in all documentation and implemented.

12.0 Callaghan campus

This section is based on the Landscape Management Implementation Plan Callaghan Campus, 3 September 2012 (LMP). For the purpose of Section 5.03 Tree and Vegetation Management of the Newcastle DCP 2012 compensatory works for vegetation removal at the Callaghan Campus is to be undertaken in accordance with this section. Vegetation pruning is to be undertaken in accordance with AS 4373 and **Appendix 5** *Tree Pruning Specification* form.

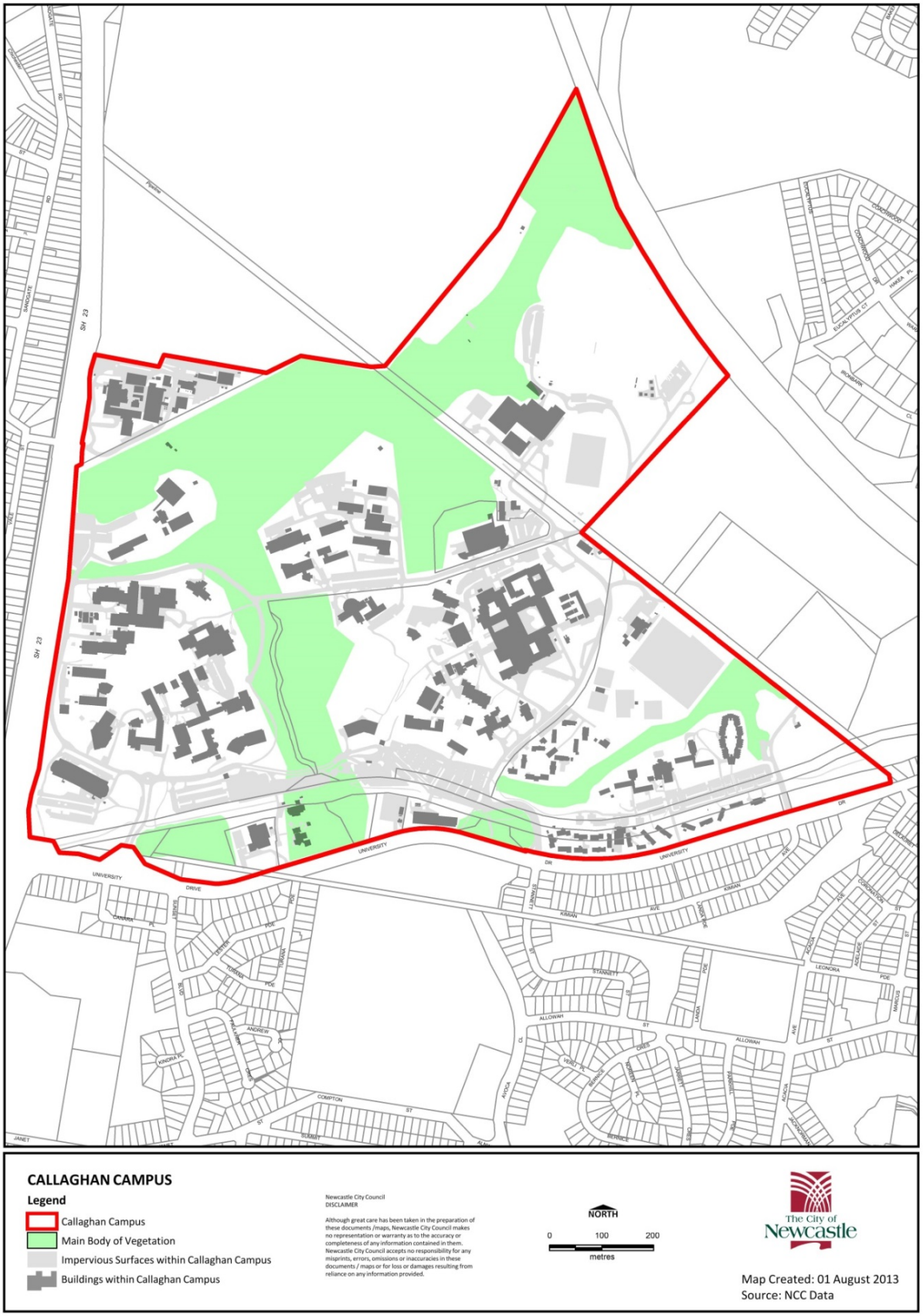
Vegetation works are to be categorised based on the category of impact the activity will have on the environment. **Table 9** is to be used to determine the category of impact an activity will have.

Once the category of impact is known, compensatory works can then be determined based on works listed in **Table 10**. Compensatory works are to be undertaken in a management zone identified in the Landscape Management Implementation Plan Callaghan Campus. The management zone where compensatory works will be undertaken is to be nominated in the development application.

It is advised that the mitigation measures in **Table 9** are undertaken to reduce the impact of the activity.

Compensatory works will be placed as a condition of consent. Council will keep a register of regeneration works which have been conditioned on developments.

Map 1: Callaghan Campus



Step 1 - Determine the category of impact the activity will have

Applicants are required to complete the below table, answering each question until a category of works is established.

Table 9 - Determine the category of impact the activity will have

This section does not apply to development which will have a 'significant impact' under section 5A of the *Environmental Planning and Assessment Act 1979*, or development which is significant under the *Environmental Protection and Biodiversity Conservation Act 1999*. Provisions of relevant State and Commonwealth legislation apply in these cases.

Question	Sub-questions	Mitigation measure
1. Will the activity impact on a vegetation community that forms part of a vulnerable, endangered, or critically endangered ecological community (ie. threatened vegetation) or threatened flora population or species? If **yes** → If **no** ↴	*If **yes** to any of the below questions the activity is categorised as **'threatened vegetation-moderate impact'.** If you answer **no** to **ALL** questions below, the activity is categorised as **'threatened vegetation – minor impact '.*** 1. Does the threatened vegetation being removed account for 10% or more of the combined canopy, midstorey and understorey on the development site? 2. Does the threatened flora habitat being removed account for 10% or more of the extent or estimated population size or threatened species or population present within the area to be impacted by the development (including construction phase)? 3. Will any remaining vegetation become isolated from the main body of vegetation? 4. Is there potential that the threatened vegetation would be used by one or more threatened fauna species for shelter, breeding or foraging?	▪ Seek an alternative location and/or modify the activity to minimise impacts. ▪ Minimise loss of fauna during clearing activities. ▪ Community liaison where appropriate. ▪ On going bush regeneration.

Question	Sub-questions	Mitigation measure
2. Will the activity impact on remnant native vegetation? If **yes** ⟶ If **no** ↴	*If **yes** to any of the below questions the activity is categorised as **'remnant native vegetation – moderate impact'**. If you answer **no** to **ALL** questions below, the activity is categorised as **'remnant native vegetation – minor impact'**.* 1. Does the threatened vegetation being removed account for 20% or more of the combined canopy, midstorey and understorey on the development site? 2. Will any remaining native vegetation become isolated from the main body of vegetation? 3. Is there potential that the area would be used by one or more threatened fauna species for shelter, breeding or foraging?	▪ Seek an alternative location and/or modify the activity to minimise impacts. ▪ Ongoing bush regeneration/weed control. ▪ Minimise loss of fauna during clearing activities
3. Will the activity result in the removal or pruning of native trees? If **yes** ⟶ If **no** ↴	NOTE: Tree pruning is categorised as 'native tree removal – minor impact'. *If you answer **yes** to any of the below questions the activity is categorised as **'native tree removal – moderate impact'**. If you answer **no** to all questions below, the activity is categorised as **'native tree removal – minor impact'**.* Tree Removal Questions: 1. Is there a hollow present? 2. Is the locally native tree removal likely to generate neighbour or community complaints?	▪ Limit tree removal to that required. ▪ Minimise loss of fauna during clearing activities. ▪ Notification when impacting immediate neighbour (i.e. loss of amenity). ▪ Community liaison where appropriate.
4. Will the activity result in the pruning or removal of exotic vegetation or weeds? If **yes** ⟶ If **no** ↴	*If **yes** to any of the below questions the activity is categorised as **'exotic vegetation and weeds - moderate impact'**. If you answer **no** to **ALL** questions below the activity is categorised as **'exotic vegetation and weeds – minor impact'**.* 1. Is there potential that the area would be used by one or more threatened fauna species for shelter or breeding?	▪ Ongoing weed maintenance. ▪ Minimise loss of fauna during clearing activities.

Question	Sub-questions	Mitigation measure
5. Will the activity impact on vegetation fringing or within a watercourse, lake, wetland, or other body of water? If **yes** ⟶ If **no** ↴	*If **yes** to any of the below questions the activity is categorised as **'water course vegetation – moderate impact'**. If you answer **no** to **ALL** questions below, the activity is categorised as **'watercourse vegetation – minor impact'**.* 1. Is there potential that the area would be used by one or more species, populations or ecological communities listed under the NSW Fisheries Management Act and/or Threatened Species Conservation Act 1995? 2. Is there potential that the area would be used by one or more threatened fauna species for shelter, or breeding? 3. Will the activity cause alterations to hydrological regimes?	▪ Sediment and erosion controls, ie. runoff and bank stability. ▪ Stormwater runoff controls. ▪ Ongoing weed control/ bush regeneration. ▪ Community liaison where appropriate.
6. Will the activity impact on a cleared area with no flora or fauna values?	The activity is categorised as **'cleared areas'**.	

Step 2: Compensatory works which are to be undertaken for vegetation removal

Once the category of impact is known (as determined from **Table 9**) compensatory works can be undertaken as outlined in **Table 10**.

Table 10 - Compensatory works which are to be undertaken for vegetation pruning and removal

Category of impact	Compensatory works to be undertaken
Threatened vegetation - minor impact	• Undertake bush regeneration of the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan. **AND** • Bush regeneration of an area at least 20% the size of the disturbed area in an identified bushland management zone within the main body of vegetation. Regeneration should be located (where possible) to provide a buffer effect and use relevant species from the threatened vegetation affected.
Threatened vegetation - moderate impact	• Undertake bush regeneration of the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan. **AND** • Bush regeneration of an area at least 50% the size of the disturbed area in an identified bushland management zone within the main body of vegetation. Regeneration should be located (where possible) to provide a buffer effect and use relevant species from the threatened vegetation affected. **AND** • If the tree contained hollows, then install three or more nest boxes in adjacent trees (or nearby areas) or on posts for each tree hollow removed.
Remnant native vegetation - minor impact	• Undertake bush regeneration over the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan.
Remnant native vegetation - moderate impact	• Undertake bush regeneration over the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan. **AND** • If the tree contained hollows, then install three or more nest boxes in adjacent trees (or nearby areas) or on posts for each tree hollow removed.
Native tree removal – minor impact	Tree Removal • Undertake bush regeneration over the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan. Pruning • No offset is required for minor pruning of foliage if it does not affect the continued health of the locally native tree (ie. pruning is not of the trunk or primary branches of the tree). Note: Pruning is to be undertaken in accordance with AS 4373 and **Appendix 5** *Tree Pruning Specification* form.

Category of impact	Compensatory works to be undertaken
Native tree removal - moderate impact	• Undertake bush regeneration over the disturbed area using locally native species and targeted weed removal for a minimum of 2 years, in accordance with the Action Plan. **AND** • If the tree contained hollows, then install three or more nest boxes for each tree hollow removed in adjacent trees (or nearby areas) or on posts.
Exotic vegetation and weeds - minor impact	• Revegetate the area where exotic vegetation or weed infestation has been (if the site is identified in the LMP as a suitable regeneration site), using appropriate locally native species as per the Landscape Management Implementation Plan (LMP).
Exotic vegetation and weeds - moderate impact	• Revegetate the area where exotic vegetation or weed infestation has been (if the site is identified in the LMP as a suitable regeneration site), using locally native species as per LMP. **AND** • If the area is more than 200m^2, then weed removal should be staged to allow an area to be revegetated.
Water course vegetation - minor impact	• Undertake bush regeneration of the disturbed area using locally native species and targeted weed removal for a minimum of two years, in accordance with the Action Plan.
Water course vegetation - moderate impact	• Undertake bush regeneration of the disturbed area using locally native species and targeted weed removal for a minimum of two years, in accordance with the Action Plan. **OR** • If not practical in the same area, use a nearby area on the same watercourse for the above regeneration activities, this can either be on or off the corridor.
Cleared areas	• Cleared areas with fauna habitat values are not addressed by this strategy and will be considered on a case by case basis.

Glossary

Action Plan: for the purpose of the University of Newcastle Callaghan Campus the term refers to the Action Plans in Section 9.3 of the Landscape Management Implementation Plan Callaghan Campus dated 3 September 2012.

Amenity: is the term used to describe the features, facilities or services that make for a comfortable and pleasant life. Amenity is not only enjoyed by residents in their homes and gardens but also in the street and public places.

Arborist: a person who holds the Australian Qualifications Framework (AQF) 5 Diploma in Horticulture (Arboriculture) or AQF 4 Certificate IV in Horticulture (Arboriculture) and is enrolled in the NSW TAFE AQF 5 Diploma in Horticulture (Arboriculture) course.

Bushland Management zone: for the purpose of the University of Newcastle Callaghan Campus the term refers to the Bushland Management zone map in Section 9 of the Landscape Management Implementation Plan Callaghan Campus 3 September 2012.

Bush Regeneration: the rehabilitation of bush from a invasive plant species or otherwise degraded plant community to a healthy community composed of native and indigenous species**.**

Canopy cover: refers to the total area contained within the vertical projection of the periphery of tree crowns (or other overstorey). Provides an indicator of the quantity of urban forest, and its capacity to provide ecological, economic, social and aesthetic benefits.

Circumference breast height: the girth of the supporting stem of a tree at a height of 1.4m above ground level measured at the trunk centre, and so as to contain the outermost projection of any flanges or buttresses.

City Arborist: person designated as such by The City of Newcastle.

Compensatory planting: tree planting required offsetting the loss of retainable tree canopy.

Council: means Newcastle City Council.

Crown: portion of the tree consisting of branches and leaves and any part of the trunk from which branches arise.

Crown projection: is the size of the tree canopy. An equation is used to work out the crown size. Crown size (m) = πr2 where r equals the average distance to canopy dripline.

Compaction: compression of the soil that creates an upper layer that is impermeable.

Diameter at Breast Height (DBH): the diameter of the tree trunk at 1.4m above natural grade.

Dead tree: where the biological function of the tree has ceased, no leaves are present and visible evidence of trunk, root plate and canopy desiccation.

Development Control Plan (DCP): has the same meaning as in the *Environmental Planning and Assessment Act, 1979.*

Note: The term is defined as a development control plan made, or taken to have been made, under Division 6 of Part 3 and in force.

Development site: includes all areas within which the development will occur and can extend across several lots or development blocks.

Disturbed area: the area which will be impacted by a development, including construction, demolition and use.

Dying tree: demonstrates reduced growth rates, sparse foliage and reduced response to damage or stress over subsequent growing seasons.

Exotic: any flora or fauna species which is not native or indigenous.

Gap-graded soil: a mix of 40mm crushed basalt aggregate, filler soil and other additives to meet specification supplied. Components are thoroughly pre-mixed before placing in trench.

Hazard: anything with potential to harm health, life or property.

Indigenous: any tree, shrub, fern, creeper, vine, palm or plant that is native to the Lower Hunter Region, and includes the flower and any part thereof.

Infiltration: the practice of discharging drainage water into the ground soil matrix.

Injuring: in relation to a tree, means a wound resulting from an activity, including but not limited to excessive pruning, cutting, trenching, excavating, altering the grade, paving or compaction within the tree protection zone of a tree. Injury includes bruising, scarring, tearing or breaking of roots, bark, trunk, branches or foliage, herbicide or poisoning, or any other action foreseeably leading to the death or permanent damage to the tree health.

Lopping: an unacceptable practice as defined in the Australian Standard AS4373 – 2007.

Main body of vegetation: is the area shown on Map 1 - Callaghan campus

Manual: the technical manual/s that support Newcastle Development Control Plan 2012.

Native: any tree, shrub, fern, creeper, vine, palm or plant that is native to Australia but not indigenous, and includes the flower and any part thereof.

Native Vegetation: has the same meaning as in the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017.* As such native vegetation is any of the following types of plants native to New South Wales:
(a) trees (including any sapling or shrub or any scrub)
(b) understorey plants,
(c) groundcover (begin any type of herbaceous vegetation),
(d) plants occurring in a wetland.

Native Vegetation Community: plant communities, comprising primarily native species, the composition and structure of which reflects the interactions between plant species, between plants and fauna and with the environment. Native vegetation communities include canopy trees (where present), understorey, and ground cover. Regrowth and newly colonising stands of native species are included as part of the native vegetation community.

LEP: the Newcastle Local Environmental Plan (LEP) is a city wide plan covering the entire local government area. The plan anticipates social and economic trends as well as the need to protect the environment. The LEP is prepared by Council and approved by the Minister for Planning and Infrastructure.

Park Tree: a public tree located in a park managed by Council. These are generally mown areas but may have some pockets of trees with understory.

Project Arborist: a suitably qualified arborist retained by a property owner or development applicant for the purpose of overseeing on-site activity involving the welfare of the trees to be retained. The Project Arborist shall be responsible for all reports, appraisals, tree preservation plans, or inspections as required.

Property: refers to any infrastructure (eg. underground water/sewer pipes, electrical cables etc.) and structural elements on private land. Structural elements include driveways, and walls which are retaining devices only.

Pruning: is the selective removal of branches in accordance with the requirements and classifications within AS4373-2007 Pruning of amenity trees.

Public Tree: tree/shrub species located on any land managed by Council.

Remnant: native vegetation community within the boundaries of the Newcastle University Callaghan Campus.

Removal: complete tree removal such as cutting to the ground or extraction of the tree or taking any action foreseeably leading to the death of a tree or permanent damage to its health or structural integrity, including but not limited to excessive pruning, cutting, girdling, poisoning, over watering, unauthorized relocation or transportation of a tree, or trenching, excavation, altering the grade within the tree protection zone, or paving within the drip-line of the tree.

Riparian zone: refers to a riparian corridor as defined by Department of Primary Industries - Office of Water - i.e. a riparian corridor that forms the transition between land and river or watercourse.

Risk: the chance of injury, loss or damage to property, a person, organisation or the community measured in terms of consequences and likelihood.

Risk management: is the process of identifying, analysing, evaluating, monitoring and communicating risks in a way that minimises losses and maximises opportunities. It is described generically in AS/NZS 4360:1999 Risk Management.

Shrub: a woody perennial plant that is generally smaller than a tree species at maturity and has many main stems or trunks.

Stormwater: the runoff from rainfall events.

Streetscape: the form, character and visual amenity of the street environment.

Street tree: public trees and shrubs within the road reserve. These have been surveyed and mapped by Council.

Street tree vacancy site: sites identified by Council for future tree planting. The sites have been identified from analysis of the Local Government Area based on criteria in the Tree Asset Management System (TAMS). The information on locations of street tree vacancy sites is available on request from Council.

Structural soil: see Gap-graded soil.

Suitably qualified person: a person with appropriate level of skills and formal training in a particular field relevant to a particular situation or works, such as a structural engineer who is required to assess structural works, a civil engineer required to assess road works.

Solar: suitable access to sunlight for human wellbeing.

Topping: an unacceptable practice as defined in the Australian Standard AS4373 – 2007.

Tree Private land: a long lived woody perennial plant greater than 3m height (or will be at maturity), with one or relatively few main stems or trunks.

Tree Protection Plan (TPP): a plan prepared by a suitably qualified arborist that details measures to protect and preserve trees.

Tree Protection Zone (TPZ): is a determined area of ground under a tree that is to be fenced off during the development of a site to ensure that activity does not cause damage to the tree or its root system.

Trenching: any excavation to provide irrigation, installation of foundations, utility lines, services, pipe, drainage or other property improvements below ground.

Urban forest: the totality of trees and shrubs on all public and private land across Newcastle LGA, and measured as a canopy cover percentage of the total area.

Urban Forest Technical Manual: produced by the City of Newcastle to supplement section 5.03 Tree Management of the Newcastle DCP 2012 by providing technical information for the design, implementation and management of tree planting in the local area.

Undesirable Species: tree species listed in Appendix 1 of this Technical Manual that are unsuitable for replanting due to negative characteristics.

Verge: the part of the street reserve between the carriageway and the boundary of adjacent lots (or other limit to street reserve). It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and planting.

Vertical mulching: auguring, hydraulic or air excavation of vertical holes within a trees root zone to loosen and aerate the soil, typically to mitigate compacted soil. Holes are typically penetrated four to six feet on centre, two to three feet deep, two to six inches in diameter and backfilled with either perlite, vermiculite, peat moss or a mixture thereof.

Weed: a plant encroaching on an area mulched for trees.

Newcastle Urban Forest Technical Manual
Part B Public Trees

February 2018

The urban forest is the collection of trees, shrubs, and other vegetation types on both public and privately owned land within the Newcastle Local Government Area. The urban forest and associated tree canopy across Newcastle provides a range of benefits for the community. Some of these benefits include shade, microclimate regulation, air quality, sense of wellbeing, diverse flora and fauna, storm water management and interception. The liveability of the city is greatly improved by having a sustainable tree canopy and green spaces.

In May 2008, Council adopted the Newcastle Urban Forest Policy and Urban Forest Background Paper in recognising the importance of the Urban Forest. The goals of the Urban Forest Policy include sustaining and maximising the Newcastle urban forest on an intergenerational basis. In June 2013, Council adopted the Newcastle 2030 Community Strategic Plan which is the community's long term vision for the city. The Community Strategic Plan identifies that over the next 20 years the Newcastle community wants a greater connection with nature, with a greener more enriching environment where the urban forest is maintained and connected.

This Technical Manual contributes to Newcastle's urban forest by providing guidance on the management of trees (including shrubs) on both public and private land within the Newcastle Local Government Area. The Manual is an accompaniment to the Newcastle Development Control Plan Section 5.03 Vegetation Management. It is separated into three parts based on the land on which the tree is located and the type of vegetation present:

- Part A provides guidance on the management of trees and shrubs located on private land.
- Part B provides guidance on the management of trees and shrubs located on public land.
- Part C provides guidance on the management of native vegetation communities on private land.

Use the Part that relates to the land on which the tree, shrub or other vegetation is located, regardless of the proposed activity.

Urban Forest Technical Manual
Part B Public Trees

Table of contents

1.0 Introduction

Part B of the Urban Forest Technical Manual is to be used for all activities relating to trees on public land (public trees). Public trees are those trees located on land managed by Newcastle City Council, including street trees, park trees, and trees within other natural areas such as bushland reserves, coastal areas, heathland and wetlands. Part B of the Urban Forest Technical Manual is to be used for:

- private development where public trees or allocated planting vacancies are located within 5m of the property boundary, or
- all public tree management activities including inspections, maintenance and planting, and
- all infrastructure design and works undertaken by Council.

1.1 How to use this manual

Part B of this Manual is presented in twelve sections:

Section 1.0 Introduction - this outlines when this part of the Manual is to be used.

Section 2.0 Public trees and Development Applications - provides the process to be followed when a Development Application impacts public trees.

Section 3.0 *Roads Act 1993* - Section 138 application - provides the process to be followed for Section 138 applications in relation to public trees.

Section 4.0 Public tree removal tree assessment tests - defines when the tree assessment tests are required for public tree removal and details what is required to undertake each of the six tree assessment tests.

Section 5.0 Public trees and infrastructure - details the process for the design of Council's infrastructure around existing public trees, and incorporating new trees into the design.

Section 6.0 Tree species selection and supply - details the ordering and supply of tree stock in accordance with NATSPEC.

Section 7.0 Tree planting - provides extensive detail on best practice planting techniques.

Section 8.0 Protection measures - provides specific detail on tree protection for public trees in relation to any works undertaken by Council, utility agencies or private development.

Section 9.0 Public tree maintenance - provides best practice methodologies for public tree maintenance activity undertaken by Council.

Section 10.0 Biosecurity - identifies the biosecurity requirements to be implemented for tree maintenance activities.

Section 11.0 Utility providers - provides guidance on offsets from trees and options to minimise damage to public trees.

Section 12.0 Arborist reports and qualifications - sets out the level of qualification required for reporting on public trees.

2.0 Public trees and Development Applications

It is Council's preference that public trees are retained and protected through appropriate design of development, and during the construction process.

Council **does not** require arborist reports for public trees, rather they are assessed by Council officers through the Development Application (DA) referral process.

When public trees or allocated planting vacancies are located within 5m of the property boundary, the applicant must undertake the following:

1. Identify the location of all public trees and planting vacancies within 5m of the property boundary on the site plans. Council must be contacted to obtain location/s of planting vacancies (Contact 4974 2000), and

2. Where the proposed design is within the tree protection zone (12 x trunk diameter measured at 1.4m above ground level in accordance with AS 4970-2009), the designer is to consider the feasibility of alternative options in accordance with the driveway crossing or works on public land test (refer to Section 4.1.6).

3. The Development Application is to include documentation to show all reasonable design options considered as part of step 2 above, and detail the feasibility review of these options.

The information provided will be considered within the development assessment process. Tree protection measures may be required as part of the consent conditions (refer to Section 8.0). Tree removal may be approved where it is clearly demonstrated that alternative design options to retain public trees is not possible. The removal and replacement of public trees is to be undertaken by Council.

Fees are charged by Council for the removal and replacement of street trees as a result of an approved development (or other causes such as vandalism, vehicle impact, etc). All fees which are charged by Council for the replacement of street tree(s) will be utilised for the planting of new tree(s). Fees may be found in Council's Fees and Charges register and are updated each year www.newcastle.nsw.gov.au/Council/Our-Responsibilities/Integrated-Planning-and-Reporting/Fees-and-Charges. Contact Council on (02) 4974 2000 to arrange quotation and payment for tree removal and planting once the development consent is received.

Consent is also required under section 138 of the *Roads Act 1993* for works of any kind within the road reserve, once a DA has been approved. The requirement for consent under the *Roads Act 1993* will be included as part of the consent conditions in the development approval.

3.0 Roads Act 1993 - Section 138 application

Particular works or activities within the road reserve, including removal or interference with a public tree, require consent under Section 138 of the *Roads Act 1993*. Consent under Section 138 of the *Roads Act 1993* may be required as a condition of a Development Application approval or is required to be finalised prior to obtaining a Complying Development Certificate under *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008*.

An application form for consent is available on Council's website:
www.newcastle.nsw.gov.au/Living/Transport/Roads/Road-permits or from Council's customer enquiry centre.

A range of infrastructure and assets, including trees, are located within the footway and road reserve and cannot be easily relocated, or in some cases relocated at all. Relocation of infrastructure can result in significant cost and should be considered when preparing development plans.

Where a section 138 application is approved the applicant may be required to undertake the following as part of the conditions:

- obtain details of utilities prior to commencement of work
- employ a suitably qualified arborist to supervise works in the vicinity of public trees
- install protective fencing in accordance with a tree protection plan (refer to Section 8.0)
- ensure access is maintained at all times along the footway in the vicinity of the works (refer to Section 8.0), and
- any damage to public land is to be restored to the satisfaction of Council. The restoration work is to be undertaken at no cost to Council.

3.1 Driveways

The removal and installation of driveways can have negative impacts on public street trees and vacant planting sites. This can result in lost planting opportunities, tree removal and associated costs. The following should be considered when undertaking design of a building and/or driveways to reduce these impacts, retain trees and tree vacancies:

- Replace a driveway in the same location as the previous one, with no additional excavation in depth or width.
- Locate the new driveway to achieve a 3m offset from a vacant planting site or an existing tree where:
  - the tree **is not** greater than 270mm diameter (measured at 1.4m above ground level), or
  - the tree **is not** greater than 4m in height above ground level at the highest point of the canopy.
- Locate the new driveway outside the required tree protection zone (12 x trunk diameter measured at 1.4m above ground level, in accordance with *AS 4970-2009*) where:
  - the tree **is** greater than 270mm diameter (measured at 1.4m above ground level), or
  - the tree **is** greater than 4m in height above ground level at the highest point of the canopy.

The assessing Council Officer will seek advice from a Council arborist regarding the proposed offset from the tree to the driveway, and any other factors such as heritage or habitat. Council may choose to retain the tree and advise of the required offset, or may approve the removal of the tree.

Removal of the tree is only undertaken where:

- the condition of the tree is poor and an alternative planting site is available elsewhere across the development frontage, or
- where there is no possible alternative to achieve a driveway as per section 4.1.6 The driveway crossing or works on public land test.

Fees are charged by Council for the removal and replacement of street trees as a result of an issued consent. All fees which are charged by Council for the replacement of street tree(s) will be utilised for the planting of new tree(s). Fees may be found in Council's Fees and Charges register and are updated each year www.newcastle.nsw.gov.au/Council/Our-Responsibilities/Integrated-Planning-and-Reporting/Fees-and-Charges. Contact Council on (02) 4974 2000 to arrange quotation and payment for tree removal and planting once the *Roads Act 1993* consent is received.

4.0 Public tree removal tree assessment tests

The tests in this section are to be used when removing street trees, parks trees, or any other public tree (unless the removal can be undertaken in accordance with one of the other criteria outlined in the City Wide Maintenance Procedure 2017). The removal of a notifiable tree/s, as defined under the City Wide Maintenance Procedure 2017, requires documentation to meet the relevant tree assessment test (see example below) and Councillor notification.

The purpose of the tests is to ensure Council's tree management meets the goals and objectives of the Urban Forest Policy. This is achieved by ensuring existing public trees are appropriately investigated with the outcome of the investigation documented. Public trees will only be removed where it is demonstrated that no practical alternative is available for retention of the tree.

The tests ensure that a foreseeable risk is not created by damaging trees, and retained trees are protected during construction works and maintenance activities. This process is in accordance with the Statewide Best Practice Manual, *Trees and Tree Roots,* and Council's' City Wide Maintenance Procedure 2017.

The tree assessment tests are undertaken in two parts, with the first part being the tree inspection and advice, and the second part being the review of options to retain trees. The level of detail provided in the first part of the tests will be determined by the circumstance and intended use.

For example:

- a resident request will result in an inspection, with relevant notes recorded in Council's tree system (TAMS). The notes and outcome of the inspection recorded in TAMS are to have regard for the tree assessment test criteria and the City Wide Maintenance Procedure 2017, whereas
- the assessment of notifiable trees, or trees for a project would undertake the inspection as above. However, the information obtained during the inspection would be expanded into a document that addresses the inspection component of the relevant tree assessment test in more detail. The level of final documentation is to be tailored to the circumstance and may be in the form of a memo with summary of site inspection or a full report.

Removal of trees on public land can be undertaken by Council as exempt development, or development without consent (through the preparation of an REF) under *State Environmental Planning Policy (Infrastructure) 2007*, or as part of works under Section 88 of the *Roads Act 1993*. However, in all of the above cases a Council arborist provides tree assessment documentation as the first part of the tree assessment test. This tree documentation is to inform the project, address impacts to trees and risk, meet insurance obligations, and provide adequate information for project approval and meeting the requirements of Council's process.

Note 1: For removal of a heritage listed item, Aboriginal object or disturbance of an Aboriginal place of heritage significance consult with Council's Development and Building Section.

Note 2: The tree assessment tests are to be undertaken in addition to the approvals above.

Note 3: Project referral forms and Tree inspection forms are contained within **Appendix 9**.

Note 4: Council projects within the road reserve (that are to be undertaken under the *Roads Act 1993*) will seek required approvals from the Office of Environment and Heritage.

Note 5: Removal of mangroves requires an approval from NSW Fisheries.

Note 6: Private requests for the removal of Public Trees to mitigate bushfire risk are to be submitted to the Rural Fire Service who will assess the risk.

The six tree assessment tests are listed in section 4.1. The full infrastructure works test (see section 4.1.5) is not required in the two circumstances detailed below.

1. A Council arborist is to inspect the trees and provide written advice (**Appendix 9**). However, the review of feasible design options under the infrastructure works test is not required where:
    - the trees within the works area are confirmed to be in poor condition by a Council arborist, and this is recorded in Council's tree asset management system, or where
    - full road reserve construction works are to occur (works that incorporate both road and footways), and a Council arborist has inspected all trees where the tree protection zone radius is encroached by the works, and confirmed in writing they will be compromised.

2. A Council arborist will not conduct a tree inspection or provide written advice, and a review of feasible design options under the infrastructure works test is not required where:
    - the works are outside the required tree protection zone radius and is noted in the design report with appropriate tree protection.

Note 1: Tree Protection Zones (12 x trunk diameter measured at 1.4m above ground level, in accordance with AS4970-2009). The DBH of multi-stem trees is to be determined using Council's online calculator. www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

Note 2: TPZ radius is measured from centre of the tree. SRZ is measured from the outer edge of the base.

Note 3: Council may decide to undertake the full infrastructure works test in some of the above circumstances.

The application of the tree assessment tests requires a review of options to retain trees. The review of each option is to be documented, including implications and feasibility to support the final determination. See **Table 1** as an example only for the Infrastructure Works Test.

Table 1 - Example of review of feasible options under the Infrastructure Works Test

Hazard	Risk Level	Option	Abatement Option	Residual risk	Feasible
Trips/Falls/ Impact by vehicle	High (22)	1	Construct a footpath on the existing footway past tree.	High (24)	No The works would significantly impact on tree health and overall structure. This work would not be in accordance with AS4970 and would compromise the trees structural root zone, significantly increase the likelihood of large branch shed or whole tree failure, sever a large area of water absorbing roots resulting in tree decline and likely death. This would constitute a foreseeable risk.
	High (22)	2	Extend the footway into the parking lane by way of kerb extension commencing at 12m from the tree to facilitate pedestrian access around the tree.	Low (5)	Yes This retains the tree and provides a safe area within the footway to walk. May shorten the crossing distance for pedestrians. There would be a loss of two parking spaces in what is primarily a suburban area. Does not affect the bus stop to the north. Does not affect turning movements of larger vehicles. This would also create an improved space for future planting. The cost associated with this work estimated at $xx.
	High (22)	3	Remove tree and turf within existing footway creating suitable pedestrian access along the footway.	Low (5)	Yes Loss of tree and 565m^2 of canopy. Tree value estimate $xx with removal and replanting cost $xx. Provides trafficable footway and addresses trip hazards.
	High (22)	4	Do nothing.	High (22)	No The site has a fully constrained footway which forces pedestrians to walk on kerb or on the road to pass. The potential risk is high and requires abatement. This would constitute a foreseeable and preventable risk.

4.1 Tree assessment tests

Public tree removal is subject to assessment under one or more of the following tests.

4.1.1 The unacceptable risk test

The objective of this test is to determine if the public tree poses an unacceptable risk that cannot be appropriately managed by arboricultural treatment, fencing, signage or other risk management measures.

The following is to be provided by a suitably qualified Council arborist:

- a tree inspection through visual tree assessment (VTA stage 1), (VTA stage 2 if more information is required), and
- a detailed tree risk assessment in accordance with industry best practice tree condition assessment methodology, and
- supporting evidence, including clear and relevant photographs of the tree(s), any hazards, targets, and demonstration of risk, and
- a review of options for managing risk other than by tree removal, and
- a summary of the risk abatement options and implications.

4.1.2 The diseased condition test

The objective of this test is to determine if the public tree is in a diseased condition that cannot be corrected by appropriate arboricultural treatment.

The following is to be provided by a suitably qualified Council arborist:

- an inspection of the tree and formal identification of the disease, and
- an assessment of the impact of the disease on the trees health and/or structural condition, and
- supporting evidence, including clear and relevant photographs of the tree(s), any visible signs of disease, and
- a review of options for managing the disease other than by tree removal, and
- a summary of the options and implications.

Where the trees structural integrity is at risk, a formal risk assessment is to be conducted using industry best practice tree condition assessment methodology.

4.1.3 The property damage test *within 12 months of assessment*

The test is to determine if public or private property is being significantly affected by the presence/location or growth of a public tree. The purpose of this test is to assess the degree of impact a tree is having on built assets (including utility services, footpaths, driveways, retaining walls and buildings) and to demonstrate whether removal is the only reasonable option to avoid further conflict within the short term, ie. 12 months.

The following is to be undertaken:

- A suitably qualified arborist is to:
  - review the condition and proximity of all relevant trees to the part of the built asset that is, or is likely to be damaged within 12 months, and

- assess the likely future growth and development characteristics of the tree(s), and
- undertake investigations to demonstrate the public tree(s) are implicated where existing damage is evident, and
- provide supporting evidence, including clear and relevant photographs of the tree(s), damage, root interaction and relationship of this to nearby trees, and
- provide the above to the person assessing damage of the built asset.

- A suitably qualified person (eg. structural, road or civil engineer) is to:
  - conduct an assessment of damage, and
  - review the arborist information in conjunction with the arborist, and
  - provide a review of options, other than tree removal, for managing the interaction between tree(s) and built assets.

4.1.4 The suppressed growth test

The objective of this test is to determine if the tree is part of a group of trees in which the spacing prevents each of the trees from attaining its desired full potential.

The following is to be provided by a suitably qualified Council arborist:

- an assessment of all trees in a group, and
- a report that:
  - demonstrates why the tree(s) in question would be the most beneficial tree(s) to remove, and
  - a site plan and clear photographic details to indicate exactly which tree(s) are to be removed, and
  - the method to be used and precautions to be adopted to protect remaining trees.

Note 1: This test does not apply to a traditional avenue planting of evenly spaced trees, or trees that are typically understorey plants.

Note 2: Caution should be exercised in removing trees from a mature /established group as changes in wind exposure could increase the likelihood of failure.

4.1.5 The public infrastructure works test

The objective of the test is to determine if a tree is likely to be significantly injured or damaged as a result of public infrastructure work. The test is applied for all public infrastructure works to avoid significant injury or damage to the tree(s) (refer to Section 4.0 for exemptions).

Significant injury or damage is defined as resulting in:

- tree death, or
- the tree posing an unacceptable risk, or
- a reduction in the remaining service life of the tree to an unacceptable timeframe.

The likelihood of significant injury must be confirmed in a report prepared by a suitably qualified Council arborist who must:

- conduct a tree inspection recorded in Council's' tree asset management system, and

- undertake a detailed assessment of the tree(s) existing health and structure, and the impact of the proposed works on the health and structure of the tree(s) to determine if significant injury or damage will occur, and
- provide a summary to the public infrastructure designer (**Appendix 9**).

The public infrastructure designer must:

- document all reasonable design alternatives to retain healthy trees, and
- ensure adequate space is provided in the design for future plantings, and
- provide the above information to the business unit manager for determination.

Note: Private trees within 5.0m of the boundary must be considered when designing and installing public infrastructure. Failure to consider this can result in the creation of a foreseeable risk. Refer to Infrastructure Works Test under Private Trees Part A section 3.4.4.5

4.1.6 The driveway crossing or works on public land test

The objective of this test is to ensure the design of driveway crossovers and other private structures and works gives appropriate consideration to alternatives to tree removal, or loss of vacant planting sites on public land.

The assessment of public trees under this test is conducted by a suitably qualified Council arborist through a referral by Council's Development and Building section. A Council arborist, upon receiving the referral, will:

- conduct a tree inspection recorded in Council's tree asset management system, and
- provide information regarding the vacant planting sites, the condition of the existing tree(s) and the minimum offsets required to maintain tree health and structure, to the assessing officer.

It must be demonstrated within the development process that the tree would prevent the installation or essential function of a proposed driveway crossing, street awning, street balcony, or other private structure or work, where such work/structure complies with Council's design standards and other requirements, and:

1. it is demonstrated that there is no reasonable alternative to removing the tree, and all reasonable alternative design considerations for the works have been considered in order to maximise the public benefits, and

2. the Council is satisfied that the proposal would not have adverse, heritage, streetscape, pedestrian or traffic impacts.

Note 1: Public benefits include minimising driveway crossovers to maximise tree space, to retain on-street parking, and to retain safe pedestrian access.

Note 2: Alternative design options considered in point 1 include: relocating and/or minimising driveway crossover widths to retain existing trees, altering development footprint, altering hard surface design, and utilising permeable pavement

5.0 Public trees and infrastructure

This section is to be used for all infrastructure works and maintenance activities undertaken by Council. This section has been separated into two parts, including:

- infrastructure design and maintenance within the root zone of existing trees (section 5.1), and
- infrastructure design incorporating new trees (section 5.2).

5.1 Design for existing trees

This section is to be used for all public infrastructure works and maintenance activities where there are existing trees. Public infrastructure works and maintenance activities undertaken as either exempt development or development without consent under the *State Environmental Planning Policy (Infrastructure) 2007* must follow this process. Where a Review of Environmental Factors (REF) is being prepared for the project, the advice received from a Council arborist and review of alternative design options must be incorporated into the REF.

When designing infrastructure around existing trees the following steps are to be undertaken:

1. Determine if the works are inside the required tree protections zone (TPZ) radius (refer to Section 5.1.1)

2. i) Where the works are within the TPZ refer the project to a Council arborist (refer to Section 5.1.2), OR

   ii) Where the works are outside the TPZ, then a referral to a Council arborist is not required. The infrastructure works test, including a review of feasible design options, is not required. However, tree protection notes are to be included on plans and in the design reports for adjacent trees to prevent damage from equipment or storage eg. no materials, equipment, site sheds or washout from machinery is to be within the TPZ of any tree.

3. Where the works are within the TPZ, a Council arborist will inspect the trees and provide advice to the designer (refer to Section 5.1.3).

4. The designer is to consider suitable options to retain trees as identified by the arborist and incorporate these into the project charter or concept report (refer to Section 5.1.4).

5. The Business Unit Manager determines the final option and signs off the concept report.

5.1.1 Determining tree protection zone

The tree protection zone (TPZ) is defined as the area required to maintain the biological function, stability and health of a tree (AS 4970 - 2009). The structural root zone (SRZ) of a tree is the inner area of the TPZ, and is the radial area critical to tree stability (AS 4970 - 2009). However, the SRZ formula does not apply to trees with asymmetrical root plates. Street trees generally have an asymmetric root system and the TPZ is considered the SRZ in these circumstances. The TPZ offset is an appropriate starting point for investigation and design. However, these offsets may be reduced based on a range of variable factors, including tree height and surrounding materials.

It should be noted that offsets within the road pavement can often be significantly reduced due to density of pavement construction. However, advice should always be sought from a Council arborist before encroaching into these zones, particularly where kerb and gutter is proposed to be removed.

A Tree Protection Zone is calculated as 12 x trunk diameter at breast height (DBH), which is measured at 1.4m above ground level. The DBH of multi stemmed trees is calculated using Council's online calculator to achieve a single stem figure. The calculator can accessed via Council's website www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator.

Note 1: The minimum TPZ radius available under AS4970-2009 is 2m. For a calculated TPZ less than 2m eg. 12 x 10cm (DBH) = 1.2m, the 2m minimum would be applied.

Note 2: The TPZ radius for palms is 1m outside the canopy edge (dripline).

Note 3: When designing works adjacent to **new or young plantings**, including storm water pits, bus stops or similar, consider the future mature size of the tree or palm. Generally footpath design can be undertaken in this circumstance using the minimum TPZ radius of 2m from the new tree.

5.1.2 Referral to a Council arborist

Where works are within the TPZ of an existing tree a referral is to be sent to a Council arborist. Referral can occur during preparation of the project charter or concept design stage. The referral is to include the following detail:

- the address / location of the site, including an aerial photograph with works location marked (see **Figure 1**), and
- the footprint of the proposed works, including distance of tree(s) from the edge of the excavation or batter works, and
- tree identification numbers from Council's mapping system, and
- a detailed description of the activity and where excavation will occur, eg. replacement of kerb on same alignment, excavation to occur at 300mm into footway.

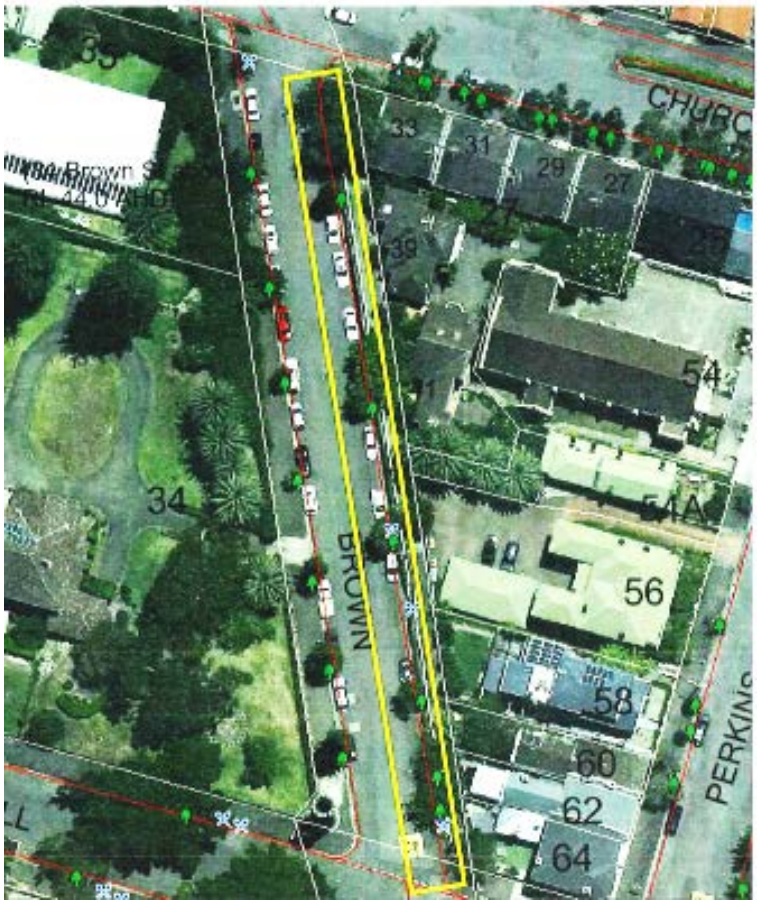


Figure 1 - Example of aerial photograph showing area of works

5.1.3 Arborist inspection and review of options

A Council arborist will inspect the tree(s) identified by the project designer in accordance with the public infrastructure works test and provide advice regarding the impact to tree(s) (**Appendix 9**). The designer will assess the feasibility of design options to retain tree(s) based on the arborist advice.

However, the review of feasible design options under the infrastructure works test is not required where:

- the trees within the works are confirmed in writing to be in poor condition by a Council arborist, and this is recorded in Council's tree asset management system, or where
- full road reserve reconstruction works are to occur (works that incorporate both road and footways), and a Council arborist has inspected all trees where the TPZ radius is encroached by the works and confirmed in writing they will be compromised.

Note 1: Whilst the infrastructure works test is not required for full road reserve construction works, Council may elect to undertake the full test in some circumstances.

5.1.4 Explore alternative design options

The following is a list of possible alternative design options that may be considered by the designer during the application of the public infrastructure works test:

- moving kerb and gutter alignment into the parking lane
- move footpath alignment, or location
- ramp or bridge over tree roots, or use elevated walkways
- install footpath without excavation and reduced batter
- move above or below ground infrastructure (eg. powerlines, watermains) away from trees
- avoid level changes, eg. maintain road height
- install small sections of kerb and gutter by hand past trees.

This list is not exhaustive and there may be other suitable design options. Additional information is available in **Appendix 3**.

5.2 Design for new trees

Assessment of the site early in the design phase provides an opportunity to ensure trees are appropriately incorporated into the proposed works. Tree roots can interact with surrounding infrastructure and avoidance of conflict is the most practical solution to limit tree root damage to other assets or structures. This results in an appropriate tree asset and adds a range of urban forest benefits

When designing for new trees the following should be considered:

1. Determine required soil volume and clearances from infrastructure (see section 5.2.1).

2. Consider alternative designs for creating additional space (see section 5.2.2).

3. Incorporate aeration and drainage into planting design (see section 5.2.3).

5.2.1 Space required below ground and clearances from infrastructure

5.2.1.1 Calculating mature tree soil volume

Trees require an adequate root system for tree stability, to maintain biological function and healthy growth. The amount of suitable soil that a tree has available will determine the amount of root system that the tree can develop and the amount of soil water and nutrients available to the tree. Tree roots are generally limited to the top 60cm of soil, with the majority located in the top 30cm, and form a broad root plate which can extend well beyond the canopy. In some cases tree roots may grow deeper in the soil, subject to oxygen levels, and are known as sinker roots. The overall stability of a tree is achieved through a combination of the shallow root plate and the sinker roots. See Council case book study on tree failure at the link below for further information and **Figure 2**.

Tree Failure Casebook History - Informing Tree Management in Newcastle - 2000-2011

Figure 2 - Tree root development

The generalized & unimpeded root system is broad and shallow (often only 200-300mm deep) with load bearing (structural) roots extending radially 2-4m with descending (sinker) roots below the trunk. Non-structural fine 'feeder' roots are wide-spreading often beyond the edge of canopy (drip line)

Graphic source - The Morton Arboretum

Soil volume required for root growth in soils is calculated as per the Cornell University formula which is widely accepted. The Cornell University formula requires the crown projection to be calculated first. Crown projection is the mature canopy spread for that particular species. Crown projection is to be calculated by a suitably qualified arborist.

- Crown projection (CP)(m2) = π x r2 π = 3.142 r = average radius(m)
- Soil volume is then calculated by
- Soil volume (SV)(m3) = CP x 0.6

Example: A mature Tuckeroo with an average radius of 4m.

CP = π x 4^2
CP = $50m^2$
SV = $50m^2$ x 0.6
SV= $30m^3$

Note: The soil volume calculation does not include the percentage consumed by the inorganic fraction where gap graded soils (eg. structural soils) are used. Therefore, the total volume of a gap graded soil with high proportion of rock particles will be greater than for other options.

Once the soil volume has been calculated the area required to achieve this volume is to be determined based on a maximum soil depth of 60cm. Depth of soil below this may allow for some sinker roots but lower oxygen levels generally restrict fine root growth.

Using the example above the mature Tuckeroo requires a soil volume of $30m^3$. At 60cm deep the surface area required can be calculated as follows:

- Surface area (SA) (m2) = Soil Volume/depth (m)
- SA = 30/0.6
- SA = $50m^2$

This cannot effectively be achieved in most street tree planting locations. Therefore, it is important to provide as much soil as possible in a given situation. Break out zones are generally ineffective as these often lead to interaction between tree roots and infrastructure. When designing new areas or full road rehabilitation, wider footways with an area clear of footpaths and utilities provide the best opportunity for increased soil volume. This results in faster establishment of canopy, healthy trees and reduced interaction with infrastructure.

The allocation of the required square metre area into width and length is to account for the development of the trees future radial structural root zone. Therefore, narrow planting beds are not suitable. See Council's online calculator or AS4970-2009 to determine the radius of the structural root zone. www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

5.2.1.2 Clearances from infrastructure to new planting(s)

Site planning and design should ensure appropriate offsets between trees, utilities and structures to avoid compromising the longevity and health of the tree. Consideration should be given to the location of trees in relation to underground or overhead services.

In accordance with the Street Tree Selection Manual, species should be selected and located to provide the clearances indicated in **Table 2**.

Table 2 - Clearances from infrastructure to new tree planting

Site Constraint	Nominal Clearance
Street intersection	10m from intersection of kerb line
Driveway	Minimum 3m from edge of driveway, subject to size of tree at maturity
Power or light pole	5m from centre of pole.
Overhead electrical service to individual properties.	2m clearance either side of the overhead service wires
Main Powerlines HV LV and ABC	See Council's Street Tree Selection Manual
Storm water inlet	Minimum 2m from edge of a pit lintel, subject to size of tree at maturity

Site Constraint	Nominal Clearance
Major underground service junction	3m from edge of junction box
Bus stops	18m on the approach and 3m on the departure
Traffic lights	10m from pole of traffic lights
Kerb and gutter	0.6m minimum from back of kerb (see note 2)
Footpath	0.4m minimum from footpath (see note 2)
House services Gas Water	Minimum 2m service to house

Note1: Refer to **Appendix 3** - Best Practice Guidelines

Note 2: The distance between the back of kerb and footpath is to be a 60/40 split for tree planting. That is: the tree is located at 60% of the distance from the kerb and 40% of the distance from the footpath. This is to provide greater protection to the kerb and gutter.

5.2.2 Consider alternative designs for creating additional space

There are a range of possible options for designing space for trees. The above ground design needs to consider the mature size of the tree in relation to the surrounding surface and proximity of buildings. The required soil volume below ground can be difficult to achieve given the competition for space with various structures, utilities and hardstand areas required as part of the urban environment.

The following list provides a number of options that can be used to incorporate new trees in the design of the works, and is to be used once the required space has been calculated (refer to Section 5.2.1.1). The following list of options is to be considered:

- excavate large planting pits or continuous trenches where space permits (Section 5.2.2.1)
- use improved planting soil below porous pavement (Section 5.2.2.2)
- provide blisters for planting bed in parking lane
- design wider verges or medians in new development sites (Section 5.2.2.3)
- create wider verges during full road rehabilitation, or bring kerb lines out during partial rehabilitation works (Section 5.2.2.3)
- installation of structural cells or load bearing soils (Section 5.2.2.4)
- use of suspended slab pavements (Section 5.2.2.4)
- installation of root barriers (Section 5.2.2.5)

5.2.2.1 Large planting pits or continuous trenches

Large pits or continuous trenches provide the greatest opportunity for trees to quickly establish. This is due to the volume of feeder roots and associated mycorrhizal fungi that can be established, which significantly increase soil and nutrient uptake.

Trenches or pits should be a minimum 3m wide and to a depth of 600mm, with the existing soil either improved or replaced with suitable planting soil. The trench or pit is to be free draining or drainage must be installed (see Standard Drawings series 3000 www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings). While the tree may look small for the size of the planting pit or trench when installed, it will quickly develop into a larger canopy within a few years.

5.2.2.2 Improved planting soil below porous pavement

A suitable soil specification and installation method for use under porous paving can be found at **Appendix 2a and 2b.** This soil consists of a rapidly draining bedding layer for the paving, which sits over a horticultural soil.

The soil specification can also be used for general planting and can be installed under footpath or cycleway pavement to increase the area for root growth. This approach can extend the life of both the tree and built assets. The added use of flexible joint products (such as Trip stop) further decreases the likelihood of interaction between trees and infrastructure.

This specification and installation method is a cost effective way of providing underground space, improved water infiltration and gaseous exchange.

5.2.2.3 Design wider verges or medians

When practicable verges should be widened or medians installed to increase space for trees. This may be achieved by moving kerb lines into the parking lane, either for a length of road or in isolated sections. The best opportunity to incorporate wider footways or install medians is where full road rehabilitation is being undertaken, or in new subdivision design.

Utilities and footpaths should be located as far from trees as possible to minimise future interaction.

5.2.2.4 Installation of structural cells or load bearing soils

Load bearing soil systems allow for horticultural grade root space beneath a load bearing surface. The technologies include suspended slab pavement, structural cells and gap graded soils.

Suspended pavement designs involve the use of piers, eg. concrete pillars or other precast concrete supports, which bridge horticultural grade soil.

Structural cells or gap graded soils are placed beneath hard surfaces to improve the volume of soil available for root development. Each planting location is different and the soil volume required varies depending on site conditions and the mature size of the tree species planted.

It is recommended that structural cells are installed as per the manufacturer's specifications.

The soil to be used is to meet Council's specification as per Standard Drawings series 3000 www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings. The soil is to be tested by a NATA accredited soil laboratory and changes made to suit the specification and chosen species.

Gap graded soil (Structural Soil ®) should not be used within the structural root zone of the chosen species, often called the zone of rapid taper. This is to ensure the tree has the opportunity to develop larger structural roots. Where gap-graded soil is to be used the soil shall be equivalent to the specification for Benedict Sand and Gravel, SmartMix™3 40mm Structural Soil Mix Product Data Sheet. If sourced from an alternative supplier a sample of the filler soil and additives shall be tested for compliance by a NATA accredited laboratory and results submitted to Council for approval prior to installation. Install 20mm GMB20 base to a minimum depth of 150mm over the finished surface of the gap-graded soil in accordance with the specification provided.

Note: Refer to **Appendix 4** for Material Specification for Gap-graded Soil and GMB20 Base

5.2.2.5 Root barriers and deflectors

The installation of root barriers at the time of planting may assist tree roots to grow away from services, pavements and other structures. Root barriers should not be installed in such a manner as to restrict essential development of stabilising roots and fine roots required to sustain tree growth.

Tree root barriers are only suitable for use in certain situations and may fail because:

- they were not installed correctly including: poor jointing, inadequate depth or length for the circumstance, or
- the tree roots have bypassed the barrier either by going over, under, around or through the joints. This can be limited by ensuring only qualified persons using proven methods for installation of root barriers, and by embedding the top of the root barrier in concrete where ever possible.

Note 1: Tree root barriers/deflectors require periodic monitoring as roots deflected downwards may return to the surface if soil oxygen levels are not sufficient to support growth at depth.

Note 2: Root barriers should not be used to restrict roots so that the tree is prevented from developing a mechanically and biologically efficient root system to achieve maturity.

5.2.3 Additional requirements for design of new trees

The addition of aeration tubes and drainage can significantly improve the success of tree planting. The following information is to be considered within any design that is to incorporate new plantings. See also Council's Standard Drawings 3000 series www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings.

5.2.3.1 Drainage

Check drainage through infiltration rate testing prior to selection of tree species. This can be provided for by either:

- geotechnical advice obtained by sampling at the planting holes, or
- conduct falling head infiltration testing.

5.2.3.2 Subsoil/subsurface drainage

One or more of these options may be considered to ensure planting holes are free draining:

- Ag-pipe: install slotted, flexible 100mm PVC pipe and fittings minimum to AS 2439.1. (Perforated plastics drainage and effluent pipe and fittings). Install 5-7mm drainage gravel filter material around Ag-pipe.
- Line flushing points: provide flushing inlets and approved surface covers to permit flushing of subsoil drainage lines.
- Auger drain holes: install a minimum of six drain holes to the bottom perimeter of the planting pit. Drain holes are to be 10cm in diameter, 60cm deep and filled with sand or fine gravel.
- Additional options as per Council's standard drawings 3000 series are: connect to stormwater system, or extend trench to allow additional infiltration.

5.2.3.3 Aeration tubes

Aeration tubes may be installed when trees are being planted to maximise gaseous exchange at depth for root growth.

Install slotted agricultural pipe within the planting hole ensuring that it has access to the atmosphere at both ends.

Note that:

- The pipe is to be set at the base of the root ball.
- The pipe inlets are to be flush or slightly proud (25mm maximum) of the final surface levels.
- The pipe ends should be wrapped with filter fabric to stop rubbish entering the pipe.
- Use a heavy duty slotted cap in busy public or vandalism prone areas. The pipe cap is to be visible from ground level and the slots are to occupy 50% of the caps surface area.
- This pipe is for aeration only.

6.0 Tree species selection and supply

6.1 Tree species selection

All tree species selections for planting on Council managed land are to be undertaken using the process defined in Council's Street Tree Selection Manual 2016.

The use of a species at any given location is subject to the plants individual requirements and site conditions. Procuring the specific species can be difficult either due to poor tree stock quality, or the plant no longer being available commercially. The critical factor is that the chosen tree species is suitable for the space and capable of growing into a mature healthy tree in the site conditions.

It is important that species considered an undesirable species or an environmental pest must not be used. The undesirable tree species list is not a list of trees that have to be removed from current locations. However, they are a list of species that will not be planted in the foreseeable future.

Note: Refer to section 7, **Table 3** Undesirable replacement tree species in the Newcastle LGA

6.2 Supply of trees

6.2.1 National specification for supply of trees (NATSPEC)

Obtaining quality trees is important to achieving consistent city wide tree plantings, superior tree growth and managing future risk.

NATSPEC Construction Information Guide: *Specifying Trees – A guide to assessment of tree quality* (2nd Edition by Ross Clark, 2003) provides industry recognised standards and specifications for tree supply.

Council will only accept NATSPEC certified trees for planting:

- as a street tree within the road reserve or other public land
- for Category 2 and 3 developments, (refer to Development Control Plan 2012, Section 7.02.01).

6.2.2 Ordering and delivery of stock

The following steps should ensure that quality trees are available at the time of planting:

1. Prior to ordering and on delivery to site a suitably qualified person is to inspect a representative sample of each batch of trees to comply with NATSPEC (**Appendix 8** provides further detail on how to assess tree stock in accordance with NATSPEC).

   This must include:

   - above-ground assessment
   - below-ground assessment
   - complete a tree balance assessment
   - root growth characteristics assessment
   - written evidence provided to Council demonstrating the tree stock meets the NATSPEC requirements.

2. Prior to delivery of tree stock the nursery is to mark orientation of north on the side of the pot as grown. Trees to be orientated in the same direction at planting.

3. At the time of delivery ensure safe loading and handling procedures and transport in a covered vehicle to avoid damage and stress to stock. Trees are to be slung by the root ball and not by the trunks.

7.0 Tree planting

Successful tree planting depends on the ability of the tree to rapidly initiate root growth and to uptake water. Planting can be undertaken at various times, but is best undertaken in autumn (March to April) when lower air temperatures greatly reduce the stress on the newly planted trees, and soil temperatures are highest to encourage root activity. Summer planting is not recommended due to high temperatures with potential extremes and increased resource requirements, eg. additional watering.

It is important to note that, the root ball of a new tree can only hold enough water for one day until the root system establishes in the surrounding soil.

The success and long-term objectives of any planting is achieved by:

- completing a full assessment of the site (refer to Council's Street Tree Selection Manual 2016), and
- selecting species appropriate to the site and suitable to the space (refer to Council's Street Tree Selection Manual 2016), and
- application of best practice site preparation, stock handling, and
- planting in accordance with best practice, and
- ensuring adequate establishment maintenance for the circumstance.

All planting on public land undertaken as part of subdivision or commercial development, is to be undertaken by a Landscape Contractors Association (LCA), or an Australian Institute of Landscape Designers and Managers (ALIDM) affiliated contractor or Arborist (minimum level AQF3), with demonstrated experience in the installation of soils, tree handling, planting and establishment of advanced trees.

7.1 Full assessment of the site

A full assessment of the site is to be undertaken in accordance with Council's Street Tree Selection Manual 2016 process. In addition, the following information is provided to assist with site assessment.

7.1.1 Soils

The properties of the growing media directly influence the growth of trees. Physical attributes of the soil affect the availability of water and the levels of oxygen in the soil while chemical attributes influence nutrient availability. Typically urban soils have been highly disturbed and/or compacted and require remediation. Soil testing will determine the type and extent of remediation required.

Trees should be planted into existing soils wherever possible. Improved soil meeting Council's specification should be used in situations where the existing site soil is deemed unsuitable for the intended use and cannot be appropriately remediated.

7.1.1.1 Soil testing - annual planting program

Soil testing for the annual planting program is to incorporate samples taken from one or more of the tree planting vacancies. The onsite testing is to include a soil texture test and pH of both the top soil and subgrade soil to a depth of 600mm. The depth of the top soil (A Horizon) and subgrade soil (B Horizon) is to be recorded.

The drainage capacity of the soil is to be determined by assessing the texture of the A Horizon and B Horizon and comparing the results to the texture triangle. The outcome is to be used to complete the drainage component of the Street Tree Selection Manual Planting Site Inspection Form.

The *Planting Site Inspection Form* categorises soil drainage into good, fair and poor. The soil types within the texture triangle (**Figure 3**) are grouped into the following as generally meeting the drainage type:

- Good Drainage - Sand, sandy loam, loamy sand
- Fair Drainage - Loam, sandy clay loam, sandy clay
- Poor Drainage - Clay, silty clay, silty clay loam, silt, silt loam, clay loam

Note: See **Appendix 10**: Measuring Soil Texture in the Field

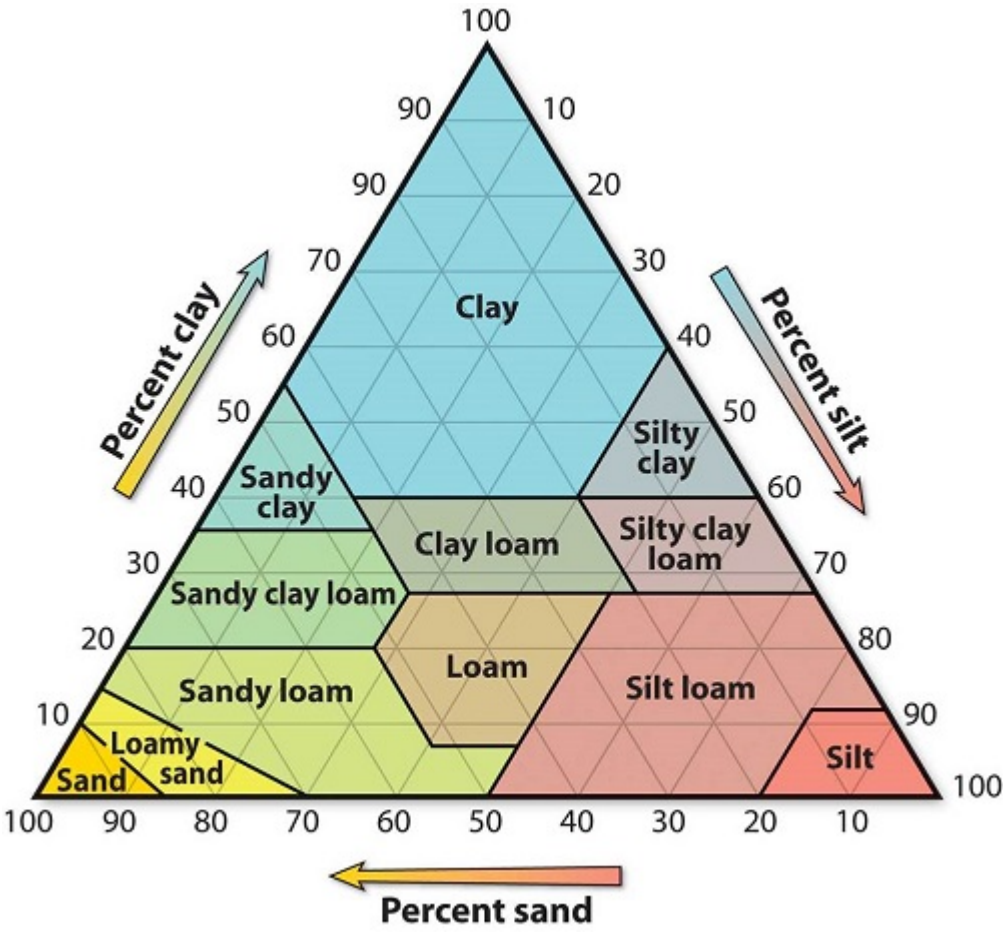


Figure 3 - Texture triangle (Source Picphotos.net)

7.1.1.2 Soil testing - Council works, subdivisions and commercial developments

During design and planning for Council works, private subdivision or commercial developments where tree planting is to be undertaken, the following soil testing is required:

1. Geotechnical assessment (including infiltration rates) of the proposed planting holes is to be conducted at the same time as other geotechnical works.

2. Full physical and chemical tests are to be undertaken by a National Association of Testing Authorities (NATA) laboratory.

3. The above information is to be provided on a plan and in documentation that incorporates soil remediation measures, or replacement, where required.

7.2 Selection of species appropriate to the site and suitable to the space

The selection of species for planting on public land is to be undertaken in accordance with the Newcastle Street Tree Selection Manual 2016.

From an urban forestry perspective, all woody species have inherent value, even those species that have some negative characteristics. For example, although Camphor Laurel is listed as ‘undesirable’ as a replacement species, the mature trees still provide essential shade, stormwater capture, and filter air pollution.

The urban forestry approach seeks to strategically manage 'undesirable' trees by discouraging the further planting of these species rather than wholesale removal. Species deemed as undesirable for use as replacement plantings are listed in **Table 3**. These species are described as 'undesirable' due to one or more of the following:

- excessive or unmanageable seed dispersal
- poisonous leaves, fruit or flowers
- excessive or unmanageable root suckering
- garden escape
- readily self-propagating from pruning and other materials from gardens
- non-local native species that is becoming an environmental weed as determined by Council
- known irritant species in certain high use areas as determined by Council.

Table 3 - Undesirable replacement tree species in the Newcastle LGA

Scientific Name	Common Name	Notes/Exceptions	Principal Reason
Acacia baileyana	Cootamundra Wattle		Native species but may become an environmental weed outside its natural habitat range
Acacia salignus	Golden Wattle		Native species but may become an environmental weed outside its natural habitat range
Ailanthus altissima	Tree of Heaven		Invasive (seed)
Albizia lophantha	Cape Wattle		Invasive (seed)
Chamaecytisus palmensis	Tree Lucerne		Invasive (seed)
Chrysanthe moides spmonolifer	Bitou Bush		Invasive (seed)
Cinnamomum camphora	Camphor Laurel	Except where the tree height exceeds 10m or the trunk diameter at 1.4m above ground level exceeds 450mm	Invasive (seed)
Cotoneaster spp.	Cotoneaster	All species	Invasive (seed)
Erythrina x-sykesii	Coral Tree		Brittle structure and Invasive due to vegetative reproduction
Ficus elastica	Rubber Tree		Invasive roots
Gleditsia triacanthos	Honey Locust	Not grafted horticultural cultivars	Root suckering
Ligustrum spp.	Privet	All species	Invasive (seed)
Nerium oleander	Oleander		Toxicity
Pyracantha spp.	Firethorn	All species	Invasive (seed)
Robinia pseudoacacia	Black Locust	Not grafted horticultural cultivars	Root suckering

Scientific Name	Common Name	Notes/Exceptions	Principal Reason
Salix spp.	Willow	All species	Invasive due to vegetative reproduction and root suckering
Schefflera actinophylla	Umbrella Tree		Invasive (seed)
Schinus terebinthifolius	Brazilian Mastic		Invasive (seed)
Syagrus romanzoffianum	Cocos Palm		Invasive (seed)

7.3 Best practice site preparation and stock handling

7.3.1 Site preparation

Site preparation should be undertaken in accordance with the following sections and Council's standard drawings 3000 series.

7.3.1.1 Types of imported soil media

Imported soil media used for tree planting should be suitable for the species of tree to be planted. The soil should have sufficient water holding capacity and adequate coarse component to ensure root growth. The soil specification provided in **Appendix 2a** provides further information.

7.3.1.2 Soil samples

Samples of imported planting soil are to be tested prior to delivery for all sites in accordance with the specification in **Appendix 2a**. The supplier is to undertake all necessary remediation measures recommended from the soil laboratory results.

For subdivision works a sample of proposed soil mix, including full soil analysis details, is to be retained and provided immediately on request to Council or an Accredited Certifier, for approval prior to installation.

Soil delivered to site is to be covered where there is a risk of weed contamination.

7.3.1.3 Street and park tree planting preparation

The key steps in site preparation are:

- Site investigations in accordance with Council's Street Tree Selection Manual 2016.
- Creation of the largest planting pit possible for the site. This may include under pavement zones for root growth.
- Removal of surface material, which may be hard stand, grass, other vegetation such as weeds or compacted/contaminated soil. Only spraying grass can lead to increased maintenance and risk of tree health/death when trying to manage grass.
- Replacement or remediation of poorer soils (refer to **Appendix 2a**).
- Installation of sub soil drainage to improve growing conditions
- Watering of the soil as it is installed to remove voids and improve establishment rates.

- Application of mulch at the time of planting by hand or mulch blower.
- Installation of tree protection measures.

7.3.1.4 Broad acre planting preparation

Planting should occur within an entire bed rather than augured holes.

The key steps to achieving success of broad acre plantings are:

- site investigations
- weed grass treatment and removal
- soil ripping both A and B horizon
- rotary hoeing (or similar) of the A horizon
- improve drainage where required
- application of mulch at the time of planting by hand or mulch blower.

Note: The use of any machinery on the prepared planting area to spread mulch generally results in compaction of the soil.

7.3.2 Stock handling

Trees can easily be damaged during transportation and installation which can affect tree health, structure and long term viability. Damage to tree trunks can effectively ring bark the trees and crushing of root balls can reduce stability and limit root growth. The following is to be applied when transporting or installing trees:

- Thoroughly water the root ball of the container stock at least twelve (12) hours prior to planting.
- Ensure the root ball is moist when it arrives at site and maintain root ball moisture by using a moisture probe if planting is delayed. Do not over water.
- Trees must be slung and lifted by the root ball only. In some cases a support sling is required to assist with guiding the tree but should take no weight.
- Plan and prepare where the tree will be planted to avoid further lifting. Holes should be correct depth and base material levelled. Never use weight of any kind to push trees down into the holes, including buckets of machines or stamping with boots.
- The root balls of trees must never be dragged or pulled by any means, including machinery or ropes to vehicles.

Note: The bark layer is live tissue that is critical to the trees survival as this layer transports soil water and photosynthates. This tissue is extremely vulnerable in young trees and must be protected.

7.4 Planting

7.4.1 Moving stock

Move trees to the dedicated planting hole by lifting or slinging under the root ball. Do not lift by the trunk or place slings around the trunk . In some cases, a support sling is required to assist with guiding the tree, but should take no weight. Smaller stock should be carried by the pot and not the trunk.

7.4.2 Tree planting

To avoid multiple lifts of the tree and potential damage ensure tree planting holes are of suitable depth and width for the size of root ball that is to be planted. The top of the root ball must finish at the predetermined height, eg). root ball to finish level with surrounding soil or just below to allow for mulch.

When the trees arrive on site:

- measure the root ball depth and width and adjust hole accordingly, and
- ensure base of the planting hole is level and at the correct height before tree is lowered into the hole.

7.4.3 Soil additives at planting

A soil conditioner such as Terracottem ® or approved equivalent is to be used in all tree planting. The additive is to be applied in accordance with manufacturer's recommendations.

7.4.4 Consolidating backfill

The consolidation of backfill is to occur to ensure soil doesn't sink post planting. This assists with stabilising the tree and helps prevent any paved surface from deforming. The following process is to be used:

1. water in the soil as the planting hole is being backfilled to remove air pockets

2. ensure backfill is not placed over the top of root ball.

7.4.5 Soil watering berm

A berm of soil is to be built around the edge of the root ball to hold water. The berm is to be covered with mulch, but must not be made of mulch. The following steps are to be used:

1. Form a soil berm 60-80mm high at the outermost edge of the root ball.

2. Ensure edge of berm overlaps the outer edge of the root ball.

3. Apply mulch to the specified depth across the planting area and over the berm.

4. Gently fill inside of soil berm area with water at completion of each tree planting.

5. The soil berm is to be maintained intact for the duration of the tree establishment period.

7.4.6 Watering

Newly installed trees, including drought tolerant species, are dependent upon watering or irrigation until established, typically for two years. The use of irrigation systems can be problematic due to unreliable performance and can result in shallow root systems. Trees require watering to below the root ball depth to establish and sustain the root system and manual watering is to be undertaken.

The root ball of a new tree can only hold enough water for one day in summer and regular watering is critical to the establishment and survival of the tree. Conversely, in winter the root ball may hold sufficient water for up to six days. Therefore, it is vital that the frequency and amount of water is determined by the time of year that planting occurs, and is subject to soil moisture tests using a soil moisture probe prior to and during watering of both the root ball and surrounding soil.

The best mechanism to achieve this is a water budget based on individual site conditions and species requirements. The water budget is to be provided as part of the planting documentation.

Watering of the new tree is to be focused on the root ball through the early establishment period. However, additional watering of the surrounding planting bed soil can slow the loss of water from the root ball. A proven method for rapid establishment and growth of new trees is contained within **Table 4** and **Figure 4**. While this may not be possible in large scale plantings it provides a guideline against which water budgets can be established.

Table 4 - Watering frequency by season

Season	***Frequency from planting***	***Amount***
Late Spring to early Autumn (includes Summer)	Daily first six weeks, Every second day for 3 weeks Every third day for 3 weeks Weekly or as required.	To field capacity
Mid to late Autumn	Every second day for 3 weeks Every third day for 3 weeks Weekly or as required	To field capacity
Winter	Every third day for 3 weeks Weekly or as required	To field capacity
Early Spring	Every second day for 3 weeks Every third day for 3 weeks Weekly or as required	To field capacity

Figure 4 - Example of two Magnolias planted at same time (2005) with different planting and maintenance approaches. Tree on left was watered using Table 4, the tree on the right was not (photo 2015).

7.4.7 Mulching

Trees are to be provided with a mulched bed at the base of the tree to prevent damage from mowing, pedestrian or vehicle movement.

The addition of **inorganic** mulch (eg. rock or gravel or recycled hardwood) benefits tree health by conserving soil moisture and reducing weed growth.

The use of **organic** coarse mulch derived from live composted material benefits tree health by conserving soil moisture, reducing weed growth, increasing soil organism activity, providing soil organic matter and plant growth nutrients.

The mulch should be retained at 75mm depth and should never exceed 100mm in depth. Mulch placed at greater than 100mm depth, or containing a high proportion of fine material will limit gaseous exchange between the soil and the atmosphere reducing soil organism activity and suppressing root development. In addition, it will reduce water infiltration which further inhibits plant growth.

The supply of organic mulch should be in accordance with Council's specification and *AS 4454 – 2003 Compost, soil conditioners and mulches*.

The area covered with mulch is to be:

- the area cultivated for planting, or
- the extent of the dripline as the tree grows. This may not be possible in all plantings eg. street plantings due to footpaths, etc.

Correct installation of mulch will:

- result in mulch tapering down to zero at the base of new trees next to the trunk, or
- result in a mulch free gap of not less than 100mm and preferably 200mm clear from the trunk of maturing or mature trees, and
- ensure that buttress or other large surface roots are not covered.

Refer to **Figure 5** for correct mulching method diagram.

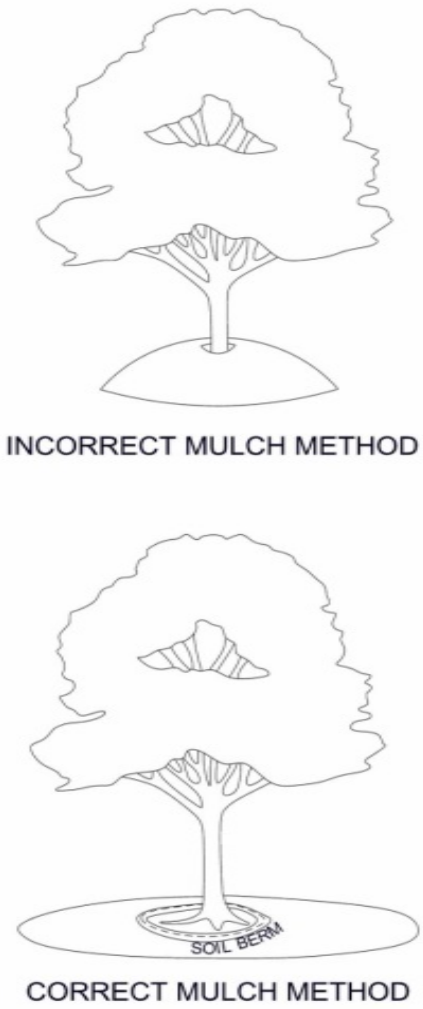


Figure 5: Mulch diagram

7.4.8 Tree staking

Trees that conform to NATSPEC quality should not normally require staking. Some circumstances, eg. areas of high wind exposure, may require staking for protection during tree establishment. The staking is to be loose so as to not restrict trees, but must not damage fragile tree trunks by rubbing.

7.4.9 Edging

Use edging to separate mulch areas from turf areas. Edging will aid in reducing turf growth into mulch areas and minimise maintenance. Edging should be installed below ground and higher than surrounding grass. However, install flush with the surrounding surface in pedestrian areas, where applicable, to avoid a trip hazard.

7.4.10 Tree guards and grates

Tree guard selection and installation is to be in accordance with Council's Standard Drawings www.newcastle.nsw.gov.au/Development/Land-Use-Planning/Standard-Drawings

The planting of trees along coastal areas can expose them to strong salt laden winds, which can damage foliage resulting in tree decline and death. The best mechanism to manage trees in these areas is a combination of species selection, frequent watering and tree guards that protect the entire tree and deflect wind. The V shaped guard is the most effective, with the leading post located in the direction of the prevailing wind direction. Along the Newcastle coast the leading post would generally be located in an easterly direction as the onshore wind tends to vary between northeast through to southeast. These guards need to be large enough to protect the entire tree. The use of antitranspirants at planting and in the first growing season can also assist. However, care should be taken as these reduce transpiration slowing the establishment of the tree.

7.5 Establishment maintenance

The establishment maintenance period is essential to ensure the tree develops a healthy and mature canopy. Where works are undertaken for commercial or subdivision development, a bond or bank guarantee may potentially be required by Council to ensure quality tree establishment is completed. The following sections detail the requirements during the establishment maintenance period for all plantings.

7.5.1 Inspections

Inspections of all new tree plantings are to be scheduled to ensure that weeding, watering and mulch requirements are met in a timely manner. The schedule is to be prepared in advance and is to cover the 104 weeks intensive establishment maintenance period. The schedule needs to be flexible enough to allow for increased inspections during periods of low rainfall, or times of greatest grass and weed growth (eg. spring).

7.5.2 Practical completion report

A Practical Completion Report is required to be submitted to Council for all tree planting undertaken in subdivisions, commercial developments or where contractors plant on Council's behalf. The following information is to be kept to support the practical completion report:

7.5.2.1 Log book record

The contractor or Council planting team is to keep a log book of all works. The log book must include the time and date of visit, name of the person in charge of the site, the duration of site visit and works carried out. The following is to be recorded:

- watering events including dates and amount
- non chemical weeding events and method used
- rubbish removal dates, amount and type
- fertiliser application dates, product specification and rate
- treatment of trees for insect pests and disease, include method, rate and date
- tree replacement date, species, root ball size, reason for replacement including failed, damaged or stolen trees
- reinstatement of mulch to required depths dates, mulch used, and volume
- formative pruning include dates and works undertaken. Pruning in accordance with AS 4373 - 2007 Pruning of amenity trees (conducted at 102 weeks).

7.5.3 Establishment and maintenance works

7.5.3.1 Watering

Regular watering should occur during the establishment period in accordance with the predefined water budget (Refer to Section 7.4.6)

7.5.3.2 Mulch replenishment

Ensure mulch is replenished as required to maintain cover and depth specified at time of planting (Refer to Section 7.4.7).

7.5.3.3 Fertilising

Fertilising trees should not be necessary if appropriate soil conditions are provided or if the trees are in a load bearing structure. Fertilising may be required for trees that have been affected by disturbance, where a soil nutrient deficiency is affecting the performance of a tree, or where pest or disease is present. The tree should not be fertilised while stressed with application occurring once the stressor has been managed.

Benefits gained from the increase in stored resources may aid the tree to overcome any stress caused by future disturbances. Nutrient requirements should be based on a soil test undertaken by a registered soil laboratory.

7.5.3.4 Weed management

The use of chemicals to control weeds can be detrimental to trees, with many large tree species highly susceptible to even small amounts of chemical. Laboratory testing has shown that weed chemicals stay active when absorbed by mulch. It is vital to tree health to minimise the use of weed chemicals within the root zone or on mulch beds wherever possible.

During establishment maintenance ensure the tree planting pit and adjacent mulch areas are free of weeds for the entire period. Weed management should be undertaken by hand with inspection frequency to be increased where required to minimise weed establishment.

Where chemicals are used to manage weeds in large continuous mulch beds, or where the weeds have established, then the application must occur using only hand wands with hoods over the nozzle. The spray must not fan beyond the footprint of the weed. Broad spraying is not permitted.

7.5.3.5 Pest and disease management

Generally, insect populations can threaten tree health to the point of mortality. Notify Council of any pests and diseases found. Treatment of pests is generally undertaken by a licensed pest control operator.

There are a range of maintenance activities that can increase the risk of pest and disease attack in trees including:

- compaction of the soil within the dripline or root zone of the tree
- imported fill that may contain disease or pests
- roto-tilling, trenching or removing soil from the tree root area
- excessive or regular watering on, or near the tree trunk
- planting water loving understory plants within the dripline
- use of contaminated mulch, soil or plant stock.

The likelihood of pest and disease problems can be reduced by:

- using mulch that is free of weed species, harmful or foreign matter in accordance with *AS 4454 - 2012 Compost, soil conditioners and mulches*
- placing mulch well clear of plant stems
- regular watering to maintain field capacity
- use of certified growing media
- using certified plant material. Request certificate from Nursery supplier to certify disease free stock
- avoiding compaction
- avoiding chemical use
- aerating compacted soil.

Note: Refer to Biosecurity for common pests and diseases in the Newcastle LGA and **Appendix 1.**

8.0 Protection measures

The purpose of this section is to ensure that appropriate tree protection measures are documented and implemented to prevent damage to all trees on Council managed land. The Australian Standard *AS4970-2009 Protection of trees on development sites* applies for trees on both private and public land, and contains information required to determine the tree protection zone and prepare a tree protection plan.

The tree protection zone (TPZ) is the distance specified within documentation and construction plans that is to be protected during all phases of any works. The TPZ is calculated as 12 x trunk diameter at breast height (DBH) which is measured at 1.4m above ground level. The trunk diameter (DBH) of multi stemmed trees is calculated using Council's online calculator to achieve a single stem figure: www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

The following information is supplied as a summary of the key elements of AS 4970 - 2009 and is to be read in conjunction with that standard. The information provided below applies to the protection of tree on public land.

8.1 Trees and Development Applications

Australian Standard *AS4970-2009 Protection of trees on development sites* requires the preparation of a tree protection plan. Arborist reports submitted as part of a Development Application are required to include a tree protection plan and tree protection requirements for public trees will be included as part of conditions of consent. This is to ensure that any public tree retained within 5m of the property boundary is adequately protected during the demolition and construction phase of development. A final tree protection plan for public trees is to be submitted to and approved by Council prior to issue of a Construction Certificate.

Inspections are to be undertaken by the Certifying Authority to ensure the tree protection measures are installed and maintained in accordance with the approved tree protection plan. Tree protection measures are to be implemented prior to the commencement of construction and remain in place until construction is complete.

8.2 Preparing a tree protection plan

Tree protection plans are to be prepared by an arborist with minimum qualification level of AQF 4.

Tree protection plans are to be prepared in accordance with *AS 4970-2009* and the information detailed in the following sections. In some circumstances the tree protections zone may require modification, for example trees on road verges. All modifications should be determined prior to construction or, where issues arise on-site, by a suitably qualified arborist who will document the modification and reasons why.

8.3 Tree protection zone fencing

All retained trees will require tree protection fencing to be established prior to any tree removal works, demolition, earthworks, or construction works. The tree protection fencing is to be installed in accordance with the approved tree protection plan.

The site supervisor is responsible for the implementation of tree protection zone fencing. The site supervisor must also ensure the fencing is maintained at the required distance from the tree, and kept secure to exclude access until completion of works and rehabilitation of the site has occurred.

8.3.1 Fencing types

The type of tree protection fencing to be used is to be specified within the tree protection plan, and is to meet the requirements and intent of the *AS 4970–2009*. The fence is to be stable and robust so as to withstand weather events and accidental impact, and is to have signage stating Tree Protection Zone No entry (see **Figures 6 & 7**).

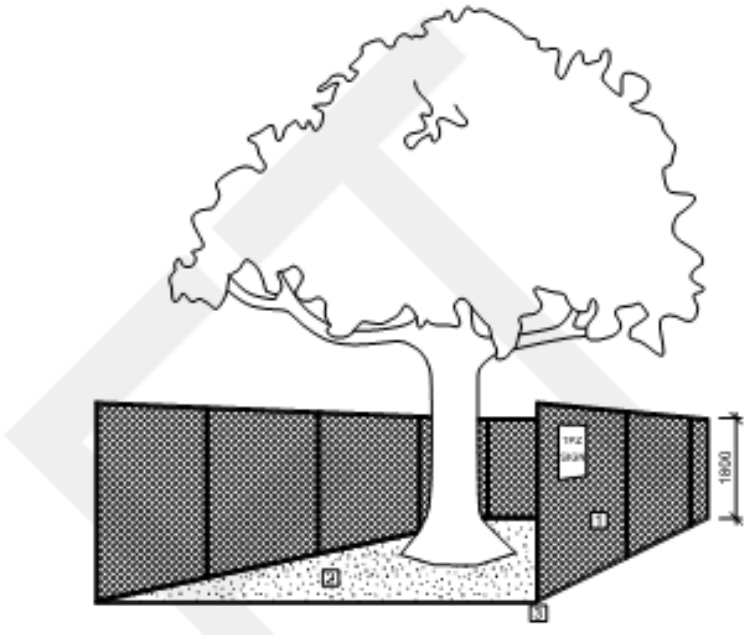


Figure 6 - Generic tree protection fencing

Figure 7 - Tree protection fence sign

8.3.2 Tree protection fencing for public footways

For trees situated within a road verge, only the area between footpath and road shall be enclosed with the required tree protection fencing for a 3m distance each side of the tree to allow access to property. Maintain pedestrian and roadway clearances for safe public use. **Figure 8a** and **8b** indicate typical treatment, however, modifications may be required.

All works adjacent to the roadway require a Traffic Control Plan as per *AS 1742.3 - Traffic control devices for works on roads*.

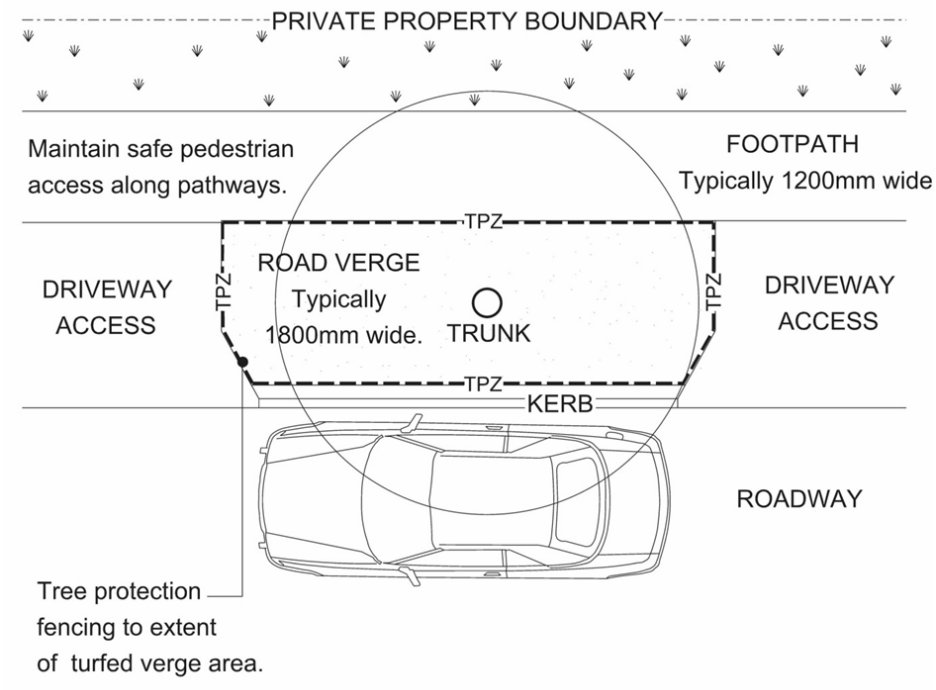


Figure 8a - Indicative tree protection on the road verge

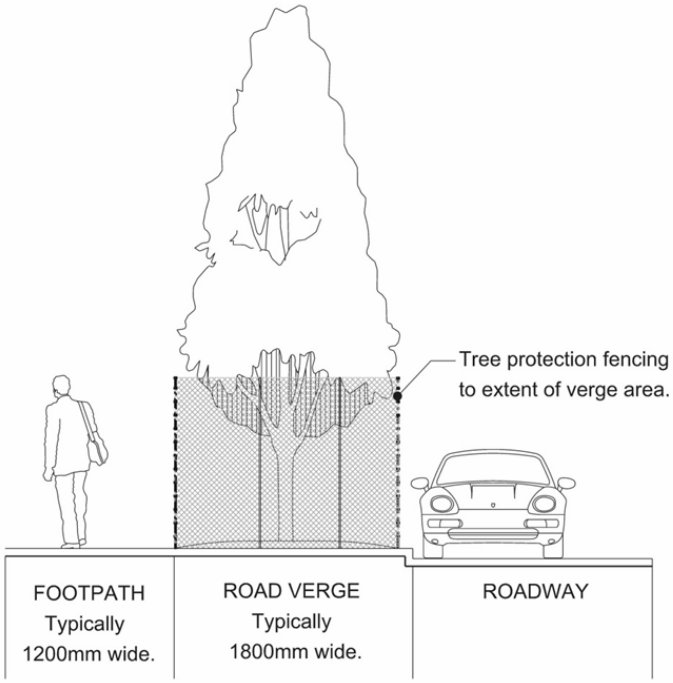


Figure 8b - Indicative tree protection on the road verge

8.3.3 Tree protection in limited space

Where public infrastructure works are required in limited space, then trunk, stem and ground protection are to be implemented in accordance with *AS 4970-2009* (see **Figure 9** below). This may also be required where access is in proximity to tree(s).

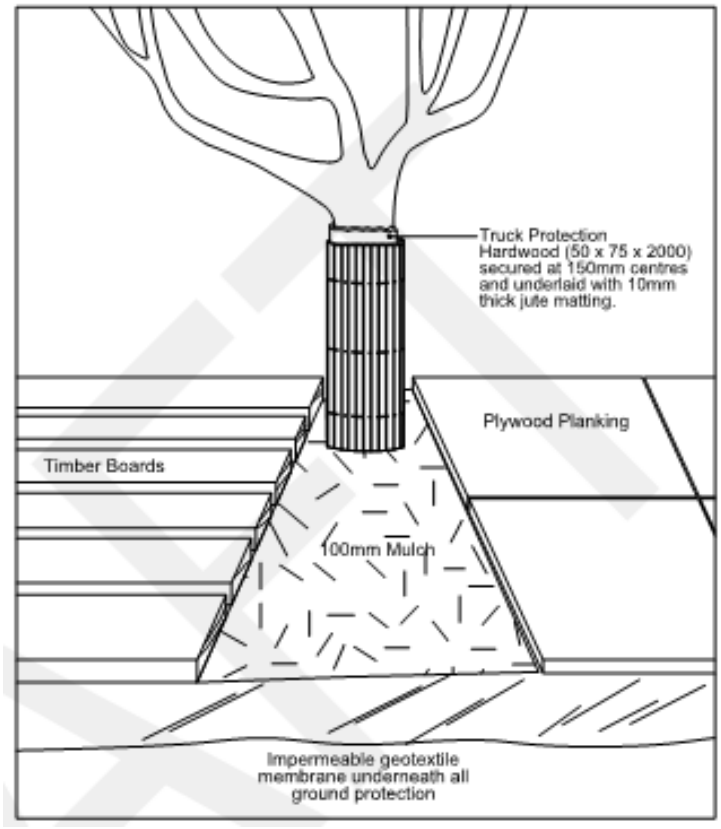


Figure 9 - Trunk and ground protection

8.3.4 Tree protection fencing in parks, reserves and bushland settings

Tree protection fencing is required for works within the specified tree protection zone on Council managed land.

The TPZ is calculated as 12 x trunk diameter at breast height (DBH) which is measured at 1.4m above ground level. The trunk diameter (DBH) of multi stemmed trees is calculated using Council's online calculator to achieve a single stem figure.
www.newcastle.nsw.gov.au/Living/Environment/Trees/Public-Trees/Online-Calculator

The protection fence is to be stable and robust so as to withstand weather events and accidental impact, and is to have a signage stating Tree Protection Zone No entry (see **Figure 6 & 7**).

In some circumstances the density of planting can require access through the tree protection zone of some trees (see **Figure 10**). Where this access is required ground protection is to be provided, which may include 200mm mulch, gravel and/or rumble boards (see **Figure 9**).

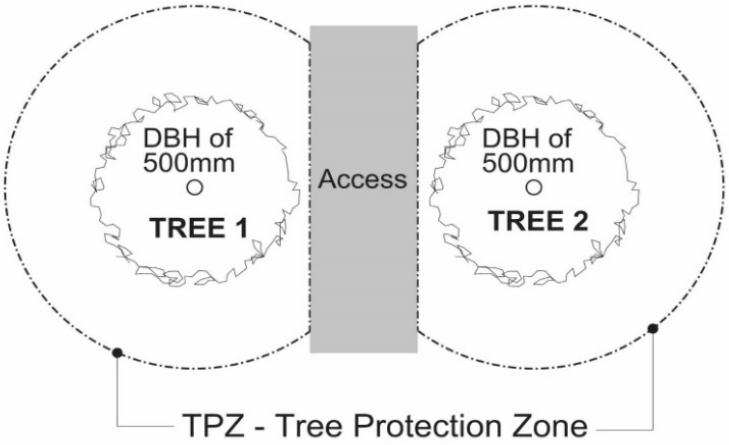


Figure 10 - Access between trees when space is limited

9.0 Public tree maintenance

The maintenance of established trees plays a vital role in ensuring the viability and sustainability of the urban forest. Works undertaken to an individual tree will determine if the tree remains healthy, or increases stress which may lead to decline. The maintenance and health of individual trees will cumulatively result in Council meeting the objectives of the Urban Forest Policy.

All public tree maintenance activities, including pruning and removal, can only be undertaken by Council. The following sections address:

- Tree Inspections
- Tree Maintenance Works (including pruning and removal)
- Infrastructure Maintenance and Public Trees.

Note: The pruning of small shrubs or hedges within Parks, or other facilities, are undertaken in accordance with appropriate horticultural practice.

9.1 Tree inspection

A request for inspection of a public tree(s) can be made via Council's website www.newcastle.nsw.gov.au/Council/Forms-Publications/Forms/Customer-Request-Form or phone (4974 2000). Inspections are undertaken by a Council arborist who will assess the tree(s) and specify appropriate works in accordance with the following:

- Council's City Wide Maintenance Procedure 2017, and
- Relevant Australian Standards (AS4373-2007, AS4970-2009), and
- Urban Forest Technical Manual Part B, Section 4.0, and
- Best Practice guidelines and arboriculture principles.

9.1.1 Outcome of inspections

The outcome of the inspection is recorded in Council's tree management system. Where works are identified these are allocated to an appropriate Council tree crew. A notice of inspection outcome is left in the resident's mail box, or posted to the relevant persons (eg. corporate body representative, property owner).

9.2 Tree maintenance works

All public tree maintenance works are to be undertaken by qualified Council staff and contractors in accordance with relevant Australian Standards and best practice requirements. The following information is provided to direct overall maintenance activities:

- Pruning is to be undertaken in accordance with the specification provided in the work order and the Australian Standard AS4373-2007. Pruning is to be undertaken in a manner that does not pose a risk to workers, the public, or property at any stage of the works. The works must not damage other parts of the tree or adjacent trees.
- Removal of trees is to be undertaken in a manner to ensure there is minimal risk to tree workers, the public, adjacent trees or property at any stage of the works.
- The management activities around trees and any root pruning is to be undertaken in accordance with the specification contained within the works order, and having regard for *AS4970-2009 Protection of Trees on Development Sites*.
- Hygiene protocols are to be implemented wherever there is a risk of the spread of disease or pest (refer to Section 10.0).

9.2.1 Compacted soils

Friable soils around trees are vital for the on-going health of the tree. Compaction of soils occurs by a range of means including foot traffic and vehicle movements. Impacts to tree health occur in the early stages of soil compaction, but generally a high level of compaction has occurred by the time symptoms such as dieback of the canopy are observed.

Soil that is compacted within the dripline of a tree can be ameliorated by:

- mulching (see section 7.4.7)
- restricting access to vehicles.

9.2.2 Mulch

The area of mulch required around a tree increases as the tree matures to ensure its biological and bio-mechanical functions are maintained. Refer to Section 7.4.7 for further detail on mulching requirements around public trees.

9.2.3 Watering

Watering regime should be undertaken in accordance with Section 7.4.6.

9.3 Infrastructure maintenance and public trees

This section applies to Council's infrastructure maintenance activities adjacent to public trees. The offset of many street trees to infrastructure is within the required tree protection zone. Therefore, removal of old infrastructure and installation of new infrastructure immediately adjacent to trees can result in an increased risk of tree failure, or reduced asset life. Outcomes can include tree dieback, death, increased risk of branch failure or structural failure. There is an increased likelihood of these outcomes with mature trees as the capacity of the tree to tolerate disturbance reduces with age.

Council has two adopted workflows to ensure trees and roots are considered when undertaking maintenance activities. These workflows provide options for the maintenance teams to carry out works without damage to the tree(s). However, where this is not possible and roots may be cut or damaged then:

- an inspection by a Council arborist and works coordinator/roads coordinator is required, and
- the works are modified to retain trees where possible (Section 9.3.1), or
- where it is determined that tree roots can be safely cut then root pruning works are assigned to Council's tree team, or
- where there are no suitable alternatives tree removal will be assigned to Council's tree team.

9.3.1 Alternatives to tree removal

The following options may be appropriate where there is an interaction between public infrastructure and tree roots:

- divert or remove the footpath
- pour kerb in asphalt or concrete directly over roots without excavation
- replace the footpath with reinforced concrete
- install tripstop or similar near trees
- grind the trips along footpath
- ramp the walking surface over the roots or lifted slab
- install of flexible paving
- use pier footings, wooden walkways.

Alternative options are to be investigated in consultation with a Council arborist to ensure the selected option will not damage the tree(s) or make them unsafe.

9.3.2 Removal of pavement adjacent to retained trees

Removal of existing pavement over tree roots is to include the following precautions to avoid tree damage:

- break the hardstand into manageable pieces to facilitate careful removal
- do not permit vehicles on the exposed roots or within the minimum distance specified in the tree protection plan
- do not remove pavement or other material that has been utilised by established roots without prior arborist advice
- apply water absorbing fabric to the exposed area immediately, wet the fabric and keep moist until the overlay surface is applied
- where tree roots are encountered within the tree protection zone, the need and implications for the cutting of any roots is to be determined in advance by a Council arborist.

10.0 Biosecurity

There is a risk to the tree population within any urban forest from a range of pests and diseases. It is critical that appropriate measures are put in place to ensure that any pest or disease is not introduced or spread.

Inspection prior to works is critical in protecting the City's canopy from the spread of disease. Any tree maintenance activities (including propagation, planting, mulching, pruning or removal works) are to ensure that the requirements of **Appendix 1** *Disease and Insect Pest Management Protocol* are included in all documentation and implemented.

11.0 Utility providers

The installation or repair of various utilities is required throughout the city. These works can significantly damage trees, particularly where trenching is required. Excavation may cause damage to trees resulting in tree death, canopy dieback or an increased risk of limb or whole tree failure.

Utility operators undertake activities under a range of legislation. These activities should not permit injury or damage to public trees that would result in a hazard. Council requires utilities, when undertaking activities that may impact upon public trees, to:

- liaise with Council's Asset Management team during the planning phase. Council's Asset Management team can be contacted on (02) 4974 2000.
- liaise with Council's public utility officer prior to commencement of works on site, and
- employ a suitably qualified arborist to supervise works in the vicinity of public trees, and
- install protective fencing to avoid damage to trees and roots, and
- manage and controll the use of machinery and private vehicles when operating in public open space.

Note: Council assets are not obtainable from dial before you dig searches.

The following section provides options for utility installation that minimises the impact to trees root systems.

11.1 Trenchless techniques

Trenchless techniques provide an alternative method to open trenching for underground service installation. For new installations, directional drilling, pipe jacking, and boring all reduce reinstatement work and maintain visual amenity.

Trenchless techniques require reliable location of other services and survey marks. Where high risk services are identified, consultation with the utility/service provider is essential.

Note: Refer to AUS-SPEC #2 Specification 305 - Trenchless Conduit Installation.

11.1.1 Underboring

Underboring is the preferred option for installing utilities in proximity to trees. Open excavation should cease at a distance from the tree, dependant on the tree size. This distance is to be determined by implementation of *AS4907-2009* having regard for notes 1, 2 and 3 below.

Where underboring will pass within the root structure of a public tree, the minimum bore depth is to be 700mm. Where underboring or open trenching is proposed adjacent to public trees, Council's conditions are required to be implemented. These conditions are available by contacting Council on (02) 4974 2000.

Directional boring is to be used when working within the tree protection zone. Where this is impractical consultation with the asset (or property) owner is required.

Note 1: Refer to Section 5 for tree protection zone information.

12.0 Arborist reports and qualifications

Council undertakes all inspections of trees on Council managed land. Council's arborists, or tender approved consultants, conduct inspections in accordance with industry best practice and Council processes. The minimum qualification required for a Council arborist (or consultants) undertaking tree inspections or writing reports is Diploma Arboriculture (Level AQF 5). The qualification should be accompanied by 5 years post qualification experience in assessing public trees and report writing.

The following are the minimum requirements for an arborist report on public trees. Report layout may vary subject to the brief and the scale of the project.

12.1 Council Arborist Report

Arborist reports prepared by Council, or on behalf of Council, must use clear and precise language and be based on the following:

1. be guided by theoretical and factual scientific concepts, and

2. be objective and disclose any pecuniary or non-pecuniary interests, and

3. state findings based on observations and discuss the connective significance of those observations, and

4. provide suitable evidence, including clear relevant photographs, and references to support claims/recommendations, and

5. provide the relevant detail of the tree assessment test where required, and

6. include the information contained in **Table 5** when prepared by consultants for Council.

Table 5 - Contents of a Consultant arborist report prepared for Council

Arborist	Full name
	Business name and ABN
	Business address
	Qualification and AQF Level, certificate number and date of award
	Business telephone and email address
The site and the brief	The full address of the site
	The full name and address of the client
	Dates of all site visits
	The project brief as provided by the client
	A table of contents including list of photographs
	A clear site plan showing relevant site details accurately plotting existing tree locations and actual crown spread
	A relevant site description including a summary of soil and drainage conditions
	A table listing each tree by number, common and scientific name, DBH, estimated height, age class, health, vigour and structure
	A summary of trees proposed to be removed and the reasons for removal

Glossary

Action Plan: for the purpose of the University of Newcastle Callaghan Campus the term refers to the Action Plans in Section 9.3 of the Landscape Management Implementation Plan Callaghan Campus dated 3 September 2012.

Amenity: is the term used to describe the features, facilities or services that make for a comfortable and pleasant life. Amenity is not only enjoyed by residents in their homes and gardens but also in the street and public places.

Arborist: a person who holds the Australian Qualifications Framework (AQF) 5 Diploma in Horticulture (Arboriculture) or AQF 4 Certificate IV in Horticulture (Arboriculture) and is enrolled in the NSW TAFE AQF 5 Diploma in Horticulture (Arboriculture) course.

Bushland Management zone: for the purpose of the University of Newcastle Callaghan Campus the term refers to the Bushland Management zone map in Section 9 of the Landscape Management Implementation Plan Callaghan Campus 3 September 2012.

Bush Regeneration: the rehabilitation of bush from a weed infested or otherwise degraded plant community to a healthy community composed of native and indigenous species**.**

Canopy cover: refers to the total area contained within the vertical projection of the periphery of tree crowns (or other overstorey). It provides an indicator of the quantity of urban forest, and its capacity to provide ecological, economic, social and aesthetic benefits.

Circumference breast height: the girth of the supporting stem of a tree at a height of 1.4m above ground level measured at the trunk centre, and so as to contain the outermost projection of any flanges or buttresses.

City Arborist: person designated as such by The City of Newcastle.

Compensatory planting: tree planting required offsetting the loss of retainable tree canopy.

Council: means Newcastle City Council.

Crown: portion of the tree consisting of branches and leaves and any part of the trunk from which branches arise.

Crown projection: is the size of the tree canopy. An equation is used to work out the crown size. Crown size (m) = πr2 where r equals the average distance to canopy dripline.

Compaction: compression of the soil that creates an upper layer that is impermeable.

DBH (Diameter at Breast Height): the diameter of the tree trunk at 1.4m above natural grade.

Dead tree: is where the biological function of the tree has ceased, no leaves are present and visible evidence of trunk, root plate and canopy desiccation.

Development Control Plan (DCP): has the same meaning as in the *Environmental Planning and Assessment Act, 1979.*

Note: The term is defined as a development control plan made, or taken to have been made, under Division 6 of Part 3 and in force.

Development site: includes all areas within which the development will occur and can extend across several lots or development blocks.

Disturbed area: the area which will be impacted by a development, including construction, demolition and use.

Dying tree: demonstrates reduced growth rates, sparse foliage and reduced response to damage or stress over subsequent growing seasons.

Exotic: any flora or fauna species which is not native or indigenous.

Gap-graded soil: a mix of 40mm crushed basalt aggregate, filler soil and other additives to meet specification supplied. Components are thoroughly pre-mixed before placing in trench.

Hazard: anything with potential to harm health, life or property.

Indigenous: any tree, shrub, fern, creeper, vine, palm or plant that is native to the Lower Hunter Region, and includes the flower and any part thereof.

Infiltration: the practice of discharging drainage water into the ground soil matrix.

Injuring: in relation to a tree, means a wound resulting from an activity, including but not limited to excessive pruning, cutting, trenching, excavating, altering the grade, paving or compaction within the tree protection zone of a tree. Injury includes bruising, scarring, tearing or breaking of roots, bark, trunk, branches or foliage, herbicide or poisoning, or any other action foreseeably leading to the death or permanent damage to the tree health.

Lopping: an unacceptable practice as defined in the Australian Standard AS4373 – 2007.

Main body of vegetation: is the area shown on Map 1 - Callaghan campus

Manual: the technical manual/s that support Newcastle Development Control Plan 2012.

Native: any tree, shrub, fern, creeper, vine, palm or plant that is native to Australia but not indigenous, and includes the flower and any part thereof.

Native Vegetation: has the same meaning as in the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017.* As such native vegetation is any of the following types of plants native to New South Wales:
(a) trees (including any sapling or shrub or any scrub)
(b) understorey plants,
(c) groundcover (begin any type of herbaceous vegetation),
(d) plants occurring in a wetland.

Native Vegetation Community: plant communities, comprising primarily native species, the composition and structure of which reflects the interactions between plant species, between plants and fauna and with the environment. Native vegetation communities include canopy trees (where present), understorey, and ground cover. Regrowth and newly colonising stands of native species are included as part of the native vegetation community.

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Property: refers to any infrastructure (eg. underground water/sewer pipes, electrical cables etc.) and structural elements on private land. Structural elements include driveways, and walls which are retaining devices only.

Pruning: is the selective removal of branches in accordance with the requirements and classifications within AS4373-2007 Pruning of amenity trees.

Public Tree: tree/shrub species located on any land managed by Council.

Remnant: native vegetation community within the boundaries of the Newcastle University Callaghan Campus.

Removal: complete tree removal such as cutting to the ground or extraction of the tree or taking any action foreseeably leading to the death of a tree or permanent damage to its health or structural integrity, including but not limited to excessive pruning, cutting, girdling, poisoning, over watering, unauthorized relocation or transportation of a tree, or trenching, excavation, altering the grade within the tree protection zone, or paving within the drip-line of the tree.

Riparian zone: refers to a riparian corridor as defined by Department of Primary Industries - Office of Water - i.e. a riparian corridor that forms the transition between land and river or watercourse.

Risk: the chance of injury, loss or damage to property, a person, organisation or the community measured in terms of consequences and likelihood.

Risk management: is the process of identifying, analysing, evaluating, monitoring and communicating risks in a way that minimises losses and maximises opportunities. It is described generically in AS/NZS 4360:1999 Risk Management.

Shrub: a woody perennial plant that is generally smaller than a tree species at maturity and has many main stems or trunks.

Stormwater: the runoff from rainfall events.

Streetscape: the form, character and visual amenity of the street environment.

Street tree: public trees and shrubs within the road reserve. These have been surveyed and mapped by Council.

Street tree vacancy site: sites identified by Council for future tree planting. The sites have been identified from analysis of the Local Government Area based on criteria in the Tree Asset Management System (TAMS). The information on locations of street tree vacancy sites is available on request from Council.

Structural soil: see Gap-graded soil.

Suitably qualified person: a person with appropriate level of skills and formal training in a particular field relevant to a particular situation or works, such as a structural engineer who is required to assess structural works, a civil engineer required to assess road works.

Solar: suitable access to sunlight for human wellbeing.

Topping: an unacceptable practice as defined in the Australian Standard AS4373 – 2007.

Tree Private land: a long lived woody perennial plant greater than 3m height (or will be at maturity), with one or relatively few main stems or trunks.

Tree Protection Plan (TPP): a plan prepared by a suitably qualified arborist that details measures to protect and preserve trees.

Tree Protection Zone (TPZ): is a determined area of ground under a tree that is to be fenced off during the development of a site to ensure that activity does not cause damage to the tree or its root system.

Trenching: any excavation to provide irrigation, installation of foundations, utility lines, services, pipe, drainage or other property improvements below ground.

Urban forest: the totality of trees and shrubs on all public and private land across Newcastle LGA, and measured as a canopy cover percentage of the total area.

Urban Forest Technical Manual: produced by the City of Newcastle to supplement section 5.03 Tree Management of the Newcastle DCP 2012 by providing technical information for the design, implementation and management of tree planting in the local area.

Undesirable Species: tree species listed in Appendix 1 of this Technical Manual that are unsuitable for replanting due to negative characteristics.

Verge: the part of the street reserve between the carriageway and the boundary of adjacent lots (or other limit to street reserve). It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and planting.

Vertical mulching: auguring, hydraulic or air excavation of vertical holes within a trees root zone to loosen and aerate the soil, typically to mitigate compacted soil. Holes are typically penetrated four to six feet on centre, two to three feet deep, two to six inches in diameter and backfilled with either perlite, vermiculite, peat moss or a mixture thereof.

Weed: a plant encroaching on an area mulched for trees.

Wetland area: for the purposed of the Urban Forest Technical Manual a wetland area includes the outer boundary of the wetland plus 100 m from that edge.

Newcastle Urban Forest Technical Manual
Part C Native Vegetation

February 2018

Newcastle's urban forest is the collection of trees, shrubs, and other vegetation types, on both public and privately owned land within the Newcastle Local Government Area. The urban forest and associated tree canopy across Newcastle provides a range of benefits for the community. Some of these benefits include shade, microclimate regulation, air quality, sense of wellbeing, diverse flora and fauna, storm water management and interception. The liveability of the city is greatly improved by having a sustainable tree canopy and green spaces.

In May 2008, Council adopted the Newcastle Urban Forest Policy and Urban Forest Background Paper in recognising the importance of the urban forest. The goals of the Urban Forest Policy include sustaining and maximising the Newcastle urban forest on an intergenerational basis. In June 2013, Council adopted the Newcastle 2030 Community Strategic Plan which is the community's long term vision for the city. The Community Strategic Plan identifies that over the next 20 years the Newcastle community wants a greater connection with nature, with a greener more enriching environment where the urban forest is maintained and connected.

This Technical Manual contributes to Newcastle's urban forest by providing guidance on the management of native vegetation communities on private land within the Newcastle Local Government Area. The Manual is an accompaniment to the Newcastle Development Control Plan (DCP) Section 5.03 Vegetation Management. It is separated into three parts based on the land on which the vegetation is located and the type of vegetation present:

- Part A provides guidance on the management of trees and shrubs located on private land.
- Part B provides guidance on the management of trees and shrubs located on public land.
- Part C provides guidance on the management of native vegetation communities on private land.

Use Part C to guide applications for native vegetation removal on private land in conjunction with State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 and Section 5.03 Vegetation Management of Newcastle Development Control Plan 2012.

Urban Forest Technical Manual
Part C Native Vegetation

Table of Contents

1.0 Introduction

To sustain and maximise Newcastle's urban forest on an intergenerational basis, it is essential that native vegetation be retained, and the ecological functions of vegetation communities protected and enhanced. The aim of Part C Native Vegetation is to provide guidance on the management of native vegetation within the Newcastle Local Government Area.

Part C is currently limited to providing guidance on applications for native vegetation clearing on private land not associated with development. The manual is to be read in conjunction with *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017* and Section 5.03 Vegetation Management of the Newcastle Development Control Plan 2012.

Before applying for a *Permit Application to Remove Native Vegetation* the applicant needs to check whether the proposal is permissible under *Newcastle Local Environment Plan* 2012, and ascertain whether the removal is associated with works or activities that require the lodging of a Development Application, or need to be assessed as complying development. A permit **will not** be issued if the vegetation removal is associated with development.

1.1 How to use this manual

Part C is presented in five (5) sections:

Section 1.0 Introduction - outlines when this part of the Manual is to be used.

Section 2.0 Native Vegetation pruning on private land (not associated with other development) - outlines the process to be followed for applications to prune native vegetation on private land not associated with a Development Application.

Section 3.0 Native Vegetation removal on private land (not associated with other development) - outlines the process to be followed for applicants to clear native vegetation on private land not associated with a Development Application.

Section 4.0 Native Vegetation clearing on private land associated with other development

Section 5.0 Glossary

2.0 Native vegetation pruning on private land (not associated with development)

2.1 Pruning of native vegetation that requires a permit from Council

A *Permit Application to Remove Native Vegetation* is to be submitted to Council when the native vegetation to be pruned is:

(a) vegetation in a threatened ecological community, or is a threatened plant species listed under the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994*.

For pruning of all other native trees and shrubs refer to **Part A Section 2.0 of the Urban Forest Technical Manual** for Council requirements.

Note: If pruning involves the removal of a limb providing habitat for native fauna, a suitably qualified fauna specialist should be consulted.

Applying to Council for a permit to prune or clear native vegetation **does not** remove the Applicant's obligation to comply with all other state and federal legislation relating to the conservation of protected and threatened species, habitats, ecological communities and populations, or sensitive environmental lands like wetlands and riparian corridors.

As such, the applicant may need to obtain additional approvals and/or licences as part of the permit application process. For example, an applicant may need to obtain a licence from the Office of Environment and Heritage for pruning of a threatened ecological community or a threatened plant species listed under the *Biodiversity Conservation Act 2016*. For further information see the Office of Environment and Heritage website.

Similarly, proposals to prune marine vegetation protected under the *Fisheries Management Act 1994* may require a permit under the Act. For further information see the Department of Primary Industries website.

A permit application to prune native vegetation will not be issued without all appropriate assessments undertaken and associated permits obtained.

Note: For pruning vegetation that is, or forms part of a heritage item, or is, or forms part of an Aboriginal object, or within a place of Aboriginal significance. Refer to *Section 5.03.04 Vegetation Management* of the *Newcastle DCP 2012* for guidance on heritage minor works notification applications.

3.0 Clearing of native vegetation on private land (not associated with development)

This section outlines the process an applicant is to follow when seeking a permit to clear native vegetation on private land, and the removal is not associated with development (eg. building a residential dwelling). This section is to be read in conjunction with *State Environmental Planning Policy (Vegetation in Non-rural Areas) 2017* and Section 5.03 Vegetation Management of Newcastle Development Control Plan 2012.

For applications relating to the removal of native trees and shrubs, where the native trees and shrubs to be removed are not:

- **×** part of a native vegetation community / vegetation assemblage,
- × within a wetland or a riparian zone,
- × a threatened species, or provide habitat for a threatened species, under state or federal legislation

refer to **Part A of the Urban Forest Technical Manual** and associated *Permit Application for Tree Removal* form.

For all other native vegetation removal applications, use the following sections.

Note: If the vegetation is located on a residential lot and has been planted for landscaping purposes, refer to Part A Urban Forest Technical Manual and associated Tree Removal application form.

3.1 Clearing of native vegetation that requires a Permit from Council

A *Permit Application for Native Vegetation Removal* is to be submitted to Council for assessment when the native vegetation to be removed is:

(a) a threatened ecological community or is a threatened plant species listed under the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994*; or

(b) 1 or more native trees or shrubs that form part of a native vegetation community, and the proposal includes the removal of native understorey; or

(c) 4 or more native trees or shrubs that form part of a native vegetation community (with or without native understorey removal); or

(d) any other native vegetation including understorey plants, groundcovers and plants occurring in a wetland, and is less than the biodiversity offsets scheme threshold identified under the *Biodiversity Conservation Act 2016*.

Clearing of native vegetation that exceeds the biodiversity offsets scheme threshold can only be undertaken with the prior approval of the Native Vegetation Panel.

Note: If the clearing of vegetation relates to a threatened species, threatened ecological community, a matter of national environmental significance, or is located on sensitive environmental lands, a **development application** may be the more appropriate pathway for the proposal to be assessed by Council. Please contact Council about your options prior to submitting your application.

3.2 Documentation to support a Permit Application for Native Vegetation Removal

The information required to support an application to clear native vegetation under a permit will be determined by the type of vegetation to be removed, the location of the vegetation (eg. within a riparian zone or wetland) and the amount of vegetation to be removed.

All Permit Applications for Native Vegetation Removal will require:

(a) a site map which identifies the location of the native vegetation to be cleared and any vegetation proposed to be retained at the site,

(c) a description of the native vegetation community and/or list of the native vegetation species proposed to be cleared, and

(d) a description of why the native vegetation is proposed to be cleared.

For proposals that involve:

(a) the removal of 1 or more native trees or shrubs that form part of a native vegetation community, and the proposal includes the removal of native understorey up to 400m^{2,}

the Applicant is to complete a *Permit Application for Native Vegetation Removal* form and attach a *Native Vegetation Summary Report (*refer to **Appendix 12** of the Urban Forest Technical Manual) that has been completed by a suitably qualified ecologist,

upon review of the application, an applicant may be required to obtain an arborist report to support the removal. If an arborist report (as per **Appendix 7** of this Manual) is required, it is to be prepared in accordance with Part A, Section 6 of the Manual.

(b) the removal of 4 or more native trees and/or shrubs that form part of a native vegetation community (with or without associated understorey removal),

the Applicant is to complete a *Permit Application for Native Vegetation Removal* form and attach a *Native Vegetation Summary Report* (refer to **Appendix 12** of this Manual) that has been completed by a suitably qualified ecologist,

upon review of the application, an Applicant may be required to obtain an arborist report to support the removal. If an arborist report (as per **Appendix 7** of this Manual) is required, it is to be prepared in accordance with Part A, Section 6 of the Manual,

the arborist report must demonstrate that at least one of the tree assessment tests under Part A Section 3.4.4 of this Manual has been met for all trees that are proposed to be removed.

(c) the removal of less than $400m^2$ of native vegetation (that does not include the removal of any trees or shrubs, or any vegetation listed at (f) or (g) below),

the applicant is to lodge a *Permit Application to Remove Native Vegetation* for assessment.

(d) the removal of between $400m^2$ and $1000m^2$ of native vegetation,

the Applicant is to complete a *Permit Application for Native Vegetation Removal* form and attach a *Native Vegetation Summary Report* (refer to **Appendix 12** of this Manual) that has been completed by a suitably qualified ecologist.

(e) the removal of greater than $1000m^2$ of native vegetation and the removal does not exceed the biodiversity offsets scheme threshold (refer to the *Biodiversity Conservation Act* 2016 for further information),

the applicant is to complete a *Permit Application for Native Vegetation* form and attach a *Flora and Fauna Impact Assessment* completed by a suitably qualified ecologist.

(f) where the proposal is to remove native vegetation within 40m of a watercourse (a riparian zone) or within a wetland area (100 m from the edge of the wetland),

the applicant is to complete a *Permit Application for Native Vegetation Removal* form and attach a *Flora and Fauna Impact Assessment*, completed by a suitably qualified ecologist,

the applicant may be required to obtain additional approvals from other NSW Government agencies to remove vegetation within these sensitive environmental zones.

(g) proposal to remove a threatened ecological community or a threatened plant species listed under the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994*,

the applicant is to complete a *Permit Application for Native Vegetation Removal* form and attach a *Native Vegetation Summary Report* (refer to **Appendix 12** of this Manual) that has been completed by a suitably qualified ecologist,

the applicant may be required to obtain additional approvals from other NSW Government agencies and/or commission impact assessments to support the removal of species, habitats and communities listed under these Acts.

Note 1: All Applicants need to clearly explain why the proposed clearing of the native vegetation is required. Vegetation clearing proposals that are associated with activities/works that require a development application to be lodged with Council, or relate to complying development, **will not be approved** using this permit.

Clearing of native vegetation on private land that is subject to development consent conditions **will not** be processed under a *Permit Application for Native Vegetation Removal*.

Note 2: For proposed clearing of native vegetation within a *State Environmental Planning Policy 14 - Coastal Wetland* **do *not apply for a permit.*** Proposals to clear vegetation within a SEPP 14 wetland require the submission of a **development application**.

Note 3: For proposed clearing of native vegetation on private land in relation to bushfire 10/50 rules **do not apply for a permit** from Council. Refer to the Rural Fire Service website.

Note 4: Council **cannot** issue a permit for clearing of native vegetation that exceeds the biodiversity offsets scheme threshold. Refer to the *Biodiversity Conservation Act 2016* and *State Planning Policy (Vegetation in non-rural Areas) 2017 for further information.* Clearing of native vegetation that exceeds the biodiversity offsets scheme can only be undertaken with the prior approval of the Native Vegetation Panel.

Note 5: State and Federal environmental conservation legislation may apply to proposals to remove native vegetation under a *Permit Application for Native Vegetation Removal.* Government issued licences, permits, controlled activity approvals, ecological reviews and impact assessments may be required, particularly for proposals that involve threatened species and associated habitat, threatened ecological communities, sensitive environmental zones including wetlands and watercourses, or matters of national environmental significance.

The applicant will need to obtain all relevant approvals and licences as required under other legislation including the *Water Management Act 2000*, *Biodiversity Conservation Act 2016*, *Fisheries Management Act 1994* and the *Environment Protection and Biodiversity Conservation Act 1999*.

4.0 Native vegetation clearing on private land associated with development

A permit **will not** be issued if the vegetation clearing is associated with development.

Glossary

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Canopy cover: refers to the total area contained within the vertical projection of the periphery of tree crowns (or other overstorey). Provides an indicator of the quantity of urban forest, and its capacity to provide ecological, economic, social and aesthetic benefits.

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Riparian zone: refers to a riparian corridor as defined by Department of Primary Industries - Office of Water - i.e. a riparian corridor that forms the transition between land and river or watercourse.

Risk: the chance of injury, loss or damage to property, a person, organisation or the community measured in terms of consequences and likelihood.

Risk management: is the process of identifying, analysing, evaluating, monitoring and communicating risks in a way that minimises losses and maximises opportunities. It is described generically in AS/NZS 4360:1999 Risk Management.

Shrub: a woody perennial plant that is generally smaller than a tree species at maturity and has many main stems or trunks.

Stormwater: the runoff from rainfall events.

Streetscape: the form, character and visual amenity of the street environment.

Street tree: public trees and shrubs within the road reserve. These have been surveyed and mapped by Council.

Street tree vacancy site: Sites identified by Council for future tree planting. The sites have been identified from analysis of the Local Government Area based on criteria in the Tree Asset Management System (TAMS). The information on locations of street tree vacancy sites is available on request from Council.

Structural soil: see Gap-graded soil.

Suitably qualified person: a person with appropriate level of skills and formal training in a particular field relevant to a particular situation or works, such as a structural engineer who is required to assess structural works, a civil engineer required to assess road works.

Solar: suitable access to sunlight for human wellbeing.

Topping: an unacceptable practice as defined in the Australian Standard AS4373 – 2007.

Tree Private land - a long lived woody perennial plant greater than 3m height (or will be at maturity), with one or relatively few main stems or trunks.

Tree Protection Plan (TPP): a plan prepared by a suitably qualified arborist that details measures to protect and preserve trees.

Tree Protection Zone (TPZ): is a determined area of ground under a tree that is to be fenced off during the development of a site to ensure that activity does not cause damage to the tree or its root system.

Trenching: any excavation to provide irrigation, installation of foundations, utility lines, services, pipe, drainage or other property improvements below ground.

Urban forest: the totality of trees and shrubs on all public and private land across Newcastle LGA, and measured as a canopy cover percentage of the total area.

Urban Forest Technical Manual: produced by the City of Newcastle to supplement section 5.03 Vegetation Management of the Newcastle DCP 2012 by providing technical information for the design, implementation and management of tree planting in the local area.

Undesirable Species: tree species listed in Appendix 1 of this Urban Forest Technical Manual that are unsuitable for replanting due to negative characteristics.

Verge: the part of the street reserve between the carriageway and the boundary of adjacent lots (or other limit to street reserve). It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and planting.

Vertical mulching: auguring, hydraulic or air excavation of vertical holes within a trees root zone to loosen and aerate the soil, typically to mitigate compacted soil. Holes are typically penetrated four to six feet on centre, two to three feet deep, two to six inches in diameter and backfilled with either perlite, vermiculite, peat moss or a mixture thereof.

Weed: a plant encroaching on an area mulched for trees.

Wetland area: for the purposed of the Urban Forest Technical Manual a wetland area includes the outer boundary of the wetland plus 100 m from that edge.

Urban Forest Technical Manual
Appendix 1 – Disease and Insect Pest Management Protocols Newcastle LGA

This appendix contains information regarding general information on disease and pest management and specific information on disease and pests identified within the Newcastle local government area, or are potential threats (Table 1.2 and 1.3).

Disease and pest management requires action to prevent the introduction of the pest or disease, and measures to prevent the spread once it is introduced. The actions can vary depending on the disease or pest as shown in table 1.1 *Heads of consideration to quarantine or contain disease or pest*. These heads of consideration should form the basis of developing hygiene protocols for a work site.

Table 1.1 Heads of consideration to quarantine or contain disease or pest

Quarantine and	Containment
define boundaries	material flow
logistics	risk level
work flow	waste disposal
organise tools	recycling

Hygiene is a critical element in reducing, excluding, eliminating and eradicating pathogens. Poor hygiene can quickly result in the spread of pests or disease which can significantly affect the overall urban forest. In some cases there is no treatment, such as for Fusarium oxysporum which leads to death of the palms affected, leading to potential elimination of a species and significant avenue plantings. Hygiene can prevent this from occurring. It is important that material that is or suspected of being infected with pest or disease should not be used for mulch or firewood.

The cleaning of equipment used on work sites, securing disease and pest free plant stock, ensuring transport of the infected material and cleaning of trucks occurs. The following detail is to be included in any hygiene protocols and is in addition to the specific information in tables 1.2 and 1.3 below.

Equipment

Equipment is to be clean entering and before leaving a site. Equipment includes:

- Boots, clothing, ropes, saws
- Regularly wash and dry ropes
- Clean and disinfect chainsaws, loppers, handsaws, secateurs and any other cutting/pruning tools
- Machinery regularly cleaned and position to not spread material outside the established work zone.

Stock

- Source tree stock from nurseries that certify stock to comply with Australian Standard 2303:2015 ‘Tree stock for landscape use.’
- Monitor plants for signs of ill health.
- Landscaping materials - source materials from suppliers who will certify products to be free of pests or diseases, including packaging and transportation.

Transport

- Soil and debris is to be removed from vehicles including cabs and footwells before leaving the established work zone.
- Ensure transported material is covered.
- Use wash down and disinfection facilities when entering or leaving waste facility sites and clean vehicles prior to the next day.

Specific Hygiene guidelines
Where an existing disease or pest is present or suspected follow the specialist guidance provided for the pest or disease in table 1.2 and 1.3 below. If removing infected material ensure removal, transport and disposal complies with the controls and hygiene columns in table 1.2 and 1.3 below. A list references is included after the tables.

Table 1.2: Tree Diseases reported in Newcastle, or recorded as a potential threat

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Armillaria root rot	*Armillaria luteobubalina*	Soil born fungus. The fungus can survive in soil for extremely long periods of time and there are estimates of up to survival for 50 years, although 20 years would be more likely. Difficult to diagnose. Early symptoms are dieback and yellowing of foliage, poor vigour. Later symptoms include splits in trunk and exudation, with mycelium under loose bark in lower part of trunk. Small olive brown to yellow mushrooms in May June at base of tree.	▪ **Prevention of spread** through Hygiene is essential as spread through plant material including mulch. ▪ **Reduce inoculum** - Grind stumps - Removal of all infected plant material from the site. - Addition of organic matter to soil. - Clearing, aerating and drying the root collar. Exposure to air dries surface wood and bark which can retard fungal activity. - Introducing a decay organism (eg. Phanerochaete filamentosa) into infested dead material in the soil, eg. stumps. Slow acting but can displace Armillaria from stump.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all equipment is clean from vegetated matter and soil before leaving the site. ▪ Where required: Excavate stumps roots and soil to a specified area. ▪ Where required: Excavate and replace soil and all woody material prior to planting. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Infected stems/trunks to be removed whole. Do not chip infected material. ▪ Do not use mulch from infected trees. NOTE: the disease can spread various heights depending on species. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Butt Rot and White Rot	*Ganoderma applanatum and Phellinus spp.*	Fungi which produce platform like hard brown brackets on palms and grey surfaced brackets on many other woody species. Airborne spores can travel vast distances lodging in bark fissures or crevices and can then grow into the tree. Wounds on trees provide easy access for the fungus. Any part of the tree can be infected and multiple infection sites can occur. Once tree is infected it will eventually die. This may take several years. Infected trees may be susceptible to wind throw.	▪ **Prevention of spread** - Avoid wounding of trees to reduce the chance of infection. - Remove infected material whole to land fill. Do not chip and use as mulch. - Initiate hygiene protocols on site to ensure spores not transported. ▪ **Controls** - There is no chemical or manual control for Ganoderma butt rot. ▪ **Manage Risk** - Any tree with brackets on it should - Be inspected through full VTA process stages 1 to 3. - Have risk assessed.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Infected stems/trunks to be removed whole. Do not chip infected material. NOTE: the spores can travel vast distances. ▪ Do not use mulch from infected trees. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Plane Anthracnose	*Apiognomonia veneta (*asexual: *Discula platani)*	A fungal disease affecting the leaves, twigs and branches of some species of plane tree including the London Plane tree. Cankers and fallen leaves are a source of new infections that are spread by rain splash and wind during the early part of the growth season. Untreated leaves become blotched and necrotic and fall prematurely. Distorted tree growth results in a decline and diseased appearance. Affected trees usually recover to produce new growth by mid-summer. However, the overall vigour of the tree can be reduced, and branch growth distorted if regular dieback experienced. The disease places the trees under stress, and potentially more susceptible to other infectious and non-infectious problems including insect attack.	▪ **Prevention of spread** - Initiate hygiene protocols on site to ensure disease is not transported. - The maintenance of tree vigour is important with adequate nutrient and water supply. - Maintain adequate air and circulation between trees. ▪ **Reduce inoculum** - Removal of infected twigs and branches by pruning is beneficial. This will be usually confined to peripheral growth resulting in limited control of the disease problem. ▪ **Control** - Chemical control is not recommended. - Collect and remove infected leaves twigs and which have when they have fallen and pruning of infected branchlets during the deciduous period can reduce the amount of spores available to re-infect new growth in spring.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. NOTE: the spores overwinter in the debris. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Powdery Mildew of Crape Myrtle	*Erysiphe lagerstroemiae*	White to greyish powdery growth on leaves, flowers and new shoots. Favoured by warm, humid conditions. Generally non-fatal but can cause dwarfing of new growth and foliage death. Heavily infected flowers may fail to open. Spores are spread by water-splash and air current.	▪ **Prevention of spread** - Planting strategies to ensure crape myrtle trees have full sun, with adequate spacing to avoid crowding. - Variant selection: select cultivars of lagerstroemia that are resistant to powdery mildew. ▪ **Control** - Inspection and treatment - Thinning to relieve congested crowns on heavily infected trees. - If limited number of shoots infected remove sprouts at the base of the plant as they are particularly susceptible. If sprouts infected fungus spreads easily. - Spray application of fungicides only where permitted by law on small trees. - Micro-injection on mature trees only if warranted for particularly important specimens.	▪ Avoid working on infected trees during windy or rainy conditions. ▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Dieback of Claret Ash	*Causal* agent unconfirmed, thought to be *Botryosphaeria dothidea*	A variant of the *Botryosphaeria* family of fungus that affects Claret Ash *Fraxinus oxycarpa* 'Raywood'. The related species Botryosphaeria dothidea also commonly occurs and causes similar symptoms on Camphor Laurel Cinnamomum camphora and Hill's Weeping Fig Ficus microcarpa var. hillii. A common endophyte that, on stressed trees, can cause a canker rot that girdles twigs and stems, leading to dieback of the affected parts. Inoculum can be spread on pruning tools. Spores produced in fruiting structures on infected stem. Spread by rain splash, insects, tools, infected plant debris and plant-plant direct contact.	▪ **Prevention of spread** - Not practical. Condition possibly exacerbated by water-stress. ▪ **Control** - No chemical control currently available. - Maintain mulch levels, supplement rainfall with irrigation when necessary.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Brittle Cinder	*Kretzschmaria deusta* *Formerly Ustulina deusta*	A facultative parasite initially causing a soft rot and in advanced stages will also remove lignin, typically in the stem base and woody roots. Can lead to brittle failure without warning signs. Will continue to decay the wood after the host tree has died. Fruiting bodies small 2-5cm 'tar spots' at base of stem/between buttresses/hidden by grass and can easily be overlooked.	▪ **Prevention of spread** - Not practical. Fruit bodies have typically formed well before infection is noticed. ▪ **Control** - Familiarity with fruiting bodies essential for early detection & diagnosis. - Regular tree inspections. - Internal and external monitoring - Tree removal - Hygiene associated with internal inspection and tree removal.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. ▪ Excavation to remove stump and larger woody roots. ▪ All stump, roots and soil around root-ball to be taken to land fill. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Fusarium wilt of Phoenix canariensis (Canary Island Date Palm)	*Fusarium oxysporum f. sp.canariensis*	Soil born fungus that infects *Phoenix* and *Washingtonia* palm species. Stays active in all living and dead palm tissue and soil. Cannot be chipped or used as mulch. Favourable soil conditions promoted by high water table.	▪ **Prevention of Spread** - Remove infected palms. Do not transplant palms from infected areas, nor install susceptible species into known diseased areas. ▪ **Control** - None. Infected palms will die. Improving drainage may help on established sites.	▪ Inspect palm prior to work. ▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Disinfect pruning/cutting tools with 30% water and 70% Methylated spirits between palms ensuring all vegetation is removed from cutting equipment. ▪ All vegetation including stump/root-ball from infected palms to be removed whole without chipping. ▪ All debris is to be tipped at a waste facility as land fill. ▪ If required - All stump, roots and soil around root-ball to be taken to land fill. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Clean and disinfect all equipment used to transport to landfill before working on next site. ▪ Back-fill hole with clean sandy loam.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Root Rot	*Phytophthora cinnamomi*	Phytophthora dieback is listed as a "key threatening process" to bushland/biodiversity under NSW State and under Federal legislation. State government agencies have developed documents detailing hygiene methodologies for work and recreation in and around P. cinnamomi management areas. Phytophthora infects the non-woody roots, rotting them off, affecting the ability of the roots to absorb water & nutrients, leading to wilting and then death. Soil born mould (sometimes called pseudo-fungus) active in wet soil conditions. Can stay dormant in dryer soil for decades until conditions reactivate lifecycle. The mould can spread through the movement of soil and mud, especially in soil fragments stuck to vehicles and in particular to footwear. Zoospores can move in free warm (tropics) water and via root-to-root contact between plants. Humans can spread P. cinnamomi further and faster than any other infestation vector. Management practices to prevent the spread of Phytophthora dieback into uninfected areas include strict hygiene measures.	▪ **Control/Prevention of Spread** - There is no effective control of the disease. - Prevention and containment methodologies include: - Hygiene protocols for all works activities - Monitoring to designate disease risk areas - Use of management zones to protect threatened flora - Host removal - When purchasing replacement stock ensure it is disease-free. - Replant with disease resistant plants.	▪ Do not enter disease risk areas during, or for three days after, rain. ▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all vehicles, equipment, boots and clothing is cleaned down and sprayed with 30% water and 70% Methylated spirits before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. NOTE: the disease can spread various heights depending on species. ▪ Clean all equipment used to transport to landfill before working on next site. ▪ Where required -Excavation to remove stump and larger woody roots. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Myrtle Rust	*Puccinia psidii*	Myrtle rust is a fungal disease that attacks new leaves, shoot tips, and young stems. On some hosts, it can attack flowers and fruit. Symptoms and severity can vary across hosts. The disease is caused by the exotic fungus *Puccinia psidii* (initially identified as *Uredo rangelii).* First identified in NSW in early 2010, it has now spread across eastern Australia and can be found from Tasmania to the Tiwi Islands in the NT. It is established in bushland reserves, home gardens, commercial operations such as production nurseries, and amenity settings such as parks and street plantings. It infects plants in the Myrtaceae family, for example the following genera: eucalyptus, corymbia, agonis, melaleuca, callistemon, syncarpia, acmena, syzygium, leptospermum, tristaniopsis, among 300 known host species. Heavy infection can kill new growth. Severe infections can kill susceptible hosts. The disease is spread by wind, water, insects people and animals. Spores can travel many kilometres from the initial site of infection. Myrtle rust spores can also spread over long distances if carried on plant material, equipment, vehicles and clothing. Various controls and strategies are outlined by the NSW Department of Primary Industries web site (see references for links).	▪ **Prevention of Spread** - Familiarity with the signs of infection allows for early diagnosis. - Stock security - ensure new plants or cuttings are free from myrtle rust. - Keep new plants separate from existing plants until disease freedom can be assured or until treated with an appropriate fungicide. - Affected plants should be removed and disposed of appropriately to minimise the spread of myrtle rust. ▪ **Control** **Chemical treatment** - There are a number of fungicides containing mancozeb, triforine, or copper oxychoride, among others, available for the control of myrtle rust. Special conditions may apply to their use, check with the NSW DPI for circumstances. Where suitable and appropriate spray infected and nearby plants with a fungicide to kill spores 3-4 days prior to removal.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all vehicles, equipment, boots and clothing is cleaned down and sprayed with 30% water and 70% Methylated spirits before leaving the site. ▪ Before being removing, smaller plants and plant parts enclose in a plastic bag ▪ Larger plants that do not fit in bags can be cut into smaller pieces and covered with black plastic ▪ All debris is to be covered/wrapped in plastic and tipped at a waste facility as land fill. ▪ Clean all equipment used to transport to landfill before working on next site.

TREE DISEASES REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Botryosphaeria dieback	*Botryosphaeria parva; B. dothidea.*	A variant of the *Botryosphaeria* family of fungus that affects Norfolk and Cook Island Pine. The related species *Botryosphaeria dothidea* also commonly occurs and causes similar symptoms on Camphor Laurel *Cinnamomum camphora* and Hill's Weeping Fig *Ficus microcarpa* var. *hillii.* A common endophyte that, on stressed trees, can cause a canker rot that girdles twigs and stems, leading to dieback of the affected parts. Inoculum can be spread on pruning tools. Spores produced in fruiting structures on infected stem. Spread by rain splash, insects, tools, infected plant debris and plant-plant direct contact.	▪ **Prevention of Spread** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and - Appropriate pruning including hygiene protocols - Removal of badly infected trees ▪ **Control** - There are no chemical controls for this disease. - Avoid pruning during wet weather (spores of Botryosphaeriaceae fungi are released up to 2 hours after rain). - Smaller dead or diseased parts could be pruned out.	▪ Do not prune during wet weather or up to 2 hours after rain. ▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Clean all equipment used to transport to landfill before working on next site.

TREE DISEASES OF SIGNIFICANCE ELSEWHERE IN AUSTRALIA - NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Cypress Canker	*Seiridium cardinale,* *S. unicorne* and *S. cupressi*	Numerous conifer species affected. Cypress canker is caused by several species of fungi whose spores enter the plants through natural fissures or through injuries. They result in cankers which exude resin from the margins or through bark fissures, and cause a vascular dysfunction similar to ringbarking. Multiple cankers can form on a single stem. This can lead to yellowing and rapid death of affected branches or stems. Spores carried by rain splashes, insects, birds and animals. Spores transferred from plant to plant on pruning tools, or through transport of infected cuttings or plants.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning including hygiene protocols. ▪ **Control** - There is no effective chemical control for this disease. - Smaller infected branches could be pruned out although pruning wounds could create opportunities for reinfection. - Severely diseased plants to be removed and diseased vegetation disposed in landfill.	▪ Do not prune infected trees during very humid or rainy conditions. ▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all cutting equipment is cleaned down and sprayed with 30% water and 70% Methylated spirits and clothing is cleaned (or bagged) before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Do not use mulch from infected trees. ▪ Clean all equipment used to transport to landfill before working on next site.

TREE DISEASES OF SIGNIFICANCE ELSEWHERE IN AUSTRALIA - NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Ink Disease of Oak	*Phytophthora cambivora*	Soil-borne fungus common in Australian soils. English Oak *Quercus robusta* is very susceptible, among others. A root-rot that gradually spreads along the woody roots and up the main stem, causing small lesions which can coalesce into larger lesions, eventually ring-barking the affected part and causing wilting followed by death. Lesions appear on the lower stem as dark patches in the bark 2-3cm across, 'bleeding' from the centre. The disease can be spread on pruning tools, but it mainly affects the stem and does not usually extend to branches.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning including hygiene protocols. ▪ **Control** - The disease can be treated with phosphonate by soil drenching, tree injection, or foliar application. Treatment is not always successful, however. - Remove dead branches as necessary. - Severely affected trees should be removed.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all vehicles, equipment, boots and clothing is cleaned down and sprayed with 30% water and 70% Methylated spirits before leaving the site. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Infected stems/trunks to be removed whole. Do not chip infected material. NOTE: the spores can travel vast distances. ▪ Do not use mulch from infected trees ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Clean all equipment used to transport to landfill before working on next site. ▪ Stump grinding required, including larger woody roots. ▪ If required - All stump, roots and soil around root-ball to be taken to land fill.

EXOTIC DISEASES – POTENTIAL THREATS TO AUSTRALIA				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Sudden Oak Death (Not yet present in Australia)	*Phytophthora ramorum*	*Phytophthora ramorum* is currently listed as a category 1 emergency plant pest in Australia because of its potentially devastating effects not only to affected plant industries, such as nurseries and landscape centres, but also to native ecosystems. It is primarily an aerial pathogen, impacting on stems, trunks and leaves. Sporangia are produced on the surfaces of infected leaves and twigs, can be dispersed by water splash to neighbouring hosts, or spread longer distances by wind and rain. The pathogen can also be carried downstream of infested areas in rivers and streams, or spread via infested soil. As cool, moist conditions favour survival, infection and spread of *P. ramorum*, the pathogen would be particularly suited to establishment in coastal areas of south-eastern and south- western mainland Australia, as well as Tasmania, should it be introduced into this country. The disease can be spread on pruning tools. See Appendices for link to NGIA Biosecurity Plan. Three different diseases can be caused by *P. ramorum*: stem or bole canker (sudden oak death), leaf blight (ramorum leaf blight) and twig blight/dieback (ramorum shoot dieback).	▪ **Prevention** - In the event that the disease is introduced to Australia, there is no prevention other than avoiding the purchase of infected stock, and otherwise maintaining trees with good cultural practice. ▪ **Control** - Chemical treatments are available but are not always successful in eradicating the disease.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the sIte. ▪ Ensure all vehicles, equipment, boots and clothing is cleaned down and sprayed with 30% water and 70% Methylated spirits before leaving the site. ▪ Infected trees are to be removed whole or in large parts and not chipped. ▪ All debris is to be tipped at a waste facility as land fill. ▪ Infected stems/trunks to be removed whole. Do not chip infected material. NOTE: the spores can travel vast distances. ▪ Do not use mulch from infected trees ▪ Excavation to remove stumps and larger woody rots of infected trees is required. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Removal of soil, stump and roots to landfill and backfilling with clean loam soil.

EXOTIC DISEASES – POTENTIAL THREATS TO AUSTRALIA				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
		Individual plant species can display more than one disease type (e.g. leaf blight, shoot dieback and stem cankers on tanoak). Leaf blight and twig blight/dieback symptoms are typically visible within five to fourteen days following infection, while bleeding cankers and whole plant dieback may not be visible for some time (ie. months or years) following an infection event. Infections typically develop rapidly under moist, temperate conditions, similar to those prevalent in the nursery environment. Sudden oak death is characterised by bleeding bark cankers, usually on the lower trunk, which cause red-brown to black discolouration of tissue below the bark. These cankers can lead to death of entire tree crowns due to necrotic girdling (ringbarking) of trunk tissue.		▪ Wash down all pruning equipment, truck and plant at completion of works and disinfect (30% water and 70% Methylated spirits).

EXOTIC DISEASES – POTENTIAL THREATS TO AUSTRALIA				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Pitch Canker of Pine	*Fusarium circinatum/ Gibberella circinata*	Threat to all pine species and Douglas Fir, especially in plantations. A fungal disease that causes bleeding cankers on branches, stems, and surface roots. Causes a vascular dysfunction leading to wilting and death of affected parts. While the major damage from this fungus is to branches, needles, trunk or stem and roots, pine pitch canker can also infect trees' reproductive structures, killing female flowers and mature cones. The fungus requires a moist substrate for infection and can be spread by insects or water splash, and where host trees have been wounded by such things as insect attack, strong winds or pruning, can be spread by the wind. The fungus can survive in soil for 6 months and in wood pieces for over 12 months. Currently there is no effective treatment for the disease in mature trees. While Douglas fir and many pine species are relatively resistant to the Pitch canker disease, Radiata or Monterey pine (*Pinus radiata*) is considered highly susceptible to the disease with mortality rates in mature trees reaching 80% in some areas of California. The disease can be spread on pruning tools.	▪ **Prevention** - In the event that the disease is introduced to Australia, there is no prevention other than avoiding the purchase/transportation of infected stock, and otherwise maintaining trees with good cultural practice ▪ **Control** - There is no chemical control for mature trees. - Smaller dead or diseased branches could be pruned out, observing hygiene protocols. - Severely affected trees will require removal, including stumps and woody roots.	▪ Set up a zone to clean off vehicles, equipment, boots and clothing as a transition from the infected area prior to leaving the site. ▪ Ensure all vehicles, equipment, boots and clothing is cleaned down and sprayed with 30% water and 70% Methylated spirits before leaving the site. ▪ Excavation to remove stumps and larger woody roots of infected trees is required ▪ Removal of soil, stump and roots to landfill and backfilling with clean loam soil. ▪ Where location of tree prevents excavation (e.g. footway) then the stump and any surface roots to be ground, and the grindings removed to landfill. ▪ Wash down all pruning equipment, truck and plant at completion of works and disinfect (30% water and 70% Methylated spirits).

EXOTIC DISEASES – POTENTIAL THREATS TO AUSTRALIA				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Fire Blight	*Erwinia amylovra*	Threat to Rosaceae family which includes pears, plums cherries, apples, cotoneaster, crabapples, flowering quince, hawthorn etc. A bacterial disease spread by insects (bees included), contaminated pruning or grafting tools, infected grafts, and any manner that carries the bacterial pathogen from an infected plant to one that is not, including wind and rain-splash. Fire blight can appear as different symptoms, depending on which plant parts are affected and seasonal timing. Blossoms, shoots, fruit, rootstock, branches and stems all have differing symptoms. Infected trees appear to be scorched by fire, hence the name 'fire blight'.	▪ **Prevention** - In the event that the disease is introduced to Australia, there is no prevention other than avoiding the purchase of infected stock, and otherwise maintaining trees with good cultural practice ▪ **Control** - There is no chemical control for mature trees. - Smaller dead or diseased branches could be pruned out, observing hygiene protocols. - Severely affected trees will require removal, including stumps and woody roots.	**AS PER MYRTLE RUST ABOVE**

EXOTIC DISEASES – POTENTIAL THREATS TO AUSTRALIA				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Eucalyptus rust (Guava rust)	*Puccinia psidii*	Eucalyptus rust (also known as guava rust) is part of the *Puccinia psidii* species complex and is closely related to Myrtle Rust. It is considered to be one of the most serious threats to Australia's eucalypt plantations, commercial native forests and natural ecosystems. It is a disease caused by a fungus which infects plants belonging to the plant family *Myrtaceae*, which includes Eucalyptus, Corymbia, Melaleuca, Lilly Pilly, Callistemon, and Turpentine, among others. Eucalyptus rust primarily attacks young (juvenile) leaves and also the flowers, shoots and fruits. First signs of rust infection are tiny raised spots or pustules on infected tissue. After a few days pustules turn a distinctive yellow colour. Infected leaves become deformed and eventually shrivel. Severe infection can cause heavy defoliation and stunt growth. Recurrent infections can lead to death of trees or shrubs.	▪ **Prevention** - As per Myrtle Rust: - Familiarity with the signs of infection allows for early diagnosis. - Stock security - ensure new plants or cuttings are free from myrtle rust. - Keep new plants separate from existing plants until disease freedom can be assured or until treated with an appropriate fungicide. - Affected plants should be removed and disposed of appropriately to minimise the spread of myrtle rust. ▪ **Control** - As per Myrtle Rust: - There are a number of fungicides containing mancozeb, triforine, or copper oxychoride, among others, available for the control of myrtle rust. Special conditions may apply to their use, check with the NSW DPI for circumstances. - Various controls and strategies are outlined by the NSW Department of Primary Industries, see Appendices for link.	**AS PER MYRTLE RUST ABOVE**

Table 1.3: Insect Pests reported in Newcastle or are a potential Threat

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Spotted Gum Borer	*Nascio vetusta*	Kills Metrosideros spp (NZ Xmas Bush). No effective treatment.	▪ **Prevention** - Do not plant susceptible species. ▪ **Control** - Removal of affected trees.	▪ No special hygiene requirements apply.
Fig Psyllid	*Mycopsylla fici*	Periodically defoliates Morton Bay Fig (*Ficus macrophylla*) and sometimes Port Jackson Fig (*Ficus rubiginosa*). Induced defoliation amplified under drought conditions and where soil compaction and/or excavation damages roots. Root damage leads to secondary pressures from pathogenic fungi which may kill trees or weaken structural integrity. A native wasp (*Psyllaephagus sp.*) parasitises the psyllid. The wasp emerges from leaves most of which will be in the litter layer beneath the tree. It is important to retain fallen leaves in the mulch beneath trees so that the wasp can continue its life cycle.	▪ **Prevention** - Fallen leaves should be spread as mulch beneath the tree. It is important that leaves are not chipped, for example, by lawn mowers, as that will destroy the biological control agent. - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Good cultural practice usually is sufficient. Chemical control to be used only as a last resort. Micro-injection into stem, or soil injection, with imidacloprid. Crown-spraying of mature trees subject to granting of special licence from NSW DPI. Note that soil injection and crown spraying will also kill beneficial organisms.	▪ No special hygiene requirements apply.

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Bag Moth, Kurrajong leaf tier	*Psychidae* spp.	Occasionally on Brushbox, Illawarra Flame and Kurrajong but also some other tree species. Moth larvae which construct shelters or 'bags' from plant material.	▪ **Prevention** - Not applicable. ▪ **Control** - Not usually necessary. Bags can be removed by hand but beware stinging spines on caterpillars. - Small trees could be sprayed with systemic insecticide, larger trees treated by micro-injection.	▪ No special hygiene requirements apply.
Winter Bronzing	*Thaumastocoris australis,* syn *T. peregrinus*	Mainly Narrow-leafed Black Peppermint Eucalyptus *nicholii* and Wallangarra White Gum *Eucalyptus scoparia*, less severe on other eucalypts and allied genera. A sap-sucker or bug. The main egg-hatching period is during the cooler months. Insect populations rapidly reach plague proportions. Sap-sucking from leaves causes foliage to turn characteristic bronze (*E. nicholii*) or red (*E. scoparia*) during winter, leading to defoliation. Repeated defoliation events can deplete tree energy reserves resulting in dieback and death. Adult bugs are highly mobile and can swarm from tree to tree if crowns contact, or be blown by wind to new trees, or even "hitch-hike" on birds. Previous widespread planting of susceptible host trees means chemical treatment is probably cost prohibitive.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning ▪ **Control** - Chemical control to be used only as a last resort. Micro-injection into stem, or soil injection, with imidacloprid. Crown-spraying of mature trees subject to granting of special licence from NSW DPI. Note that soil injection and crown spraying will also kill beneficial organisms.	▪ Ensure all material is chipped promptly. ▪ Where practical hose vehicles off before leaving site ▪ Transport material in covered vehicle. ▪ Ensure all equipment, clothing, tools and vehicles are washed or cleaned before moving to other areas. ▪ Report to Council immediately.

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Scale Insects	*Numerous* species	Sap sucking insects commonly found on Lilly Pilly leaves and stems, and other species. Chinese Tallow Tree *Sapium sebiferum* is also highly susceptible to Chinese Wax Scale, especially when growing as street trees. Bugs excrete honeydew which provides a substrate for sooty mould that forms on leaves and surrounds. Sooty mould coats leaves, reduces photosynthesis and weakens trees. Honey-dew also drips onto whatever is beneath tree, causing nuisance.	▪ **Prevention** - Avoid purchase of infested stock. Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - On smaller trees, spray white-oil directly over scales to cause suffocation, oil can be mixed with insecticide. Do not spray on when temp >300. - Micro-injection into stem, or soil injection, with imadocloprid on larger trees. Crown-spraying of mature trees subject to granting of special licence from NSW DPI. Note that soil injection and crown spraying will also kill beneficial organisms.	▪ Pruning's should be promptly chipped to destroy scales.
Borers/Longicorn Beetle/ Jewel Beetle	*Phoracantha spp*. and many other species.	Numerous woody species including Eucalyptus, Corymbia, Acacia *et al*. Note that trees are part of the food chain and some borer damage is normal. Larvae generally feed in phloem and/or sapwood and will typically create exit hole at surface just before pupation. Some species like bulls-eye borer and giant wood moth induce long split in bark over hole. Borers are only a problem if they repeatedly and in great numbers attack a tree year after year. Short-lived species such as acacia are typically 'recycled' by borers at the end of the tree's life.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Removal of badly damaged trees.	▪ No special hygiene requirements apply.

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Spitfires/Painted Cup Moth	*Doratifera spp*.	Stinging moth larvae common on Eucalyptus, Corymbia, melaleuca, guava, apricot. Insect family Limacodidae. The stout, slug-like caterpillars are usually a pale green, and may be marked with purple or brown, depending on the species. Each end of the caterpillar is often armed with clusters of sharp spines. When the caterpillar is disturbed, these spines are erected, but at rest they are retracted inside tubes. The spines cause intense stinging if they touch the skin, and may even cause large lumps to appear. Adult cup moths lay clusters of eggs on the leaves of food plants such as Eucalyptus and other trees, and often cover them with hairs from their own bodies. When the caterpillars hatch, they begin to feed in groups on the surface of a leaf. As they mature, they move off to feed on a whole leaf each. When the cup moth caterpillar is ready to pupate, it spins a hard, smooth oval or pear-shaped cocoon (the 'cup') attached by the base to a twig. The moth emerges by pushing off a circular cap or lid.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Not usually necessary. Branches with heavy infestations could be pruned off. Beware of stinging spines.	▪ No special hygiene requirements apply.

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Sycamore (Plane Tree) Lace Bug	*Corythucha ciliata*	Sap sucking insect native to North America, feeds on the undersides of leaves of Sycamores (Plane Trees), especially *Platanus occidentalis.* It was identified on London Plane Trees growing in Sydney CBD in 2007 by an Irish entomologist holidaying in Australia. Adults and nymphs feed on the underside of leaves. This initially causes white stippling, progressing to bronzing, chlorosis and, eventually, premature leaf drop. Severe infestation in late summer can even cause defoliation. Several consecutive years of heavy infestation may kill trees. Damage to plane trees has been worsened by the stress brought on by drought conditions. Outbreaks often occur in January to February and are associated with low rainfall. Current infestation appears to not affect trees west of Newcastle and Cooks Hill. Is easily spread on clothing, equipment and vehicles. Pest overwinters in crevices of buildings or trees.	▪ **Prevention** - Avoid purchase/transport of infested stock. - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Hygiene protocols to avoid spread. - Pruning works to be undertaken when infestation present. - Removal of severely damaged trees. - Use of water blasting up in amongst canopy can	▪ Ensure all material is chipped promptly. ▪ Where practical hose vehicles off before leaving site ▪ Transport material in covered vehicle. ▪ Ensure all equipment, clothing, tools and vehicles are washed or cleaned before moving to other areas with Plane trees.

INSECT PESTS REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Fig-leaf Beetle	*Poneridia semipullata*	Mainly on Port Jackson Fig, but can occur on other species. Both the adult and the larvae are defoliators of fig trees, but each cause different damage. Larvae usually feed in groups (they resemble sawfly larvae) grazing the lamina (leaf surface) and leaving white, papery leaf-tissue behind. Very young grubs are yellow but later become black. They are a fleshy, hairy, roughened grub, widest at the head end and growing to about 1 centimetre. Clusters of young grubs look like sawdust on the leaf. There may be several generations per season. Adults feed on the leaves also, chewing from the margin inwards until the leaf is totally consumed. Adult beetles are about 1 centimetre long and are dull-brown with prominent antennae. Generally, leaf beetles are most destructive from October through to about March, but when large populations are present, damage may occur over a longer period. Adults persist over winter. Populations of Fig-leaf Beetle can periodically increase rapidly and can defoliate entire trees. Repeated defoliation events can cause branch dieback and in extreme case, tree death. Fig-leaf Beetle is usually controlled by its own predatory beetle. Occasionally, populations of Fig-leaf Beetle will reach plague proportions and may require chemical control.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Spraying with carbamate-based insecticides is possible for smaller trees but may require a special licence from the NSW DPI for use on large urban trees. - Large trees - micro-injection into stem, or soil injection, with imidacloprid. Note that soil injection and crown spraying will also kill beneficial organisms.	▪ No special hygiene requirements apply.

INSECT PESTS IN AUSTRALIA – NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Lantana Tree Hopper	*Aconophora compressa*	This Central American species of bug was released by the Queensland Department of Natural Resources & Mines in 1995 as a biological control for weedy species of Lantana. The bug has since also been found damaging Fiddlewood and Jacaranda. The bug has been anecdotally reported as far south as Terrigal but as yet not reported in Newcastle. The treehopper is brown and up to 8 millimetres long with a horn-shaped head. The bugs assemble in large numbers and suck sap from the stems of host plants. Most of its known host species are in the verbena family (verbenaceae). In its native habitat in Mexico it is only associated with plants in genus Lantana. The treehopper lays eggs on plant stems and then guards the eggs against predators. Nymphs progress through five instars before reaching adulthood in about 45 days. Populations can rapidly reach plague proportions. Mass removal of photosynthates through sap sucking can quickly deplete tree reserves, leading to dieback and death of affected parts. It excretes copious amounts of honeydew, which cause other problems of sooty mould.	▪ **Prevention** - Avoid purchase/transport of infested stock. - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - No practical non chemical controls.	▪ Ensure all material is chipped promptly. ▪ Where practical hose vehicles off before leaving site. ▪ Transport material in covered vehicle. ▪ Ensure all equipment, clothing, tools and vehicles are washed or cleaned before moving to other areas. ▪ Report to Council immediately.

INSECT PESTS IN AUSTRALIA – NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Cuban Laurel Thrips	*Gynaikothrips ficorum*	Mainly on Hill's Weeping Fig *Ficus* microphylla var. *hilli*. Adult and nymphal thrips feed on the upper surface of young and expanding leaves, causing reddish feeding scars along leaf midribs. Leaves in the process of unfolding become deformed, tightly curled and folded, appearing crescent-shaped. Damaged leaves may first turn reddish, then dark brown and hard, before dropping from the plants. Besides causing unsightly plant damage, infestations slow plant growth. Occasionally, Cuban laurel thrips also bite people who come into contact with infested plants.	▪ **Prevention** - Maintain tree health through good cultural practice, i.e. prevent soil compaction, carry out mulching, reliable irrigation, fertilising when necessary, and appropriate pruning. ▪ **Control** - Small trees – prune off new growth to eliminate oviposition sites and the population should die out before additional new plant growth emerges. - Spraying with systemic insecticides is possible for smaller trees but may require a special licence from the NSW DPI for use on large urban trees. - Large trees - micro-injection into stem, or soil injection, with imidacloprid. Note that soil injection or crown spraying will also kill beneficial organisms.	▪ Prompt chipping of prunings.

INSECT PESTS IN AUSTRALIA – NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
Ash Whitefly	*Siphoninus phillyreae*	Ash whitefly (Siphoninus phillyreae) is a pest of several horticultural crops and ornamental plants in Europe and north Africa. It has spread to the United States and New Zealand, and been detected in South Australia and New South Wales. When not under the control of its natural enemies, it can cause significant damage to host plants. Affected plants have unsightly sooty mould which grows on honeydew produced by the pest. The first sign of an ash whitefly infestation is the small (1-2mm), white, winged adults resting on host plant leaves or fluttering around like tiny moths when disturbed. On an infested plant, the undersides of the leaves carry large numbers of adults and nymphs. The fourth stage nymphs are distinctive with noticeable spines that are tipped with globules of white waxy material. The whitefly is particularly noticeable on deciduous hosts when they are shedding leaves. The adults swarm around the plant as they prepare to search for an evergreen host. Ash whitefly breeds on a range of ornamental hosts including ash species, crepe myrtle, privet, magnolia, buckthorn and hawthorn and on fruiting plants including pomegranate, olive, apricot, peach, pear, Japanese plum, apple, citrus and quince. The pest can also infest other small tree and shrub species when populations are high.	▪ **Prevention** - Avoid purchase/transport of infested stock. Note that Ash whitefly can be moved on plants from infested areas and can also be moved accidentally in vehicles and on clothes. ▪ **Control** - Pending registration of chemicals for control, should be similar to control for other sap-suckers. - Probable: Small trees – spray with systemic insecticide such as Confidor™, Rogor™, and similar. Micro-injection into stem, or soil injection, with imidacloprid on larger trees. Crown-spraying of mature trees subject to granting of special licence from NSW DPI. Note that soil injection and crown spraying will also kill beneficial organisms. - The pest can be suppressed through the introduction of its natural enemies such as Encarsia inaron. Ash whitefly has been brought completely under control in the USA through the use of this parasite. - (Main source: Queensland Department of Agriculture & Fisheries)	▪ Ensure all material is chipped promptly. ▪ Where practical hose vehicles off before leaving site ▪ Transport material in covered vehicle. ▪ Ensure all equipment, clothing, tools and vehicles are washed or cleaned before moving to other areas. ▪ Report to Council immediately.

INSECT PESTS IN AUSTRALIA – NOT REPORTED IN NEWCASTLE				
Common Name	**Scientific Name**	**Comment**	**NCC Control potential controls**	**Hygiene requirements for all works**
		Ash whitefly has shown a preference for a temperate climate and temperate species of plants. Heavy infestations lead to premature leaf drop, wilting and smaller fruit. Whitefly infestations produce large quantities of honeydew on which black sooty mould grows. Damage includes loss of fruit and, at times, tree death. When the pest was first introduced to California in the United States without its natural enemies, it caused a significant amount of unsightly damage to ornamental trees in the urban landscape. Street inventories in 14 cities in California recorded 17% of trees affected.		

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Powdery mildew - http://ccmg.ucanr.edu/files/123752.pdf (not a great website) and http://www.clemson.edu/extension/hgic/pests/plant_pests/trees/hgic2002.html

Plane Anthracnose - http://www.elmsavers.com.au/factsheet/pests-and-diseases/plane-tree-anthracnose and https://www.rhs.org.uk/Advice/Profile?PID=694; http://www.metrotrees.com.au/disease-problems-in-the-genus-platanus/

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Botryosphaeria parva - https://www.csu.edu.au/__data/assets/pdf_file/0004/455197/NWGIC-fs4-botdieback.pdf

Ash White Fly: Queensland Department of Agriculture & Fisheries - https://www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant/ash-whitefly)

Other useful websites:

Chemicals & Pesticides: NSW Environment Protection Agency - http://www.epa.nsw.gov.au/pesticides/index.htm

Biosecurity: NSW Department of Primary Industries - http://www.dpi.nsw.gov.au/biosecurity

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Newcastle City Council Tree Pit Soil Specification

Specification: Newcastle City Council Tree Pit Soil Specification

Part A. 'Fit-for-purpose' performance description

A high permeability medium for use as the growing medium and light pavement support in urban tree pit installations. The permeability, aeration and compaction resistance are the important physical factors to consider in this mix however the nutrition is equally important to sustain plant life. The mix is installed in two or three layers; 100mm of medium coarse sand on top of one or two layers of Amsterdam tree soil as per Figures 1 and 2. The Amsterdam Tree Soil A horizon is comprised of predominantly medium coarse sand with 2-5% clay and 4-5% organic matter. The B horizon is comprised of predominantly coarse sand with 2 – 4% clay and <3% organic matter.

Part B. Product specification (technical parameters)

Generally, the soil must be free of 'unwanted material' and must meet all the Target ranges of Tables 1.0 and 2.0. Where engineers have otherwise specified permeability that specification will over-ride permeability from Table 1.0.

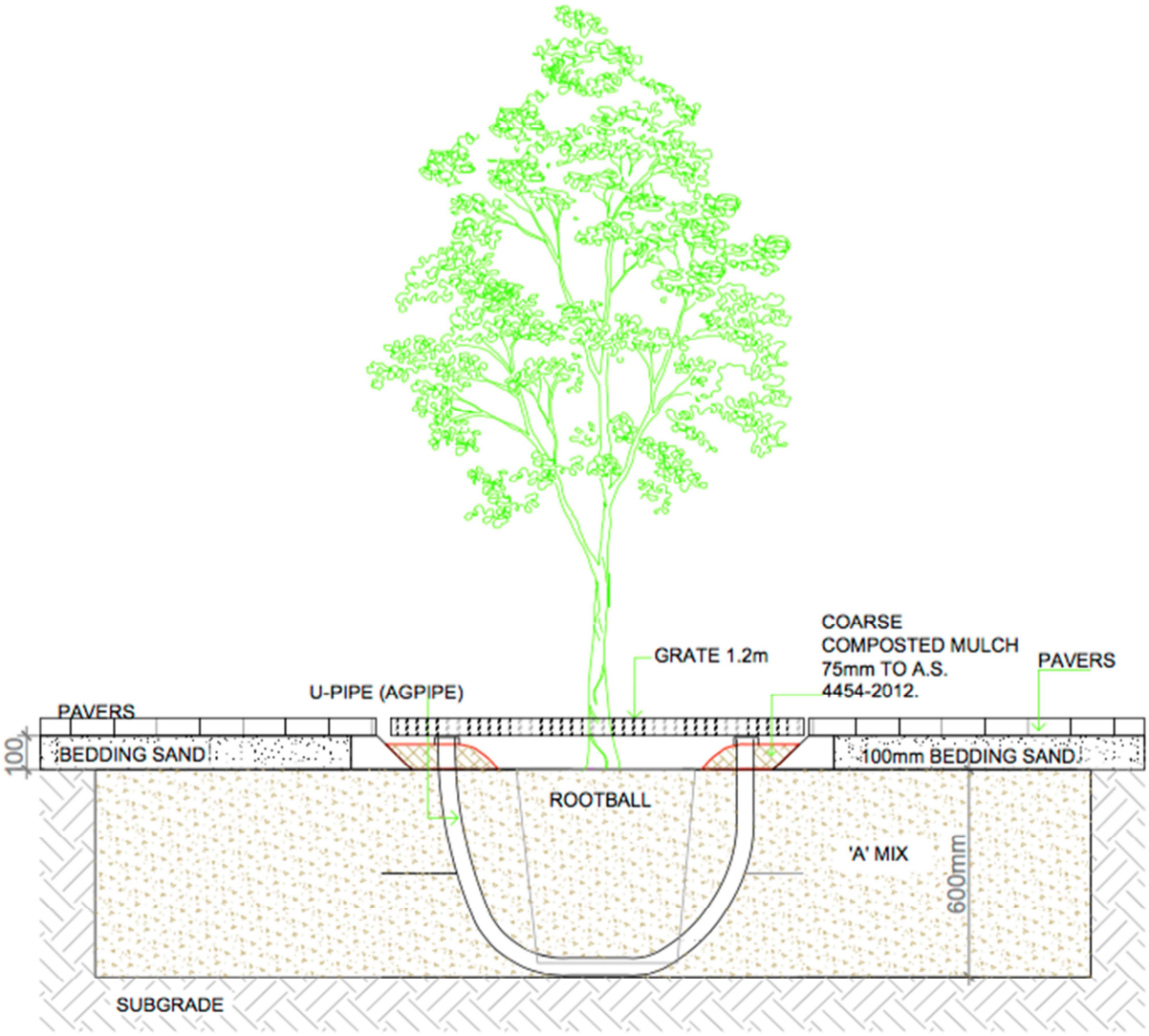

Figure 1: Two-layered Amsterdam Tree Soil Profile. Refer to Council's standard drawings for design details.

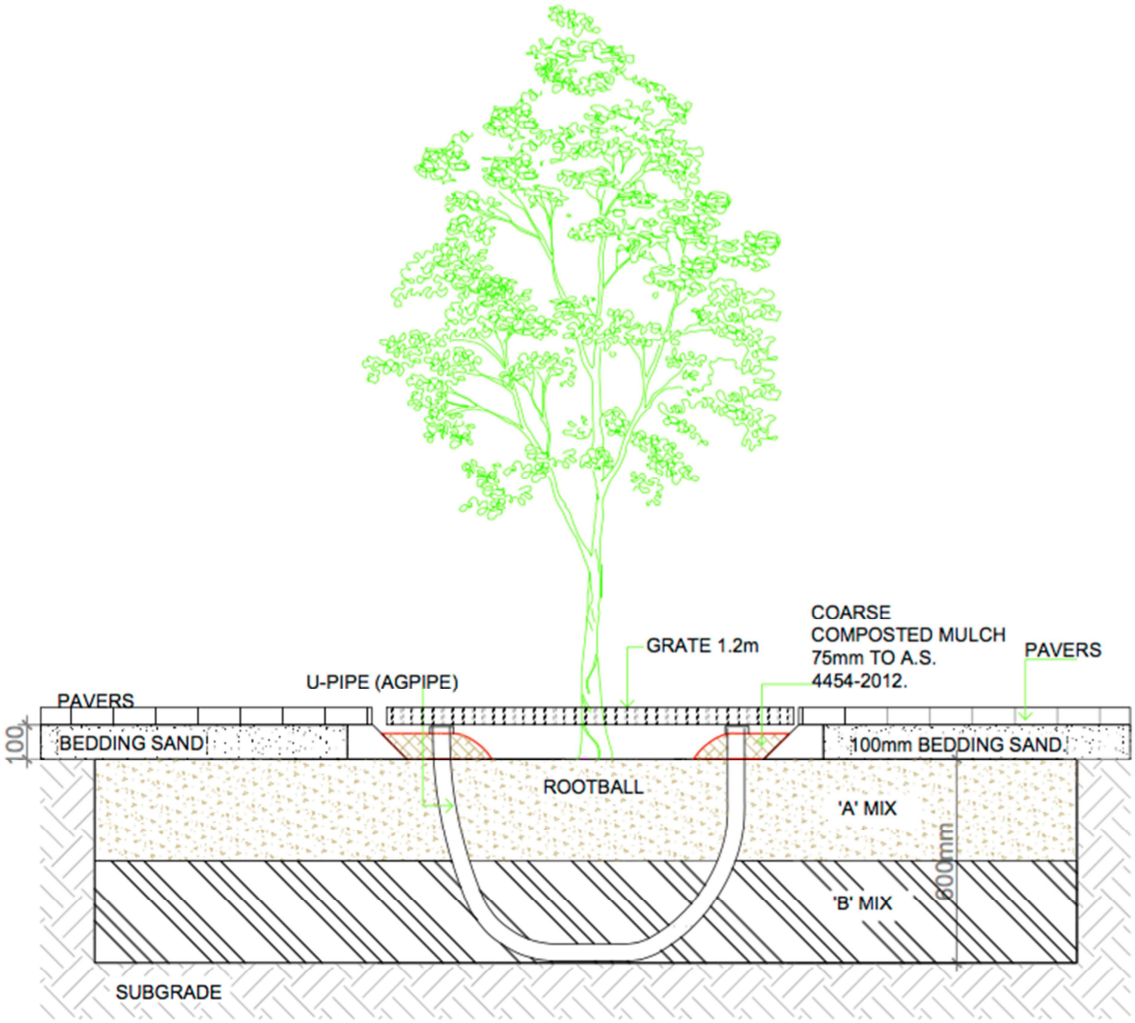

Figure 2. Three-layered Amsterdam Tree Soil typical profile. Refer to Council's Standard Drawings for design detail.

Table 1 Physical properties – A & B horizons

Property	Units	Target range (A mix)	Target range (B mix)
Texture, preferred range	n/a	Sandy Loam	Loamy sand
Permeability (USGA)	mm/hr	25 - 50	40 - 80

Property	Units	Target range (A mix)	Target range (B mix)
Wettability	mm/hr	>5	>5
Large particles (naturally occurring)			
2–20 mm	% w/w	< 20	< 20
> 20 mm	% w/w	< 10	< 10
Visible contaminants > 2 mm (glass, plastic and metal)	%w/w	< 0.5	< 0.5
D60/D10 of the sand	-	>2.5	>2.5
pH (1:5 in water)	pH units	5.5–7.5	5.5–7.5
Electrical conductivity (1:5)	dS/m	< 1.2	< 1.2
Phosphorus P-Tolerant Plants	mg/kg	30 – 80	N/A
Phosphorus P-Sensitive Plants	mg/kg	< 30	N/A
Available nitrogen	mg/kg	> 25	N/A
Organic matter	% w/w	3-5%	<3%
Target particle size distribution			
2.0–3.35 mm fine gravel	% w/w	< 7%	< 7%
1.0mm very coarse sand	% w/w	5-20%	5 – 20%
0.50mm coarse sand	% w/w	< 60%	<70%
0.25mm medium sand	% w/w		
0.15mm fine sand	% w/w	< 40%	<35%
0.106mm very fine sand	% w/w		
0.053mm very fine sand	% w/w		
0.02mm silt	% w/w	< 10%	<5%

Property	Units	Target range (A mix)	Target range (B mix)
0.002mm clay	% w/w		

Note that the particle size ranges are suggested, and the compacted hydraulic conductivity is a more important parameter for suppliers to meet. Predicting hydraulic conductivity based on particle size is difficult and variable.

The bedding sand will be a well-graded material that meets the following particle size requirements.

Table 2 Physical properties Bedding Sand

Sieve size (mm)	**Unit**	**% Passing**
9.52	% w/w	100
4.75	% w/w	90 – 100
2.36	% w/w	80 – 100
1.18	% w/w	50 – 85
0.600	% w/w	25 – 60
0.300	% w/w	10 – 30
0.150	% w/w	5 – 15
0.075	% w/w	0 - 10

Part C. Example components for the soil supplier

The following table outlines suggested components that may likely meet the physical Target ranges of this specification. This is **not** part of the product specification. It is an example for the edification of the soil supplier of what might meet the product specification. The arrangement of soil elements is shown in Figure 10.1.

Example suggested components for the A and B horizons

Component	**A mix**	**B mix**
Loamy sand or sandy loam soil	20% v/v	10 – 20% v/v
Medium coarse sand (0.2-0.5mm)	70–80%	70 – 85% v/v

	v/v	
Composted soil conditioner conforming with AS4454	20 - 30% v/v	10% v/v

Example base level Target ranges for fertilisers for the A mix layer (to be verified by laboratory testing and per agronomist's report)

Organic fertiliser (e.g. poultry manure)	5 kg/m^3 or 500 g/m^2
Compound controlled release fertiliser NPK (16:4:14)	4 kg/m^3
Trace element mix	0.1 kg/m^3 or 10 g/m^2

For the purposes of tendering, the contractor must allow for the inclusion of the above soil amendments, but the specific amendments required must be verified by laboratory testing and agronomist recommendations.

Planting and Installation details
Soil Specification under paved areas.

Trees in Limited Space

The specification prepared for Newcastle a Council based on the Amsterdam tree soil pits comprise compacted soil in two or three layers. At the surface, a paving bedding layer of medium – coarse sand is compacted to 100% Proctor Density. The Amsterdam soil below is usually one layer (A mix) and is compacted to 1.5 – 2.0 MPascal, which equates to about 70 – 80% Proctor Density (Couenberg, 1993) by way of watering in layers. Note that Councils standard drawings and soil specification have been finalised in consultation with NCC engineers.

In this situation, trees will be containerised by the surrounding environment such as roads or buildings, and have limited surrounding space. Pits will generally be in a 3.4m wide footpath, and have a 1.2m grate installed at the surface. The root ball is excavated to 600mm depth. The U-pipe or drainage sheets will facilitate oxygen transport within the profile (see figures 4 and 5). Where the site has good drainage, then the 2 soil layers (bedding sand over A Mix figure 4) should be used. Where the site has poor drainage, then the 3 soil layers (bedding sand over A and B horizon figure 5) should be used.

Ideally, trees along the footpath will be spaced close enough together to warrant a continuous trench. Continuous trenching will provide additional space for roots to inhabit, and decrease the risk of roots seeking the surface close to the root ball. If pits are isolated, only smaller trees should be planted, and the risk of heave is increased. (see Councils Street tree Selection Manual 2016)

When using grates, the centre hole must be enlarged as the tree grows, otherwise it will girdle the tree, and at the same time the grates will lift (Urban, 2008). With limited space, it must be expected that trees will not grow to their maximum capacity. These footpath trench situations are most suited to small to medium trees.

Use trees with minimal surface rooting such as plane trees to minimise heave. Fig trees, for example, will cause heave.

Installation Detail

There are two details in the figure below taken from the original SESL report prepared for Council.

- Figure 1 Typical cross section:

  Is to be used in footways with good subsoil drainage (e.g. sand). This option installs 2 layers. One layer is the A mix soil and the other is the bedding sand for the pavers.

- Figure 2 Typical cross section:

  Is to be used in footways with poorer subsoil drainage (e.g. silty loam or clay). This option installs 3 layers. Two distinct soil layers A and B mix and one layer of bedding sand for the pavers.

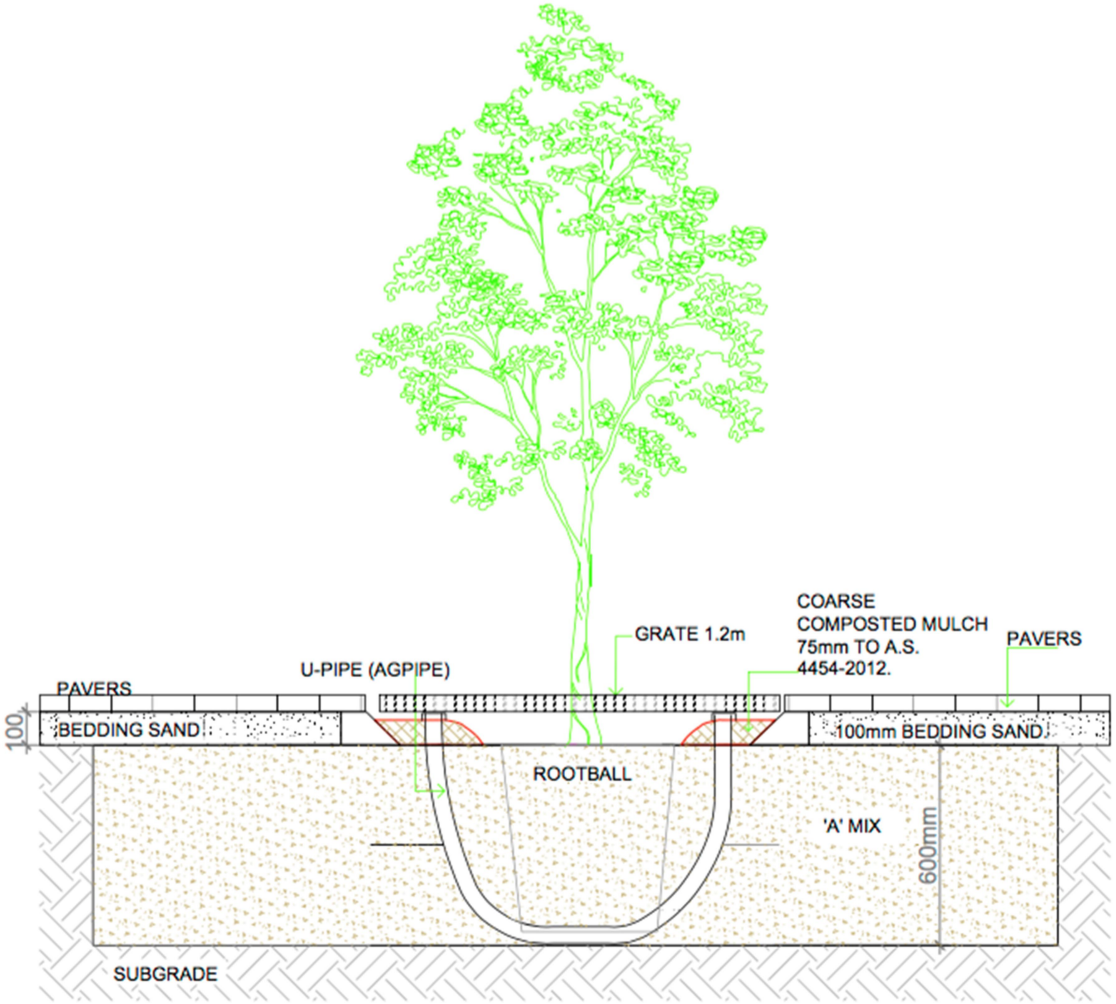

Figure 3 Typical cross section: Restricted space good drainage option (2 layers). Refer to Council's standard drawings for design detail.

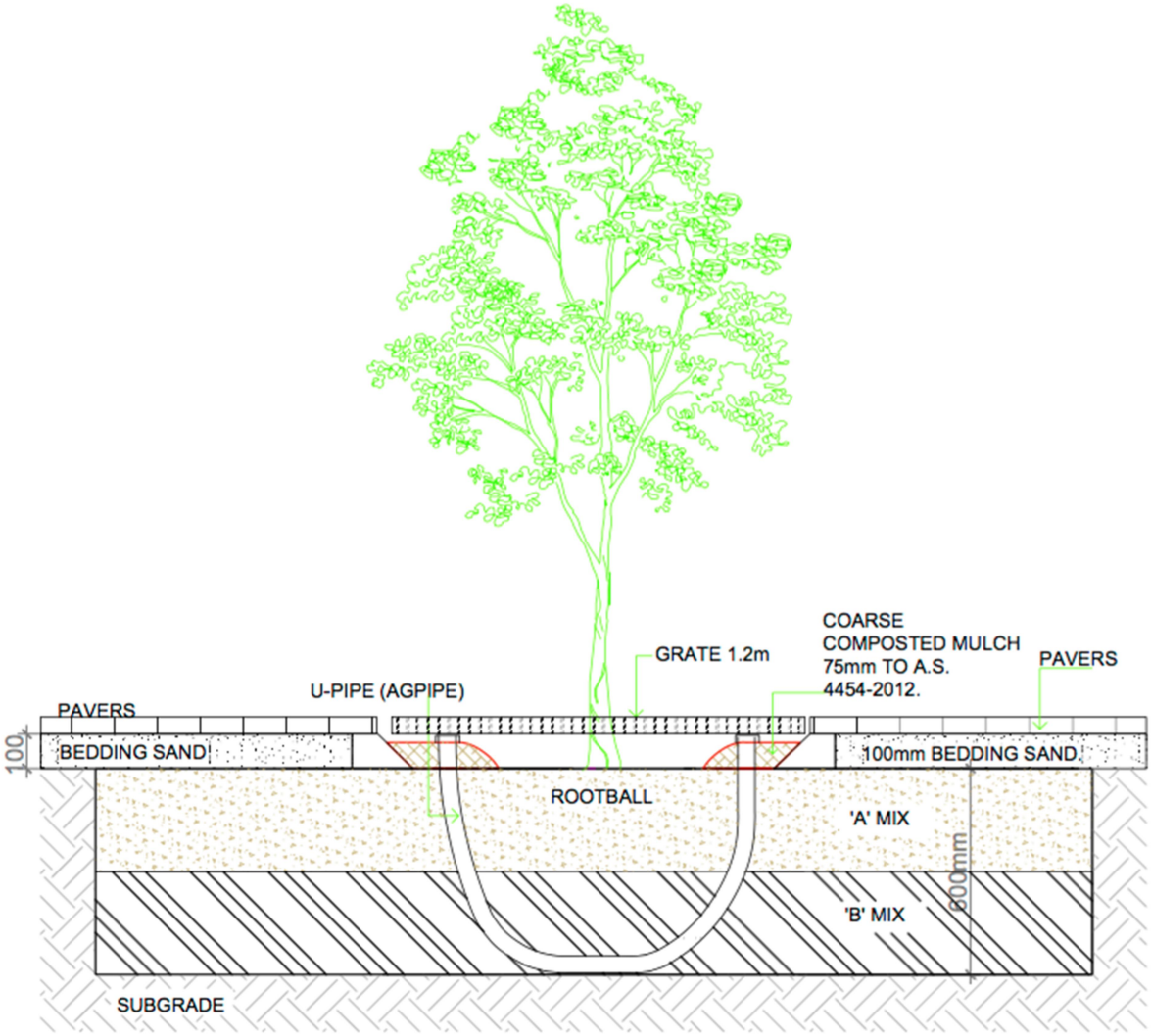

Figure 4 Typical cross section: Restricted space poor drainage option (3 layers). Refer to Council's standard drawings for design details.

Compaction

The blends provided by the suppliers that met the specified requirements were analysed to determine maximum dry density (100%) compaction, and the saturated uncompacted density. Comparing the two results allows an understanding of how compacted the material becomes when watered but not subjected to additional compaction.

The two blends that met the specification almost reach between 93% and 100% density, just by saturating with water.

As the USGA hydraulic conductivity method is a saturated hydraulic conductivity, this indicates that even at maximum compaction, these blends will still have a permeability of >30mm/hr which is ideal for street tree pits.

Installation Instructions

1. Locate services
2. Excavate pit to 600mm depth. Link pits with trenches if required. Excavate by hand around services if required.
3. If required as per drawing, install a U-pipe into the base of the pit, with both ends open to the surface
4. Do not artificially compact the A or B horizon soil
5. Backfill the pit with 300mm of A or B horizon mix as required. Wet the material during progressive placement of this 300mm layer being careful not to completely saturate the soil. The soil will slump naturally.
6. Install the additional 300mm of the A horizon mix over the surface until level with the top of the root ball. Wet the material during progressive placement of this layer being careful not to completely saturate the soil (i.e. no separation of by particle size should occur).
7. Do not cover the root ball with any soil.
8. If additional fertilizer is required, add slow release fertilizer across the surface of the soil.
9. Above the rootball, but taking care to keep mulch directly off the tree trunk, add maximum 75mm of coarse mulch that meets Councils requirements for course mulch and AS 4454 requirements
10. Install grate attaching to concrete edge.
11. Install bedding sand over the areas to be paved and lightly compact to achieve 100% Proctor Density. Note: the method used should not compress the soil below. Typically this will be two passes with a vibrating plate as the mechanical compaction (not roller).

3.1 Risk management strategies for existing trees

Strategy	Description
Monitor trip points	Where no other practical method can be employed to prevent this occurring, a regular trip point inspection program should be instigated and pavement replaced or repaired as necessary.
Flexible pathways	Use of flexible material such as bitumen, paving, or rubber compounds for footpaths and tree surrounds, will reduce the occurrence of trip points and is less expensive and easier than concrete to maintain or replace when necessary.
Re-direct pathways	Where space allows, pathways should be re-directed away from trees/tree roots. It may also be beneficial to reduce the newly directed pathway
Bridging Footpaths	Self-supporting construction methods, such as pier and beam could be used to raise pathways above the roots, allowing for root expansion without damaging the pavement. Timber bridges are an effective option.
Root pruning	Non-structural roots could be pruned on a predetermined basis under the guidance of a qualified arborist. This practice could be combined with installation of root barriers where appropriate.
Root barriers	Where future problems are perceived, barriers could be installed to deflect roots away from pavement or services.
Tunnelling for services	Tunnelling (directional boring) rather than open trenching for underground services will greatly reduce public risk as well reducing injury to tree roots. If located deeply, root contact with the pipeline may be minimised as the majority of roots of most species will remain within the top 1 metre of soil (based on a soil with medium texture).
PVC welded piping	Replacement of old porous clay pipe mains with PVC or polyurethane mainlines will significantly reduce the potential for tree root entry.
Preventative tree maintenance	Trees in public areas should be regularly inspected and maintenance, such as dead-wooding and developmental pruning carried out as prescribed. Pruning should always be undertaken in accordance with AS 4373-2007 Pruning of amenity trees.
Raising pathways	Where appropriate, pathways could be raised to reduce direct root pressure on the pavement. Care must be taken not to build up soil against the trunk of a tree. Aeration piping, in conjunction with geo-textile fabric and gravel should be installed between root zone and new pavement to aid with gas exchange to roots. Care should be taken to shape the new surface to drain water away from the trunk of the tree.
Insulated (ABC) cabling	Replacement of uninsulated overhead powerlines with insulated & bundled cables will reduce both the clearance needed and the pruning costs and severity.
Underground power and communications cables	The initially high cost of installing power underground may in fact be a practical option when compared with the projected cost of repeated pruning, the risk that this work involves to operators, the negative impact on trees, loss of public amenity and of urban forest economic contributions.

Strategy	Description
Diverting services	Services could be diverted along roadways, rather than in the nature strip where a valuable stand of trees is present. To make this option more attractive to service providers, Council's may wish to consider waiving road opening fees.
Diverting kerb/gutter	When possible, kerb/gutter could be diverted around tree roots or further away from the trunk, creating an island around the tree.
Enlarging root zone	Where space allows, a designated area above the root zone of the tree should be enlarged/created to accommodate surface roots. Rather than turf, this area could be formed into a garden bed, mulched or covered with a suitable tree grate.
Formative pruning	Early pruning will reduce the development of structural weaknesses in older trees. Refer to AS4373-2007 Pruning of amenity trees.
Remove target	In some situations it is preferable to remove a potential target, such as a seat rather than to remove a tree in order to abate a hazard.
Remove the defect	This could include pruning of live or dead branches or the removal of co-dominant stems.
Tree engineering	In some cases cabling may be used to support tree structure or to control the direction of a possible failure. This is highly specialised work.
Tree removal	In some situations it may be preferable to remove a tree and replace with a more suitable species, perhaps in an alternative location. In all cases of tree removal it is necessary to ensure that the removal is mitigated in order to ensure the future integrity of the urban forest.

Table 3.2: Common interactions and impacts between trees and structures

Structure	Typical causes of conflict with trees	Impact by trees	Impact on trees
Footpaths Concrete, Pavers and Bitumen	Pathways located too close to trees, bitumen laid over tree roots.	Lifting, heaving and cracking leading to trip hazards and increased risk.	Root pruning and root scalping leads to root decay & a potential loss of stability; reduced water and nutrient uptake; reduction of soil oxygen; loss of natural nutrient recycling; and elevated tree stress.
Kerb and Gutter Concrete	Pathway cross overs located too close to trees. Lifting, heaving, cracking and displacement.	Lifting, heaving, cracking and displacement Drainage interruptions.	Restricted root distribution effects tree stability and the critical availability of water and elements.
Underground Services Power, fibre optic, water, gas	Improperly laid eg. poorly jointed, inadequately compacted backfill; inappropriate backfill materials, pipes retained past their useful life and requiring renewal, use of technology that does not account for the dynamics of tree root development.	Blockages, crushing, displacement and heaving.	Root loss during installation; incipient decay following excavation. Changes in water table fluctuations; gas leaks; soil saturation.

Structure	Typical causes of conflict with trees	Impact by trees	Impact on trees
Overhead Services Power lines, Phone and Cable TV	Inappropriately located poles, poles shorter than prescribed heights, wires lower than prescribed height, uninsulated wires where insulated cables would be less restrictive on tree planting and safer near people, above ground transformers.	Branch and whole tree failures; wind whipping. Electrical outages, blackouts, fire, restricted access to poles.	Reduced amenity and environmental contributions ie. shade and shelter, aesthetics, PM 10 absorption; incipient decay. Poor public image for street trees.
Buildings and other load bearing structures	Minimum distances not observed, reactive soils.	Lifting and cracking of foundations; subsidence; branch and fruit shedding; reactive soils drying and wetting cycles.	Damage during site preparations and construction, reduced sunlight, wind tunnelling.
Traffic and pedestrians	Compaction.	Vehicle hitting trees. Blocked vision of road signs and access places. Trip points in footpaths.	Trees damaged or killed by vehicle accidents. Heavy and repeated pruning to achieve visibility. Decay of roots and loss of stability from root grinding for footpaths.

Table 3.3: Tree planting risk zones in streets

	ZONE A Most constraints (Greatest risk)	ZONE B Moderate constraints (Moderate risk)	ZONE C Fewest constraints (Minimum risk)
Electrical and telecommunications	uninsulated low and high voltage wires bushfires areas	bundled cables (ABC) insulated cables	no powerlines
Below ground services typical layouts	fibre optic cables high voltage power	water mains, gas mains stormwater	no underground services
Slope	steep slope	moderate slope	generally flat land
Paved areas	area wholly paved surface wholly sealed brick pavers laid on sand bedding	partially paved areas non reinforced concrete	grass up to 6m
Verge width	less than 3m	from 3m to 4m	4m or wider
Building set back	None	Less than 6m	6m or greater
Street lighting	over pedestrian crossing traffic intersections	street lighting other than crossings and intersections	no street lighting
Safety signage ie. traffic signs	dual carriageways arterial roads high density residential streets	medium density residential streets arterial roads in rural zones	low density rural/residential streets
Traffic	heavy vehicles public transport in heavy volumes	public transport in moderate volume heavy vehicles in moderate volumes	public transport in low volume residential traffic in low volume Cul-de-sacs
Soils	severely compacted shallow reactive clay acid sulphate poor drainage	moderately compacted urban fill moderate drainage	Undisturbed soil deep profile medium texture good natural drainage
Water table	high	moderate depth	deep water table

Table 3.4: Risk management control strategies

Control Strategy	Description
Root Barriers	Installation of root barriers to manufacturer's specification at the time of planting will assist tree roots to develop away from services, pavements and other structures. **Note of caution:** Tree root barriers do require periodic monitoring as roots deflected downwards will return to the surface if soil oxygen levels are not sufficient to support growth at depth. Roots can also grow over the barrier in some situations.
Soil Compaction	Proper compaction of the soil when back filling trenches or around utility easements and house footings will direct tree roots away from these areas. By achieving and maintaining compaction to 95% root growth can be inhibited through the depravation of oxygen.
Pseudo Street Trees	Residents could be encouraged to plant trees within their boundaries in preference to street tree planting. This might allow larger species to be used, and reduce pressure on pavements and services.
Design of new roads and pathways	The design of new roads and footpaths should be undertaken with consideration for tree planting on the nature strip or in the road pavement to ensure appropriate allocation of space.
Provision of aeration and irrigation	Where there is to be continuous paving around a tree, the installation of an aeration and irrigation system should be considered. Where irrigation is installed and properly operating, a tree root system will be proportionally smaller than without irrigation.
Pavement Openings	Pavement openings at the base of the tree should be as large as possible to reduce the future impact of buttressing roots on pavements. Position of the tree should be a good distance (eg. 1m) from the kerb line to reduce the likelihood of future cracking.

Table 3.5: Tree planting site characteristics

	A Most Constraint	B Moderate Constraint	C Least Constraint
Climate	• Frontline salt wind exposure • Prevailing wind exposure • Rain shadow • Extensive sealed ground surface	• Second line coastal salt influence • Moderate wind exposure • Partial rain shadow • Partial ground surface sealed	• Minimum salt influence • Minimal wind exposure • No rain shadow • Minimal ground surface sealed
Slope	• Steep slope	• Moderate slope	• Minor slope to flat land
Aspect	• Southern & western exposure	• Either southern or western exposure	• Northern & eastern exposure
Street Width and Usage	• Narrow; CBD residential and commercial • Arterial (high traffic volume)	• Non CBD; narrow residential & commercial • Suburban collector roads (medium volume traffic)	• Average to wide residential/commercial • Wide residential
Soil Type and Drainage	• Reactive clay • Poor drainage • Salinity	• Non-reactive clay • Average drainage	• Free draining open textured soil
Services	• Above ground and below ground utilities	• Above or below ground utility services	• No utility services

Urban Forest Technical Manual

Appendix 4 – Material Specification Gap-graded Soil and GMB 20 Base

4.1 Gap-graded soil specification

Gap-graded soil shall be equivalent to the specification below. A sample of the filler soil and additives must be tested for compliance with the specification and results submitted to Council prior to installation.

Gap-graded Soil Transportation - Gap-graded soil shall be delivered to site pre-blended. The soil mix shall be transported in a moist condition to prevent segregation of components.

Gap-graded Soil Mix Components by Volume

- 80% 40mm Basalt aggregate. Narrowly graded uniform sized angular clean hard and durable gravel sized 25mm to 75mm.
- Filler Soil – 10% Screened Menangle Sandy Loam and 10% Screened Virgin Clay (remove any clay greater than 15mm)

Table 4.1.1 Required Filler Soil Properties

Property	Unit	Quantity/ Acceptable Range
Chemical		
pH in water (1:2)	mS/cm	5.5 - 7.0
pH in CaCl2	mS/cm	5.5 - 7.0
Electrical Conductivity	dS/m	< 2.5
Soluble Cations		
Sodium	% ECEC	< 5
Potassium	% ECEC	5 - 15
Calcium	% ECEC	60 -75
Magnesium	% ECEC	5 - 25
Calcium : Magnesium		2 - 6
Nutrient mg		
Phosphorous (Bray)	Mg/kg	< 30
Ammonium	Mg/kg	< 200
Nitrate	Mg/kg	< 100
Sulphate	Mg/kg	40 < 100
Physical		
Organic matter	% by mass	<1
Permeability - AS4419	cm/hr	2 - 100
Toxicity Index		> 50
Wet ability		> 5
Bulk Density (Standard)		> 0.7
Particle Size Distribution (Aggregate)AS1141.11	% Passing through sieve	
75 mm		100
53 mm		91
37.5 mm		64

Property	Unit	Quantity/ Acceptable Range
26.5 mm		34
19 mm		24
13.2 mm		22
9.5 mm		22
6.7 mm		21
4.75 mm		21
2.36 mm		21
1.18 mm		20
0.60 mm		18
0.30 mm		12

4.2 GMB 20 base specification

GMB 20
(Reference: RTA - Unbound and Modified Base and Sub-Base Materials for Surfaced Road Pavements)

Install 20mm GMB 20 to a minimum depth of 150mm over the finished surface of Gap-graded soil.

Table 4.2.1 GMB 20 Properties

Ref: Table 3051.1 - Unbound Material (Based on Particle Size Distribution) - Specification Requirements

Property	Defect Weighting Value	GMB 20 Base
RTA T106: (a) Coarse Particle Size Distribution [i] Passing AS Sieve (% by mass)		
75.0 mm	2	-
53.0 mm	2	-
37.5 mm	2	-
26.5 mm	2	100
19.0 mm	2	95-100
13.2 mm	2	50-70
6.70 mm	2	30-55
2.36 mm		20-30
RTA T106 & T107: (b) Maximum Permitted Deviation of Material Supplied from Nominated Particle size distribution [i, iv] Passing AS Sieve (% by mass)		
75.0 mm	1	-
53.0 mm		-
37.5 mm		-
26.5 mm		-
19.0 mm	2	-
13.2 mm	2	±8
6.70 mm	2	±5
2.36 mm	2	±4
425 µm vii	1	±3
75 µm vii	1	±2

Property	Defect Weighting Value	GMB 20 Base
RTA T107: (a) Fine Particle Size Distribution Ratios expressed as percentages		
A. Pass 425 µm sieve % / Pass 2.36 mm sieve		30-50
B. Pass 75 µm sieve % / Pass 425 µm sieve		30-50
C. Pass 13.5 µm sieve % / Pass 75 µm sieve		-
RTA T108: Liquid Limit (if material non-plastic) [i] For natural or manufactured		max 20[v]
For recycled building material		max 27
RTA T109: Plastic Limit (if plastic) [i]		max 20

4.3 Additives and fertilizer schedule

The following additives are to be thoroughly mixed with the filler soil prior to blending with crushed aggregate. Additives will be tested for compliance, and results submitted to the Principal's representative prior to blending with the crushed aggregate.

Table 4.3.1 Additives/Fertiliser Schedule for structural Soil Mix

Additives	Rate
Magrilime	600g/m3 (to bring pH to 5.5 – 6.5)
Trace element mix	300g/m3
Potassium nitrate	500g/m3
Ammonium nitrate (Nitram)	500g/m3
Superphosphate	500g/m3
Iron sulphate	1500g/m3
8-9 month control release fertiliser	500g/m3
Magnesium sulphate	400g/m3

Tree Pruning
Specification

The City of Newcastle

Part 1: Applicant and site details

1. Details of the property owner

Property Owner to retain completed form for min 2 years.

*This form **is to** be submitted with Heritage Minor Works Form where pruning is proposed for Heritage Listed Items or Aboriginal heritage.*

Title: ☐ Mr ☐ Mrs ☐ Miss ☐ Ms ☐ Other .....

Family name (or company) .....

Given name/s .....

Postal address.....

..... Postcode .....

Phone……..Alternative phone.....

E-mail .....

Only if a company:

Contact person ……Reference no .....

2. Location and title description of the property

To correctly identify the land.

Unit No ……House No ……Street.....

Locality.....

Lot(s)……Section.....

Deposited Plan(s) ……Strata plan .....

Other .....

(Get these details from the rate notice or property deeds, or from Council property maps)

Part 2: The Person competent in arboriculture assessment

3. The person competent in arboriculture assessment is

Qualification
(minimum Level AQF 3 required or overseas equivalent)

AQF Level:……..in arboriculture Certificate No: .....

Course Provider: .....

OR

Equivalent Qualification: .....

Certificate No: .....

Course Provider: .....

As the competent person I have:

1. carried out a thorough inspection of the tree to be pruned.
2. determined the need for pruning.
3. specified the current and subsequent pruning requirements.
4. determined that the specified pruning will not adversely affect the tree.
5. considered all applicable planning, heritage and protected species legislation in the context of the proposed pruning.
6. assessed each tree for hollows or other likely habitat, and either (circle A or B):
   a. found no evidence to warrant further assessment, or
   b. have arranged for further assessment by an ecologist or wildlife specialist prior to pruning

I recommend the specified pruning be carried out by a person suitably qualified and experienced in arboriculture with the minimum AQF level 2 in Arboriculture, and that the pruning be undertaken only in accordance with this specification.

Lopping, topping, wound painting and flush cutting shall not be undertaken and climbing spikes shall not be used except in order to assist in the aerial rescue of an injured person.

Part 3: Pruning Classes and Specification Details

4. Note

Fill in details only for the class or classes of pruning specified.

For DEAD WOOD pruning, the minimum diameter and location of branches to be removed shall be:

.....

.....

For CROWN THINNING, the percentage of the total crown to be removed and the maximum diameter and location of branches to be removed shall be:

.....

.....

For SELECTIVE PRUNING, the branches to be removed shall be:

.....

.....

For REDUCTION PRUNING, the extent of crown or limb reduction shall be:

.....

.....

For CROWN LIFTING, the clearances to be achieved and the maximum diameter and location of branches to be removed shall be:

.....

.....

For REMEDIAL PRUNING the initial and subsequent pruning events and the pruning requirements shall be:

.....

.....

The detailed reason(s) for recommending the REMEDIAL PRUNING are

.....

.....

.....

For PALM PRUNING, tools shall be disinfected to minimise the chance of spreading palm disease including Palm Wilt

Signature of competent person: ..... Date: .....

Report Storm Damage Tree Removal

The City of Newcastle

Date: _____

Part 1: Applicant and site details

1. Details of the property owner

Property Owner to provide copy of completed form to Council for Heritage Listed Trees within 5 days of removal. For all other cases Owner to retain completed form for min 2 years.

Title: ☐ Mr ☐ Mrs ☐ Miss ☐ Ms ☐ Other .....

Family name (or company) .....

Given name/s .....

Postal address.....

..... Postcode .....

Phone……..Alternative phone.....

E-mail .....

Only if a company:

Contact person ……Reference no .....

1. Location and title description of the property

To correctly identify the land.

Unit No ……House No ……Street.....

Locality.....

Lot(s)……Section.....

Deposited Plan(s) ……Strata plan .....

Other .....

(Get these details from the rate notice or property deeds, or from Council property maps)

Part 2: The Arborist or person who undertook removal of the tree

2. All requirements must be completed for this to be a valid form

Name: ……Phone: .....

Address:.....

As the person who undertook the removal I have:

1. carried out a thorough inspection of .....(number) tree/s .....(species), and
2. determined that the tree/s structure is significantly compromised, and therefore poses an unacceptable risk to life and property, and
3. assessed each tree for hollows or other likely habitat, and either (circle A or B):
   a. found no evidence, or
   b. arranged for local wildlife group (eg. Wires) to attend during removal.
4. attached appropriate clear photos to adequately demonstrate the trees structural failure.
5. only removed tree/s where their structure was compromised, and there was no practical alternative to retain them.
6. provided a site plan on page 2 to show where the tree was located in relation to the dwellings and boundaries.

Signature of person who owns Tree: ..... Date: .....

Signature of person who removed Tree: ..... Date: .....

Arborist Report
To support Permit Application for Tree Removal

The City of Newcastle

Date: _____

Part 1: Applicant and site details

1. Details of the property owner

This form is to be attached to the Permit Application for Tree Removal form.

Title: ☐ Mr ☐ Mrs ☐ Miss ☐ Ms ☐ Other .....

Family name (or company) .....

Given name/s .....

Postal address .....

..... Postcode .....

Phone..... Alternative phone .....

E-mail .....

Only if a company:

Contact person .....

2. Location and title description of the property

To correctly identify the land.

Unit No ..... House No ..... Street .....

Locality .....

Lot(s) ..... Section .....

Deposited Plan(s) ..... Strata plan .....

Other .....

(Details from rate notice or property deeds, or from Council property maps)

Part 2: The person competent in arboricultural assessment is

3. The person competent in arboriculture assessment is

Qualification
(minimum AQF Level 5 in arboriculture and relevant experience in accordance with Part A, Section 6.0 of the Newcastle Urban Forest Technical Manual.)

Business name .....

Name of arborist .....

Phone ..... E-mail .....

AQF Level …….. in arboriculture Certificate No .....

Course Provider .....

As the competent person I have:

1. carried out a thorough inspection of the ..... (number) tree/s to be removed.
2. determined the need for removal.
3. specified the tree assessment test that applies.
4. determined that no suitable remedial action is possible.
5. considered all applicable planning, heritage and protected species legislation in the context of the proposed removal.

	6. assessed each tree for hollows or other likely habitat, and either (circle A or B): a. found no evidence to warrant further assessment, or b. have arranged for further assessment by an ecologist or wildlife specialist prior to submission of this document. 7. attached appropriate clear photos to demonstrate the issues raised with the tree/s and any other relevant factors as required under the tree assessment test/s. 8. considered all the relevant information under Part A section 3 of the Newcastle Urban Forest Technical Manual. 9. included an accurate site diagram showing location of trees/s in relation to structures and boundaries. 10. included an underground utility diagram where removal relates to these. 11. only recommended removal of trees where there is no practical alternative.
4. Select the relevant Tree Assessment Test	☐ 3.4.4.1 The Unacceptable Risk Test ☐ 3.4.4.2 The diseased condition test ☐ 3.4.4.3 The property damage test *within 12 months of assessment* ☐ 3.4.4.4 The suppressed growth test

The following information is provided to support the tree removal application at the above address. This information addresses all of the requirements of the selected tree assessment test, and any other information required in accordance with Part A section 3 of the Urban Forest Technical Manual. Relevant information regarding disclaimers, photos, and any other evidence to support the application is attached to this form.

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Name of competent person: .....

Signature of competent person: ..... Date: .....

NCC ASSESSMENT FOR COMPLIANCE WITH NATSPEC GUIDELINES

Checklist to be completed with reference to Clark, R. (2003)
Specifying Trees. A guide to assessment of tree quality. (2nd edn). NATSPEC//Construction Information.

The City of Newcastle

Tree Species:

	Tree No	1	2	3	4	5
	BALANCE ASSESSMENT	Refer to pages 20-27				
complete for small trees	**Tubes/cells** Height above soil level = 1.5 - 2.5 x height of tube or cell					
	Trees < 20L refer toTable 3.1					
	Bend Test					
complete for large trees (>20L)	**Desired size index for pot size** refer to tables 3.5, 3.6					
	Total Tree Height (A) tip of tree to top of pot/rootball in meters					
	Calliper (mm) @ 300mm above top of pot					
	Actual Size Index = height (m) x calliper (mm)					
	ABOVE GROUND ASSESSMENT:					
	Health & Vigour (Y or N) foliage & extension growth same size, colour as shown in vigorous healthy spp.					
	Free from Pest & Disease (Y/N)					
	Free from Injury					
	Self Supporting (Y/N) (refer to page 40 NATSPEC)					
	Stem Taper (Y/N)					
	Stem Structure (refer to pg 10 NATSPEC)					
	Included Bark (Y/N) Bark ridges at junction of branches/ stems is convex					
	Trunk Position (Y/N) (central or >10% variance - refer to page 12)					
	North Point Marked (Y/N)					

Tree No	1	2	3	4	5
Apical Dominance (Y/N) has a defined single leader + apical bud intact					
Crown Symmetry variation is < 20%					
PRUNING ASSESSMENT:	Refer to pages 3-8				
Clean Stem Height (B) in (m)					
% (B/Ax100) is not >40% of total tree height					
Fresh Pruning Wounds (C) is <20% of total tree height (A)					
Wound diameter (X) is not >50% of the Calliper (Y) immediatel above point of pruning					
BELOW-GROUND ASSESSMENT:	Refer to pages 28-32. Provide photos and a summary of findings of investigative sampling undertaken				
25% MOVEMENT TEST (Y/N) No evidence of cracking or socking within root ball					
Root Division - conforms (Y/N)					
Root Direction - conforms (Y/N)					
Rootball Occupancy - conforms (Y/N)					
Rootball depth mm					
Height of Root Crown above pot soil level in mm					

Comments on investigative/ destructive sampling

Sampling undertaken by:

Signature: _____ Name: _____

Position/ Qualifications: _____ Date: _____

"Council Use Only"

Project Referral for Park Trees

Referring Officer: Phone:

Date:

Project Name:

Project Construction start date:

Location

Park:

Street /Suburb:

Area/s:

Side of Street: ☐ Odd numbered ☐ even numbered

Tree ID \#:

Scope of Works

Type:

Where:

Excavation:

Footpath Distance from tree/s:

Length:

Width of footpath:

Structure Offset of works to tree/s:

Building Alignment:

☐ Demolition ☐ Construction

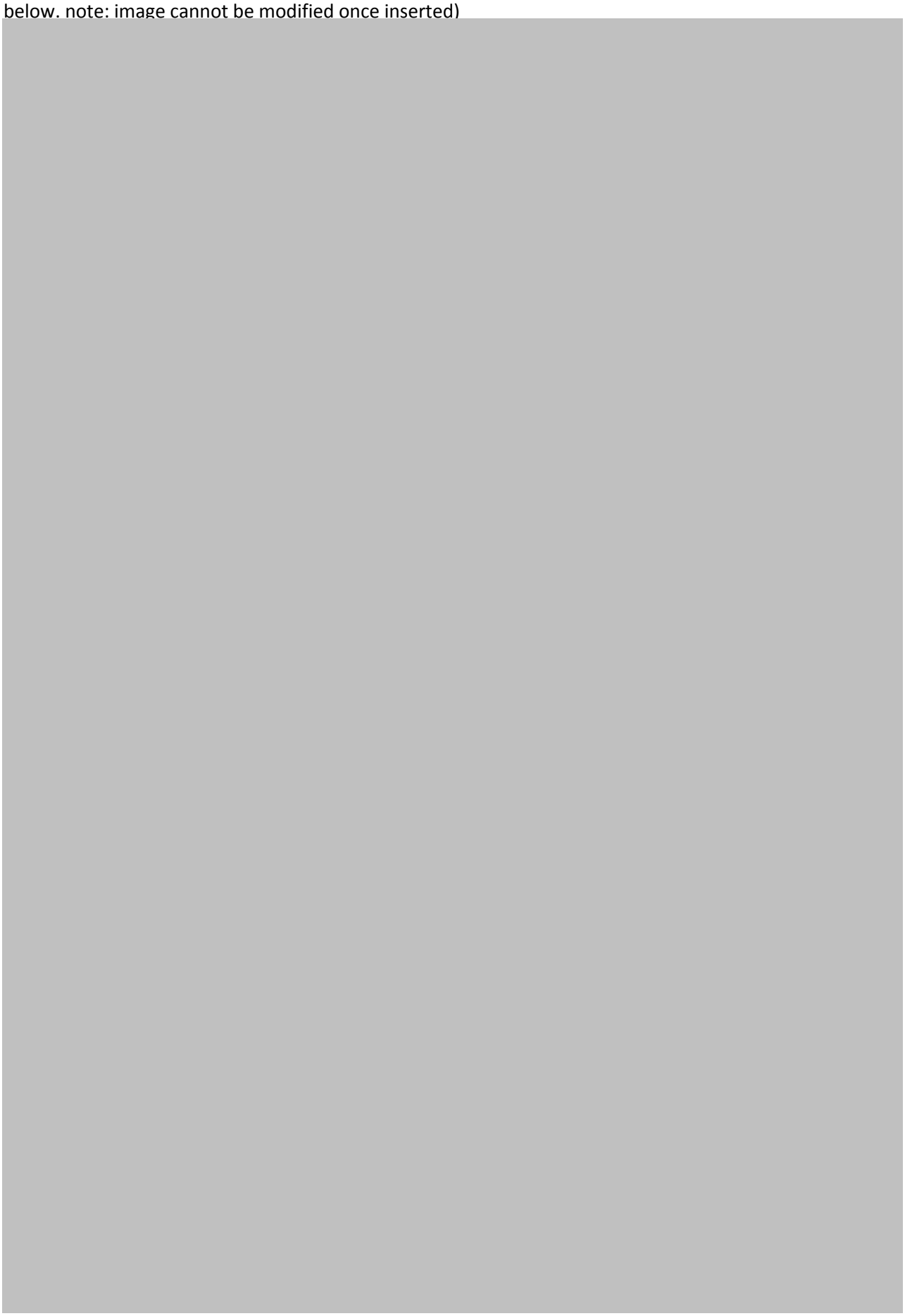
Stormwater Location:

Offset to trees:

Level Changes:

Additional information if required:

Diagram /Aerial Image showing location and footprint of works. (Image must be converted to PDF before inserting below. note: image cannot be modified once inserted)



"Council Use Only"

Project Referral for Street Trees

Referring Officer: Phone:

Date:

Project Name:

Project Construction start date:

Location

Street:

Suburb:

Street Section/s:

Side of Street: ☐ Odd numbered ☐ even numbered

Tree ID \#:

Scope of Works

Type:

Where:

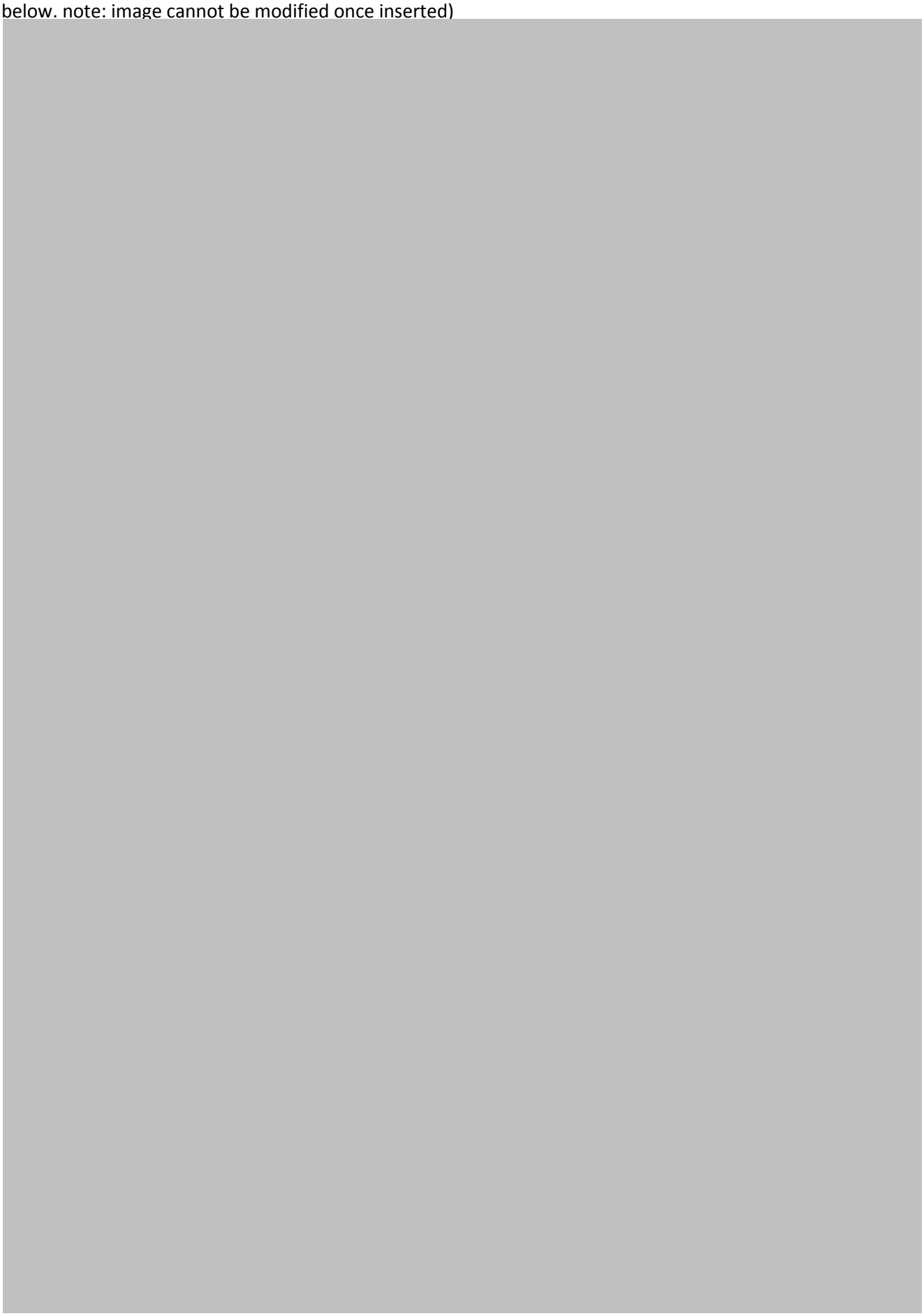
Excavation:

Footway	Distance behind Kerb:
	Footpath location from boundary:
	Width of footway:
Kerb & Gutter	Alignment:
Road	Alignment:
	☐ Resurface ☐ Construction
Stormwater	Location including offset:
	Width of lintel:
	Distance behind Kerb:

Level Changes:

Additional information if required:

Diagram /Aerial Image showing location and footprint of works. (Image must be converted to PDF before inserting below. note: image cannot be modified once inserted)



"COUNCIL USE ONLY"

Tree Inspection Form Projects

Project: **TRE:** **Date:**

Location: **Inspector:**

Tree ID	Species	Comment	Age	Height (m)	ULE	DBH (cm)	Health	Structure	Suitable to retain	TPZ footway (m)	TPZ roadside (m)	Tree compromised by works

Explanation of column headings

TPZ measured from centre of tree and is tree protection zone for tree health and stability.

DBH is diameter measured at 1.4m above ground level

ULE is anticipated Useful life in the current circumstances.

Suitability to retain = is the tree worth keeping/designing around.

TPZ footway = footway area including under kerb and gutter where most roots proliferate required to retain healthy /stable tree. TPZ is generally modified from 12 x dbh

TPZ roadside = distance from centre of tree into the road that is required for tree health and stability. TPZ is generally modified from 12 x dbh

Tree compromised by works: Y = Tree would need to be removed if works as described are implemented. N = Tree not affected. Unknown = Insufficient information to determine

Comments are the Arborist inspection comments from Council tree system

MEASURING SOIL TEXTURE IN THE FIELD

Key points

- Soil texture is a measure of the relative proportion of the various soil particle size fractions in soil.
- Soil texture affects the physical and chemical properties of a soil.
- Field texturing is a quick method of determining soil texture, and enables an immediate interpretation of texture down the soil profile.

Background

Soil texture is an estimate of the relative amounts of sand, silt and clay particles in a soil. The physical and chemical behaviour of a soil is influenced strongly by soil texture (Bowman & Hutka, 2002), which will vary due to the differences in the type and mineral composition of the parent material, the soils position in the landscape, and the physical and chemical weathering processes involved in soil formation. Soil texture affects the movement and availability of air, nutrients and water in a soil (Hunt and Gilkes, 1992) and is often used to estimate other soil properties, particularly soil water properties, if no direct measurements are available (NLWRA, 2001). A simple measure of soil texture is the way a soil feels when manipulated by hand.

Measuring soil texture

Field or hand texturing is a measure of the behaviour of a small handful of soil when moistened and kneaded into a ball slightly larger than the size of a golf ball (NSW Agriculture, 1988) or bolus and pressed out to form a ribbon between the thumb and forefinger (figure 1). The behaviour of the soil during bolus formation, and the ribbon produced, characterises the field texture.

Field method

Take a sample of soil and remove the >2mm fraction (gravel—see below, roots, organic material) by sieving or by hand. The sample should be sufficient to fit comfortably into the palm of your hand. Moisten the soil with a little water and knead it into a bolus (figure 1). Continue to work the bolus, adding more soil and water if necessary, until the soil no longer sticks to your fingers and there is no apparent change in plasticity (usually 1–2 minutes). If the bolus is worked for a long time it may dry but it can be re-wet (the moisture of the sample will influence the length of the ribbon formed).

Using a clean, moistened hand, place the bolus between your thumb and forefinger and slide your thumb across the soil (shearing) to extrude a ribbon. Try to make a thin continuous ribbon about 2 mm thick and 1 cm wide. Measure and record the length of the ribbon produced using a rule. Soils with high clay content are further categorised by moulding the bolus into rods. If the rods fracture the soil is assigned a texture grade lighter than a medium clay. A breakdown of field texturing categories is given in table 1. This method has been adapted from McDonald *et al.* (1998).

Gravel (particles >2 mm) is removed from the soil prior to texturing because it does not contribute to chemical and some physical properties of soils.

Laboratory method

A laboratory determination of soil texture gives a more detailed and reliable measure of the relative amounts of sand, silt and clay particles in a soil. The common term for measuring soil texture in the laboratory is particle size analysis (PSA). Particle size analysis determines particle size distribution (PSD) of a soil and while field texture is closely related to the PSD (McKenzie *et al.*, 2004), texture classes assigned from field texture and PSA are not always equivalent. For example, sodic soils have a heavier field texture than is suggested by the laboratory determined PSA. For a more detailed description of this method please refer to "Particle Size Analysis" fact sheet.

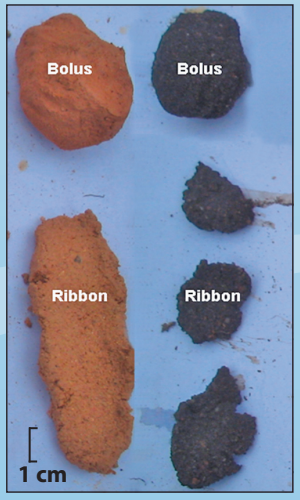


Figure 1: *Manipulation of soil for field texturing. The properties of each soil when doing this determines texture.*

Table 1: *Classification based on field texturing of soils. The combination of 'Behaviour of Moist Bolus' and 'Ribbon Length' gives an indication of 'Field Texture Grade'. Adapted from McDonald et al. (1998).*

Field Texture Grade	Behaviour of Moist Bolus	Ribbon Length (shearing between thumb and forefinger)	Approximate Clay Content (%)
Sand	Coherence nil to very slight, cannot be moulded; single sand grains adhere to fingers.	Nil	<10% (often <5%)
Loamy Sand	Slight coherence.	≈5 mm	5–10%
Clayey Sand	Slight coherence, sticky when wet; many sand grains stick to fingers; clay stains the hands.	5–15 mm	5–10%
Sandy Loam	Bolus just coherent but very sandy to touch; dominant sand grains are of medium size and are easily visible.	15–25 mm	10–20%
Loam	Bolus coherent and rather spongy; smooth feel when manipulated, no obvious sandiness or 'silkiness'; may be greasy to the touch if much organic matter is present.	≈25 mm	≈25%
Silty Loam	Coherent bolus; very smooth to silky when manipulated.	≈25 mm	≈25% (with silt)
Sand Clay Loam	Strongly coherent bolus, sandy to touch; medium size sand grains visible in finer matrix.	25–40 mm	≥25%
Clay Loam	Coherent plastic bolus, smooth to manipulate.	40–50 mm	20–30%
Clay Loam, Sandy	Coherent plastic bolus; medium size sand grains visible in finer matrix.	40–50 mm	30–35%
Silty Clay Loam	Coherent smooth bolus; plastic and often silky to the touch.	40–50 mm	30–35% (with silt)
Sandy Clay	Plastic bolus; fine to medium sand grains can be seen, felt or heard in clayey matrix.	50–75 mm	35–40%
Light Clay	Plastic bolus; smooth to touch.	50–75 mm (slight resistance to shear)	35–40%
Light Medium Clay	Plastic bolus; smooth to touch.	≈75 mm (slight–mod. resistance to shear).	40–45%
Medium Clay	Smooth plastic bolus; handles like plasticine; can be moulded into rods without fracture.	≥75 mm (mod. resistance to ribbon shear).	45–55%
Heavy Clay	Smooth plastic bolus; handles like stiff plasticine; can be moulded into rods without fracture.	≥75 mm (firm resistance to ribbon shear)	≥50%

Glossary terms

Bolus: the ball of soil formed by manipulating the soil by hand.
Coherence: the ball or bolus of soil holds together.
Parent material: weathered and unweathered rock or soil from which soil is formed.
Plasticity: the ball can be deformed and holds its new shape strongly; typical of clays.
Shearing: sliding the thumb across the soil to form a ribbon.
Silkiness: the smooth, soapy or slippery feel of silt.
Sodic: soils with a high level of exchangeable sodium (can lead to poor soil physical conditions).

Further reading and references

Bowman GM, Hutka J (2002) Particle Size Analysis. In 'Soil Physical Measurement and Interpretation for Land Evaluation' (Eds. NJ McKenzie, HP Cresswell, KJ Coughlan) pp 224-239. (CSIRO Publishing: Collingwood, Victoria).

Hunt N, Gilkes R (1992) 'Farm Monitoring Handbook'. (The University of Western Australia: Nedlands, WA).

McDonald RC, Isbell RF, Speight JG, Walker J, Hopkins MS (1998) 'Australian Soil and Land Survey Field Handbook' (Australian Collaborative Land Evaluation Program: Canberra).

McKenzie NJ, Jacquier DJ, Isbell RF, Brown KL (2004) 'Australian Soils and Landscapes An Illustrated Compendium' (CSIRO Publishing: Collingwood, Victoria)

NLWRA (2001) 'Australian Agriculture Assessment 2001, volume 1' (National Land and Water Resources Audit).

NSW Agriculture (1998) SOILpakTM For dryland farmers on the red soil of Central Western NSW (Eds. A Anderson, D McKenzie, J Friend) (NSW Agriculture).

Author: **Katharine Brown** (The University of Western Australia)

This soilquality.org.au fact-sheet has been funded by the Healthy Soils for Sustainable Farms programme, an initiative of the Australian Government's Natural Heritage Trust in partnership with the GRDC, and the WA NRM regions of Avon Catchment Council and South Coast NRM, through National Action Plan for Salinity and Water Quality and National Landcare Programme investments of the WA and Australian Governments.

Dead or Dying Tree Removal

The City of Newcastle

Date: _____

Part 1: Applicant and site details

1. Details of the property owner

Property Owner to retain completed form for minimum 2 years.

*This form **cannot** be used for Heritage Listed trees or trees required to be retained as habitat under another consent.*

Title: ☐ Mr ☐ Mrs ☐ Miss ☐ Ms ☐ Other .....

Family name (or company) .....

Given name/s .....

Postal address.....

..... Postcode .....

Phone……..Alternative phone .....

E-mail .....

Only if a company:

Contact person ……Reference no .....

2. Location and title description of the property

To correctly identify the land.

Unit No ……House No ……Street.....

Locality .....

Lot(s)……Section.....

Deposited Plan(s) ……Strata plan .....

Other .....

(Get these details from the rate notice or property deeds, or from Council property maps)

Part 2: The Arborist or person who undertook removal of the tree

3. All requirements must be completed for this to be a valid form

Qualification
(minimum AQF Level 3 in arboriculture and relevant experience in accordance with Part A, Section 6.0 of the Urban Forest Technical Manual.)

Business Name: .....

Qualification and Certificate Number: .....

Name: ..... Phone: .....

Address: .....

.....

As the person who undertook the removal I have:

1. carried out a thorough inspection of .....(number) tree/s .....(species), and

   (circle A or B)

   A. determined that the tree/s demonstrates reduced growth rate/s, sparse foliage and reduced response to damage or stress over subsequent growing seasons, or

   B. that the biological function of the tree has ceased, no leaves are present and visible evidence of trunk, root plate and canopy desiccation, and

2. assessed each tree for hollows or other likely habitat, and either (circle C or D):

   C. found no evidence, or

   D. advise that local wildlife group (eg. Wires) attend during removal, and

3. attached appropriate clear photos to adequately demonstrate the selection of either 1A or 1B above, and

4. only removed tree/s where their condition met the requirements of 1A or 1B above, and there was no practical alternative to retain them, and

5. provided a site plan on page 2 to show where the tree was located in relation to the dwellings and boundaries.

Signature of person who owns Tree: ..... Date: .....

Signature of inspecting Arborist: ..... Date: .....

Native Vegetation Summary Report

To inform Permit Application for Native Vegetation Removal

(Appendix 12 - Part C Urban Forest Technical Manual)

The City of Newcastle

Date: _____

Part 1: Applicant and site details

1. Details of the property owner

This form is to be attached to the *Permit Application for Native Vegetation Removal* for areas up to 1000m^2.

Title: ☐ Mr ☐ Mrs ☐ Miss ☐ Ms ☐ Other .....

Family name (or company) .....

Given name/s .....

Postal address .....

..... Postcode .....

Phone..... Alternative phone .....

E-mail .....

Only if a company:

Contact person .....

2. Location and title description of the property

To correctly identify the land.

Unit No ..... House No ..... Street .....

Locality .....

Lot(s) ..... Section .....

Deposited Plan(s) ..... Strata plan .....

Other .....

(Details from rate notice or property deeds, or from Council property maps)

Part 2: Ecological review of native vegetation proposed to be removed

This review is to inform an application for a permit to remove private native vegetation **not** associated with development.

Refer to the *Biodiversity Conservation Act 2016*, *Biodiversity Conservation Regulation 2017, State Environmental Planning Policy (Vegetation in Non-rural Areas) 2017,* the *Newcastle Local Environment Plan 2012*, and Section 5.03 Vegetation Management *Newcastle Development Control Plan 2012.* Part C of Council's Urban Forest Technical Manual (Manual) provides further guidance.

3. Provide details of the qualified professional* engaged to review the vegetation to be cleared

*A suitably qualified practitioner possesses a relevant Science, Environmental Science or Natural Resources Degree and has atleast 2-3 years demonstrated experience.

Note: If the removal is limited to 1 native tree and minimal understorey clearing, ie. < 400m^2, contact Council to discuss proposal **prior** to engaging an ecologist.

Business name .....

Professional Qualifications: (please detail professional qualifications and experience and/or attach current CV to this form)

.....

.....

As a suitability qualified and experienced practitioner I have:

1. carried out an inspection of the …… trees and/or …… (area m^2) vegetation to be removed, and
2. considered all applicable planning and protected species legislation in the context of the proposed removal, and
3. assessed impacted trees for hollows or other likely habitat, and

4. appended an accurate site map showing the location and extent of the vegetation to be cleared (attached to form or within an attached report), and

5. provided detail regarding native vegetation communities present on the site and listed flora species to be removed (on this form or within an attached separate report), and

6. provided detail as to any anticipated impact on threatened species, populations or communities as a result of the proposed vegetation removal. Including details regarding hollows and habitat features present on site, and whether an impact assessment may need to be undertaken, and

7. provided recommendations as to any approvals or licences that may be required to undertake the vegetation removal under State and Commonwealth legislation, and

8. included photographs of the vegetation to be removed.

Note: If the trees or shrubs are to be removed because of an issue of risk or property damage, an arborist report may be required to support the removal. Refer to Part A of the Manual and Appendix 7 for arborist qualifications and report requirements.

4. Complete all items in the checklist

Place a ✓ in the box for Yes, or **X** in the box for No.

If the answer is no, provide additional details below.

Further ecological assessment may be required and/or referral to other NSW Government Agencies.

Note: Item 4.10 - a permit for vegetation clearing **will not** be issued for removals within a SEPP 14 - Coastal Wetland or SEPP 26 - Littoral Rainforest. Contact Council about submitting a Development Application.

☐ 4.1 The native vegetation to be removed does not exceed 1000m^2.

Note: If the proposed removal of native vegetation is greater than 1000m^2 **do not complete** this form. A Flora and Fauna Impact Assessment is required.

☐ 4.2 The native vegetation to be removed is not within a riparian zone (within 40m of a watercourse), or within a wetland area (within 100m of wetland vegetation or swamp).

Note: Council **will not** consider a permit for removal of native vegetation within a riparian zone or a wetland area, without an accompanying Flora and Fauna Impact Assessment. Approvals and licences from all relevant NSW Government Agencies will also need to be obtained.

☐ 4.3 The native vegetation to be pruned or removed is not listed as a threatened plant species or forms part of a threatened ecological community under the *Biodiversity Conservation Act 2016*.

☐ 4.4 Based on a consideration of factors outlined in Section 7.3 of the *Biodiversity Conservation Act 2016* (5 - part test), the proposed vegetation removal is not likely to significantly affect threatened species, ecological communities or their habitats.

☐ 4.5 The native vegetation to be removed is not within a marine or estuarine area. Vegetation to be removed is not listed under the *Fisheries Management Act 1994*.

☐ 4.6 The proposal does not impact a matter of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999*.

☐ 4.7 The native vegetation clearing is not within a high biodiversity value area, as defined by clause 7.3 (3) of the *Biodiversity Conservation Regulation 2017.*

Note: Council **will not** issue a permit for the removal of native vegetation that is within a high biodiversity value area identified on the Biodiversity Values Map. www.environment.nsw.gov.au/biodiversity/entryrequirements.htm

	☐ 4.8 The native vegetation to be cleared does not include trees or shrubs that contain hollows or active nests (at the time of assessment). ☐ 4.9 The native vegetation to be removed or pruned is not: ☐ a heritage item, or forms part of a heritage item, ☐ an Aboriginal object, or forms part of an Aboriginal object, ☐ within a place of Aboriginal significance. ☐ 4.10 The native vegetation to be removed is not within a *State Environmental Planning Policy 14 - Coastal Wetland* or associated buffer zone, within a *State Environmental Planning Policy 26 - Littoral Rainforest,* or on land to which *State Environmental Planning Policy No 71 - Coastal Protection* applies.

Please provide information as outlined at Questions 4 and 5 above. This information is required to inform Council's assessment of the Applicant's Permit Application for Native Vegetation Removal.

A separate report can also be appended to this form (including any required impact assessments to support the application).

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Name: .....

Signature: ..... Date: .....