LEICHHARDT COUNCIL TREE MANAGEMENT TECHNICAL MANUAL – TREES ON PRIVATE PROPERTY

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SECTION 1 – INTRODUCTION

Trees are an important feature of the urban environment, and provide many benefits to a community, both individually and collectively including:

a. enhanced visual and physical amenity;

b. improved environmental performance;

c. provision of important habitats and facilitation of biodiversity; and

d. social and cultural connections to places.

Collectively, trees in the urban domain are known as the “urban forest”. Leichhardt’s urban forest is a combination of street trees, park trees and trees on private property. Council has developed this Technical Manual to supplement the development controls contained in Part C1.14 - Tree Management of the *Development Control Plan 2013*. It provides guidance on the following aspects:

a. technical requirements for the assessment, management and protection of trees on development sites;

b. assessment methodologies and considerations for determining tree applications;

c. how to calculate the Structural Root Zone (SRZ) and Tree Protection Zone (TPZ) of a tree;

d. qualification requirements for arborists;

e. details of pruning requirements; and

f. tree replacement.

SECTION 2 – TREES AND DEVELOPMENT

2.1 APPLICATION

This section applies to all development sites upon which trees are located and where a proposed development will impact trees, including removal or pruning. It applies to development applications, permits and minor works under all parts of the *Leichhardt Development Control Plan 2013*, and not only to development applications under Part C1.14 – Tree Management.

Development works have the potential to cause significant loss and damage to the urban forest. In order to minimise any adverse impact on the urban forest, they must be given due consideration as part of the design process.

2.2 STANDARDS

The provisions of Australian Standard *AS4970 – 2009 'Protection of trees on development sites'* and the provisions set out in this Technical Manual are to be complied with for all development within the Leichhardt Local Government Area.

Trees that are in good health and condition, that are sustainable in the medium to long term and make a positive contribution to amenity, heritage or ecological values shall be retained as part of any new development wherever possible. Mature trees can add significantly to the marketability and aesthetic quality of a development and cannot be easily replaced in the short term with new tree planting.

2.3 PRELIMINARY TREE ASSESSMENT

When planning for new development, the constraints imposed by existing trees should be considered from the very early stages of the design process. Existing trees should be evaluated by a qualified Consulting Arborist (AQF Level 5) as part of the site analysis. This should be undertaken prior to any detailed design work so as to inform the site layout and design.

2.4 DETERMINING TREE RETENTION VALUES

Tree Retention Values are utilised to guide site analysis, site planning and development design. The key objective of this process is to ensure the retention of good quality trees that make a positive contribution to the value of the development and the municipality, and to ensure that adequate space is provided for their long term preservation.

The Retention Value of a tree is a balance between its sustainability in the setting in which it is located (the 'landscape') and its significance within that setting ('landscape significance').

A consulting arborist (AQF Level 5) is to determine the retention value of a tree if any development is proposed within the Tree Protection Zone (TPZ) of a tree. This includes:

a. prescribed trees on land upon which development is proposed;

b. trees on adjoining land; and

c. street trees.

In order to determine how much space trees require for their long term viability, Tree Protection Zones (TPZs) and Structural Root Zones (SRZs) for each tree should be calculated in accordance with *AS 4970:2009 'Protection of trees on development sites'*.

These TPZs and SRZs must be displayed to scale on the site analysis. The site analysis should be based on a detailed site survey drawing. The constraints to development imposed by existing trees must be considered in the design process.

Note: For further detail on the methodology for determining Tree Retention Value refer to Appendix 1 of this Technical Manual.

2.5 INCLUDING TREES IN DESIGN DEVELOPMENT

Clearance between the building and tree canopy should be taken into account during the design phase. Provision of adequate clearance should take into consideration:

a. any projecting structures, such as balconies or awnings;

b. the roofline; and

c. the requirement for temporary scaffolding to be erected during construction.

High structures should preferably be located outside the canopy drip-line in order to avoid or minimise canopy pruning, making allowance for temporary scaffolding and reasonable clearance for future building maintenance and the future growth of the tree.

It may be feasible to avoid adverse impact on existing tree roots by adopting construction methods that minimise incursion to the Tree Protection Zone. These may include, for example, piered footings with suspended slab or sub-frame, cantilevered sections, pier and beam footings, alternative pavement design and the like.

Following development of the concept design, a Consulting Arborist should review the design and assess the potential impact of the proposal on existing trees. Any recommended design changes, to ensure the retention of any trees considered worthy of preservation, should be taken into consideration and the plans amended as necessary, before finalisation of the DA plans. Following finalisation of the DA drawings (and prior to submission to Council), the potential impact of the proposed development on existing trees should be made by a consulting arborist and submitted as a report (Arboricultural Development Impact Assessment) together with the development application.

2.6 TREE PROTECTION ZONES (TPZ) AND STRUCTURAL ROOT ZONES (SRZ)

The intention of the TPZ is to ensure protection of the root system and canopy from the potential damage from construction works and ensure the long-term health and stability of each tree to be retained. Suitable protective devices, such as temporary fencing, trunk protection boards or ground protection (where appropriate) must be installed to ensure adequate protection of a tree from construction activity and avoid disturbance within the TPZ.

The Structural Root Zone (SRZ) is located within the TPZ and provides the bulk of mechanical support and anchorage for a tree.

The following activities are not permitted within specified Tree Protection Zones:

a. excavations and trenching (with exception of the approved foundations and underground services);

b. ripping or cultivation of soil;

c. mechanical removal of vegetation (using an excavator or similar);

d. soil disturbance or movement of natural rock;

e. soil level changes including the placement of fill material (excluding any suspended floor or slab);

f. movement and storage of plant, equipment & vehicles;

g. erection of site sheds;

h. affixing of signage or hoardings to trees;

i. storage of building materials, waste and waste receptacles;

j. storage of bulk materials such as sand, gravel, soil, spoil or similar materials;

k. disposal of waste materials and chemicals including paint, solvents, cement slurry, fuel, oil and other toxic liquids; and

l. any other physical damage to the trunk or root system or any other activity likely to cause damage to the tree.

2.7 CALCULATING THE TREE PROTECTION ZONE AND STRUCTURAL ROOT ZONE

The indicative TPZ area shall be calculated as specified in Section 3.2 of *AS 4970:2009 'Protection of trees on development sites'*.

The indicative SRZ shall be calculated as specified in Section 3.3.5 of *4970:2009 'Protection of trees on development sites'*.

Additionally the consulting arborist shall consider and address specific site factors that may influence the location of the TPZ and/or structural tree roots. Examples of factors to be considered are (but not limited to) the location of rocks, footings, watercourses, structures, other vegetation and soil types. The indicative SRZ and TPZ may require adjustment accordingly.

2.8 INCURSIONS TO THE TREE PROTECTION ZONE

Under *AS 4970:2009 Protection of trees on development sites*, an incursion of up to 10% of the area of the TPZ is considered acceptable, provided that there is no encroachment to the SRZ. Appendix D of *AS 4970:2009 Protection of trees on development sites* shows examples of acceptable incursions to the TPZ. Major (> 10%) incursions to the TPZ may require more detailed investigations, such as exploratory excavations and root investigation to enable an informed evaluation of the potential impact of the proposed works – refer to 2.10 of this section.

2.9 INCURSION INTO THE STRUCTURAL ROOT ZONE

Incursions into the SRZ are not likely to be supported unless the consulting arborist has undertaken exploratory investigation and can demonstrate that there will be minimal impact to the tree.

2.10 EXPLORATORY EXCAVATION

Exploratory excavation may be required where the proposed encroachment created by the development works exceeds 10% of the Tree Protection Zone of any *Prescribed Tree* if so requested by Council or required by the consulting arborist to determine the impact of the development on the tree. The purpose of the investigation is to verify the quantity, size, type, depth and orientation of tree roots along the perimeter of the proposed encroachment in order to make an informed judgement in relation to the potential impact on the tree.

Exploratory excavation shall only be carried out using non-destructive or non-injurious techniques, such as careful digging using hand held implements, using compressed air (Airspade®), water pressure, or suction (vacuum device) or a combination of these techniques, to carefully remove soil without damaging roots. The work shall be undertaken by an arborist with a minimum qualification of AQF Level 3. Once roots are exposed, a visual examination can be carried out by a consulting arborist to evaluate the potential impact of the proposed root loss on the health and stability of the tree.

The results of the root investigation together with a Arboricultural Development Impact Assessment must be documented in a report prepared by a qualified consulting arborist and submitted together with the DA. The report shall contain information that demonstrates that the tree will remain viable in conjunction with the works.

2.11 PROTECTION OF TREES ON DEVELOPMENT SITES

Trees that are required to be retained as part of the approved development must be protected from potential damage caused by construction activities. Council will impose conditions on approved development for the protection of trees where such trees are considered at risk of damage.

Tree Protection can include fencing, trunk/branch protection and ground protection. Refer to Section 4 of *AS 4970:2009 'Protection of trees on development site*s' for detailed requirements. Refer to *2.6 – Tree Protection Zones (TPZ) and Structural Root Zones (SRZ)* of this manual above for activities prohibited within any Tree Protection Zone.

2.12 TREE PROTECTION PLAN

In some cases Council will require that a Tree Protection Plan (TPP) is submitted to Council. The plan shall be prepared by a consulting arborist and should at a minimum include a detailed plan of the locations of, and specifications for, tree protection measures.

The TPP is also likely to include a monitoring schedule relating to critical points during the works (hold points) where the consulting arborist is required to visit the site and confirm that works are being undertaken as conditioned by Council/as required.

SECTION 3 –TREE WORKS ASSESSMENT

3.1 MATTERS FOR CONSIDERATION

Council will have regard to the following matters for consideration when determining any proposal to conduct tree works or remove a tree/s:

a. the ecological, heritage and amenity values of the tree and any potential loss of ecological, heritage and amenity values resulting from any proposed tree works or removals;

b. whether it can be demonstrated that the tree is unsuitable for site conditions including:

   i. soil type and depth or other prevailing environmental conditions;

   ii. insufficient space available for future growth and development;

   iii. inappropriateness of the position relative to underground or overhead services, structures or buildings;

Note: these considerations are to be firmly established in an Arboricultural Report prepared by a consulting arborist (AQF Level 5) in accordance with Section 3.3 – Appropriate assessment methodologies of this manual. It must be demonstrated that the identified issues cannot be remediated by any other reasonable or practical means.

c. the condition of the tree, where a tree is dead or dying, or where it is assessed that it poses a threat to human life or property to the satisfaction of Council (refer Section 3.3 Appropriate Assessment Methodologies and Section 4.0 Hazard/Risk Assessment for further information on this);

d. whether public infrastructure is being significantly damaged by the tree which cannot be remediated by any other reasonable and practical means;

e. where damage to significant structures on private property is occurring and cannot be remediated by any other reasonable or practical means;

f. where the repair or replacement of blocked or damaged sewer pipes cannot be undertaken by any other reasonable and practical means;

g. whether the proposed tree works are to restore views that can be demonstrated by the Applicant to have formerly existed and where the tree works can be undertaken without resulting in:

   i. significant impacts to the tree;

   ii. destruction or diminution of its natural form or branching habit; or

   iii. compromise to the structural integrity of the tree;

h. whether the tree is deemed to be of *landscape significance* - a Tree that rates as 1, 2 or 3 when assessed against the criteria contained in the table in Appendix 5 of this Technical Manual.

3.2 DIAGNOSTIC TESTING

Where structural defects in trees are sited as justification for tree pruning or removal, Council may require diagnostic testing. Testing is likely to be required where the tree is of landscape significance and the extent of a defect cannot be ascertained from an external visual examination. Certain defects (such as internal cavities, fractures and decay) may require diagnostic testing in order to verify the

extent and significance of the defect. Specialist equipment, such as the Picus® Sonic Tomograph or a Resistograph® can be used to undertake diagnostic testing.

The results of any diagnostic testing must be included in a report prepared by a consulting arborist and submitted to Council (where requested) to enable a determination of the application.

The report must include the following information:

a. results of the Visual Tree Assessment;

b. results of the diagnostic testing (resistance testing, sonic testing, pathology or soil tests) including clear and legible copies of charts or graphs or other supporting data;

c. an explanation of the findings, and

d. recommendations for remedial action in consideration of all available options, including managing or mitigating risk.

3.3 APPROPRIATE ASSESSMENT METHODOLOGIES

Table 1: Appropriate Assessment Methodologies

Demonstrated Situation	Methodology for demonstration
The tree is located where the prevailing environmental conditions are unsuitable	A Visual Tree Assessment (refer Appendix 2) will be undertaken in conjunction with a site analysis. Council may request that an Arboricultural report prepared by an AQF Level 5 Arborist is submitted (refer Section 6). The report shall demonstrate and substantiate that the tree is unsuitable for the prevailing environmental conditions.
The tree is in a state of irreversible decline or is dead	A Visual Tree Assessment (refer Appendix 2) will be undertaken in conjunction with a site analysis. Council may request that an Arboricultural report prepared by an AQF Level 5 Arborist is submitted (refer Section 6). The report shall demonstrate and substantiate that the tree is in a state of irreversible decline or is dead and that removal is the only viable option.
The tree poses a threat to human life or property	A Visual Tree Assessment (refer Appendix 2) will be undertaken in conjunction with a site analysis. Council may request that an Arboricultural report prepared by an AQF Level 5 Arborist is submitted (refer Section 6). The report shall demonstrate (refer to Section 4) and substantiate that the tree is a threat to human life or property and that removal is the only viable option.
The tree is causing significant damage to public infrastructure which cannot be remediated by any other reasonable and practical means	A site assessment will be undertaken by Council's Arborist and/or Engineer and/or Building Surveyor. Recommendations for managing the damage will be presented to the tree owner for action. Relevant Council Policies will be considered.
The tree is causing considerable damage to significant structures on private property which cannot be mitigated or remediated by any other	A Visual Tree Assessment (Appendix 2) will be undertaken in conjunction with a site analysis. Council may request that an Arboricultural (refer

Demonstrated Situation	Methodology for demonstration
reasonable and practical means	Section 6) report prepared in liaison with a report from a Structural Engineer (refer Section 6.3) is submitted. The report shall demonstrate that the damage cannot be mitigated or remediated by any practical means other than the removal of the tree.
The replacement of damaged or failed sewer pipes or storm water lines cannot be undertaken with the retention of the tree	A Visual Tree Assessment (Appendix 2) will be undertaken in conjunction with a site analysis. Council may request that an Arboricultural (refer Section 6) report prepared in liaison with a report from a licensed plumber (refer Section 6.3) is submitted. The report shall demonstrate that the sewer pipes or storm water lines cannot be undertaken with the retention of the *Tree*
The tree is deemed to be a tree of landscape significance.	Refer to Appendix 5. The tree may be classified as a tree of landscape significance if it is classified as 1 (Significant), 2 (Very High) or 3 (High) according to the criteria in Appendix 5.

SECTION 4 – RISK ASSESSMENT

4.1 ARBORIST QUALIFICATIONS AND REPORTING FOR RISK ASSESSMENT

Council may require a Tree Hazard Assessment report where applicants consider that a tree is potentially hazardous. A consulting arborist shall be engaged to undertake a tree hazard assessment.

The submitted report shall include (but not be limited to) the following information:

a. a detailed description of the location, size and nature of the hazards. For example cavities, basal decay, poor branch attachments etc;

b. a detailed description of the hazard/risk rating system used;

c. the results of the tree rating when assessed against the system used; and

d. recommendations for minimising or removing the hazard/risk based on the observations made and discussion in relation to the viability of tree retention.

The potential risk of the subject tree/s is to be assessed against the criteria outlined below using a suitable methodology such as the Quantified Tree Risk Assessment (Ellison, 2005), Tree Risk Assessment Qualified (Smiley, Matheny and Lilly, 2011) or another method that can be suitably demonstrated and supported in writing by the reporting arborist. The results of the risk assessment are to be documented in an arboricultural report in accordance with the requirements outlined in section 6 of this Technical Manual.

4.2 Hazard/risk Criteria

There are many methods available for assessing the risk relating to an observed structural flaw (hazard) in a tree. For example:

Matheny and Clark (1994) have developed a rating system or model for quantifying the risks associated with trees in urban areas. This model takes into account three key factors, with each factor rated from 1 to 4 (i.e. a highest total rating of 12). The three key factors are:

a. failure potential (extent and significance of defects present);

b. size of defective part (e.g. small equals less than 15cm diameter, large equals greater than 75cm in diameter); and

c. target rating (use and occupancy e.g. low equals occasional use, high equals constant use).

Norris (2007) states that essentially tree risk assessment requires inputs derived from the following:

a. is there a hazard or defect and how likely is it to fail?

b. is there a risk target?

c. how much damage will the hazard cause if it impacts the target?

Risk of tree failure will generally be assessed in relation to the probability of the failure, the size of the part that may fail and the nature of the target.

SECTION 5 – ARBORISTS

Tree work is a specialised skill and climbing and removing trees is inherently dangerous. It is therefore important that persons undertaking tree works are suitably qualified, as outlined below in Table 2: Qualifications for arborists:

Table 2: Qualifications for Arborists

Task/Activity	Minimum Qualifications

Assess and carry out tree pruning, exploratory root investigation and tree removal.	• AQF Level 3 or equivalent in Arboriculture
	• Registered as a member of either:
	  ○ Tree Contractors Association Australia
	  ○ Arboriculture Australia

All tree assessment and report preparation including: ○ tree health and condition assessment; ○ tree retention value assessment; ○ Arboricultural impact assessment; ○ tree protection plan; ○ root mapping; ○ testing with a sonic tomograph; or ○ testing with resistance drilling technology.	• AQF Level 5 or equivalent in Arboriculture
Project Arborists in relation to all development.	• AQF Level 5 or equivalent in Arboriculture

The Australian Qualification Framework (AQF) is a quality assured national framework for education and training. It provides nationally recognised and endorsed qualifications through a competency based training system.

Arborists with the appropriate qualifications can be contacted through the following organisations –

- Institute for Australian Consulting Arborists

  Website: www.iaca.org.au
- Arboriculture Australia

  www.arboriculure.org.au
- Tree Contractors Association

  www.tcaa.com.au

SECTION 6 – PROFESSIONAL REPORTS

6.1 GENERAL REQUIREMENTS

In some instances, Council may require an Arboricultural Report to be submitted to enable a thorough assessment of an application for tree works or removal. Reports prepared by professionals such as qualified Consulting Arborists (AQF Level 5) often in liaison with structural engineers and licensed plumbers are prepared and submitted to establish a direct link between the tree and the reported impacts and issues.

In general, Council will require that the methodologies outlined in Table 1, Section 3.3 – Appropriate Assessment Methodologies (refer also to relevant appendices) be used to assess and demonstrate existing or potential impacts of a tree/s.

All reports shall be presented as a professional technical report with appropriate references to any literature cited.

6.2 ARBORIST / ARBORICULTURAL REPORTS

Examples of information that may be required / provided in an Arborists Report:

a. visual tree assessment;

b. information relating to the health or structural condition of the tree that cannot be seen from a ground-based inspection i.e. the documentation and assessment of observations resulting from an aerial (climbing) inspection;

c. the results of testing of the tree with equipment such as a Resistograph®, Picus® Sonic Tomograph, or Arboradix™ Pole Sensor. These instruments can provide information relating to the percentage of sound wood remaining in partially decayed trunks, branches or roots and root locations;

d. the results of a non-invasive root investigation providing root mapping as a result of hand excavation under the supervision of an *Arborist* or excavation using an Airspade® or Airknife;

e. Tree Management Plans that might include tree pruning specifications in accordance with AS 4373-2007 Pruning of amenity trees. These plans often document proposed pruning as ‘marked up images’ for clarification in terms of proposed/approved pruning;

f. calculations relating to Structural Root Zones (SRZ) and Tree Protection Zones (TPZ) in accordance with AS4970-2009 Protection of trees on development sites;

g. Tree Protection Plans relating to development sites; and

h. information relating to site conditions and suitability to the requirements of the tree/s.

6.3 STRUCTURAL ENGINEER’S REPORTS

Applicants may also be required to provide a report from a structural engineer where property damage is alleged to be caused by a tree and the link to the tree is not obvious to the Council Arborist.

It is important that these reports contain the results of onsite investigation (usually this will require non-invasive excavation (refer Section 2.10 – Exploratory excavations) supervised by an Arborist (AQF Level 3 minimum), to limit damage to the tree. Where damage is attributed to tree roots there must be a direct link established between the tree and the damage.

It should be noted that unsubstantiated opinion is not an acceptable basis for recommendations relating to the removal of trees. The report must demonstrate that there is a direct link to considerable damage to significant structures that cannot be mitigated or remedied by means other than removal of the *tree*.

6.4 REPORTS ACCOMPANYING TREE PERMIT APPLICATIONS

The following information is required in the preparation of Arboricultural Reports to accompany a Tree Permit Application:

The report is to be prepared by a qualified consulting arborist (AQF Level 5). The report must be prepared as a professional technical report (as noted above) and must include the following information:

a. the name, qualifications and contact details of the author;

b. the property address and a sketch plan showing the location of the subject tree/s within the property;

c. each tree shall be numbered on the plan to correspond with the report;

d. details of the scope of the report and the methodology used in the assessment, including the date that the assessment was undertaken;

e. results of a Visual Tree Assessment (refer Appendix 2) undertaken on the subject tree/s, including the correct botanical and common names, height and canopy spread, trunk diameter measured at 1.4m from ground level, approximate age, health and vigour, evidence of any pests or disease, structural integrity and stability (presence of structural defects), suitability to the site conditions, proximity to existing structures and services, and estimated Useful Life Expectancy (ULE – refer Appendix 4 – Useful Life Expectancy Categories);

f. supporting evidence such as photographs, where appropriate; and

g. recommendations for remedial action in consideration of all available options.

Table 1, Section 3.3 – Appropriate assessment methodologies outlines the methodologies which Council considers are appropriate to be used.

6.5 REPORTS ACCOMPANYING DEVELOPMENT APPLICATIONS

Arboricultural Development Impact Assessment / Arboricultural Reports must be submitted in accordance Council's DA Lodgement Checklist and as required by Council's specifications for Development Application documentation.

6.6 REQUIREMENTS FOR PROPOSED MAJOR INCURSIONS INTO TREE PROTECTION ZONES

Where proposed tree works involve a major incursion into a tree's Tree Protection Zone (TPZ) the following will apply:

Major incursions (greater than 10 percent as calculated in accordance with AS 4970:2009) to a tree's TPZ will require more detailed investigations under the guidance of a consulting arborist (minimum AQF Level 5 Arboriculture). The project arborist must demonstrate that the tree/s would remain viable. This may require root investigation by non-destructive methods and with consideration of relevant

factors in accordance with Clause 3.3.4 of *AS 4970:2009 Protection of trees on development sites*. The results of the investigations are to be documented in the manner outlined below in an arboricultural report accompanying the development application, in addition to the requirements outlined in Section 6.2 – Arborist / Arboricultural Reports of this manual.

a. calculations of each subject Tree's TPZ and SRZ in accordance with *AS 4970:2009 Protection of trees on development sites* and shown hatched on a scale drawing;

b. the extent of the proposed encroachment and area of the proposed investigations shall also be indicated on the scale drawing;

c. calculations of the percentage of the TPZ area that is subject to the encroachment;

d. details of the methodology used in the proposed investigations;

e. details of the size, type, quantity, depth and orientation of the roots encountered and an assessment of the potential impact of root loss on the tree;

f. any feasible options for retaining any substantial roots encountered (by amending design or construction methods) should be reviewed and discussed;

g. detailed tree sensitive and site specific construction methods shall be recommended; and

h. submitted architectural/landscape plans shall be consistent with the recommendation in the report.

SECTION 7 – PRUNING REQUIREMENTS

7.1 STANDARDS

Australian Standard *(AS) 4373:2007 Pruning of amenity trees* outlines appropriate pruning practices and procedures that reduce the risk of damage and injury to trees. All pruning work must be undertaken in accordance with that document. Correct pruning practices respect the natural form and branching habit of a tree and work with the trees natural defence mechanisms against disease to avoid damage and injury to trees. Proper pruning involves cutting selected branches back to the branch collar in accordance with 'Natural Target Pruning' techniques.

Natural Target Pruning is a pruning technique that involves identifying the correct angle and alignment for pruning cuts by forming 'targets' between the commencement of the cut at the outer edge of the Branch Bark Ridge and the end of the cut at the point where the lower part of the branch meets the branch collar. Such a cut will not leave a stub or cause damage to the remaining trunk or branch, leading to better wound closure (occlusion).

Pruning should always be limited to the minimum amount necessary to achieve the desired aim. Significant loss of foliage created by excessive pruning may weaken the tree, leading to premature decline or predisposition to branch failure or disease, creating potential hazards.

A tree permit or development application approval must be obtained prior to carrying out works on all prescribed trees. Additionally work methods on the site are to be in accordance with the NSW Workcover *Code of Practice for the Amenity Tree Industry (1998).*

7.2 PROTECTION OF FAUNA DURING TREE WORKS

It should be noted that many native fauna species are protected by law and penalties apply to anyone causing harm to protected fauna species. Where trees are to be removed that may contain nesting sites, possum drays or hollows that may be suitable as nesting sites for arboreal mammals, birds or bats, special measures must be adopted to mitigate the risk of injury or death of animals that may inhabit the tree. These measures include:

a. prior inspection of nesting site and hollows to ascertain the presence of wildlife;

b. sectional dismantling of trees (rather than clear felling);

c. rescheduling work until after fledglings have left the nest site; and

d. relocation of any protected fauna species under the supervision of a licenced Wildlife Carer. Wildlife Carers are licenced by the National Parks and Wildlife Service.

SECTION 8 – TREE REPLACEMENT

Replacement planting is critical to ensure the long term sustainability of the urban forest. Trees inevitably need to be removed due to natural decline and senescence, safety issues, new development, storm damage and a variety of other valid reasons. Where approval is granted for the removal of a prescribed tree either by way of a tree works permit or to accommodate new development, replacement planting will generally be specified as a condition of consent.

The selection of the species of the new tree and its position within the site will generally be at the discretion of the applicant to determine although in some cases more specific conditions will be imposed. Residents are encouraged to seek professional horticultural advice when selecting and planting new trees. The following general guidelines are provided to assist in selecting the correct species and determining the most appropriate position for new trees to be planted.

8.1 SPECIES SELECTION

Leichhardt Council Local Government Area contains a variety of soil conditions, topography and aspects which affect the types of species that will grow and perform satisfactorily. The selected species should be appropriate to the site conditions and appropriate to the context in which they are planted.

When selecting species of trees for new planting, consideration should be given to:

a. appropriateness of the species to the site soil conditions type and depth and the available soil volume to support the tree;

b. the ultimate (mature) size of the tree relative to the available above and below ground space;

c. appropriateness of the species to the climate of the area and microclimate of the site;

d. the nature of the species (deciduous or evergreen);

e. the suitability of the species to the site conditions;

f. any nuisance characteristics of the species, such as shedding of fruit, bark and leaves relative to the position; and

g. the character of the site and locality (does the species need to be sympathetic with any period plantings).

Locally-indigenous native species (those formerly occurring naturally within the local area) are the most beneficial in terms of providing habitat and food sources to native birds and animals and promoting biodiversity.

The planting of Nuisance Species and Environmental Weed Species are not supported.

8.2 SITING OF REPLACEMENT TREES

When siting new trees, consideration should be given to:

a. their ultimate mature size in relation to existing buildings and structures, particularly in relation to root and canopy development;

b. proximity to underground and overhead services; and

c. solar access to private open space areas (both within the site and on adjacent sites), living areas, utility areas (clothes drying etc) and solar panels.

8.3 PLANT STOCK QUALITY

Good quality plant stock is imperative to ensure the best chance of survival, reduce establishment time and reduce the potential for formation of growth defects (especially in the branching structure and root plate) as the tree develops.

In order to ensure good quality plant stock is installed within new developments and as replacement trees, all plant stock shall be certified compliant with the NATSPEC guideline "*Specifying Trees – A Guide to assessment of Tree Quality*".

Where not otherwise specified, the minimum size of new container-grown plant stock should be 25 litres.

8.4 ESTABLISHMENT MAINTENANCE

Newly planted trees generally require an intensive period of care and maintenance in the early stages of their development until they become established.

In order to ensure satisfactory establishment of newly planted trees, the following maintenance tasks must be carried out on a regular basis for a minimum of two years after planting:

a. supplementary watering for at least the first two growing seasons until there is adequate root development;

b. control of competitive weed growth;

c. replenishment of mulch;

d. pruning to remove any defective branches;

e. control of pests and diseases;

f. fertilising; and

g. adjustment of any artificial support (stakes and ties should be removed within 12 months of planting).

APPENDIX 1 – METHODOLOGY FOR DETERMINING TREE RETENTION VALUE

The process for determining the retention value/s shall involve a considered methodology. On development sites the retention value is to be used to assist in determining the constraint value of each tree in the context of any proposed development.

Trees will be assessed as having a 'High', 'Medium', 'Low' or 'Very Low' retention value. Trees with 'High' retention values shall be considered as a priority for retention, trees with a 'Medium ' retention value shall be considered for retention where this is possible and trees with 'Low' or 'Very Low' values are not generally considered as a constraint to development.

An example of an acceptable process is detailed as follows -

Step 1 – Undertaking the Visual Tree Assessment

The assessment shall be based on a visual inspection of the tree/s from ground level using relevant aspects of the Visual Tree Assessment (VTA) method (Mattheck & Breloer, 1994). In summary, the inspection shall result in the notation of the dimensions of the tree, the density and health of the foliage in conjunction with an examination of the form and structure of the trunks, branches and crown and an assessment of the health and soundness of these elements of the tree.

Refer to Appendix 2 for Visual Tree Assessment procedure /considerations.

Step 2 – Determining Useful Life Expectancy (ULE)

Each tree can be assigned a ULE (Useful Life Expectancy) value as developed by Barrell (1996). The objective of a ULE assessment is to assign a relative value to individual trees within a group for the purpose of informing future management options. In summary, ULE is the (safe with an acceptable level of risk) life expectancy of each tree modified by economic considerations, impacts on trees with a longer ULE and the retention of the amenity of the wider landscape.

The Useful Life Expectancy (ULE) methodology can be used to categorise trees as follows:

a. Long (Greater than 40 years);

b. Medium (Between 15 and 40 years);

c. Short (Between 5 and 15 years);

d. Transient (Less than 5 years); and

e. Dead or hazardous (no remaining ULE).

f. Refer to Appendix 3 for ULE consideration process and to Appendix 4 for ULE categories table.

Step 3 – Determining the Landscape Significance Rating

The 'landscape significance' of a tree is a measure of its contribution to amenity, heritage and ecological values. Whilst these values are fairly subjective and difficult to assess consistently, some measure is necessary to assist in determining the Retention Value of each tree. To ensure a consistent approach, the assessment criterion shown in Appendix 5 shall be used. A tree may be considered 'significant' for one or more reasons. A tree may meet one or more of the criteria in any value category (heritage, ecology or amenity) shown in Appendix 5 to achieve the specified rating. For

example, a tree may be considered 'significant' and given a rating of 1, even if it is only significant based on the amenity criteria.

Based on the criterion in this table, each tree will be assigned a landscape significance rating as follows:

a. Significant
b. Very High
c. High
d. Moderate
e. Low
f. Very Low
g. Insignificant

Refer to Appendix 5 for Landscape Significance Rating table

Step 4 – Determining the Retention Value

The Retention Value of a tree is increased or diminished based on its sustainability in the landscape, which is expressed as the ULE. A tree that has a high Landscape Significance Rating, but low remaining ULE, has a diminished value for retention and therefore has an appropriate Retention Value assigned. Conversely a tree with a low Landscape Significance rating even with a long remaining ULE is also considered of low Retention Value.

Refer to Appendix 6 for Tree Retention Value matrix.

Step 5 – Analysing the Implications for Proposed Development

The following tables describe the implications of the Retention Values on site layout and design:

Table 3: Tree Retention Priorities

Retention value	Recommended action
"High"	• These trees are considered worthy of preservation; as such careful consideration should be given to their retention as a priority. • Proposed site design and placement of buildings and infrastructure should consider the Tree Protection Zones as discussed in the following sections to minimise any adverse impact. • In addition to Tree Protection Zones, the extent of the canopy (canopy drip-line) should also be considered, particularly in relation to high rise developments. Significant pruning of the trees to accommodate the building envelope or temporary scaffolding is generally not acceptable.
"Moderate"	• The retention of these trees is desirable. • These trees should be retained as part of any proposed development if possible, however these trees are considered less critical for retention. • If these trees must be removed, replacement planting should be considered in accordance with Council's Tree Replacement Policy to compensate for loss of amenity.
"Low"	• These trees are not considered to worthy of any special measures to ensure their preservation, due to current health, condition or suitability. They do not have any special ecological, heritage or amenity value, or these values are substantially

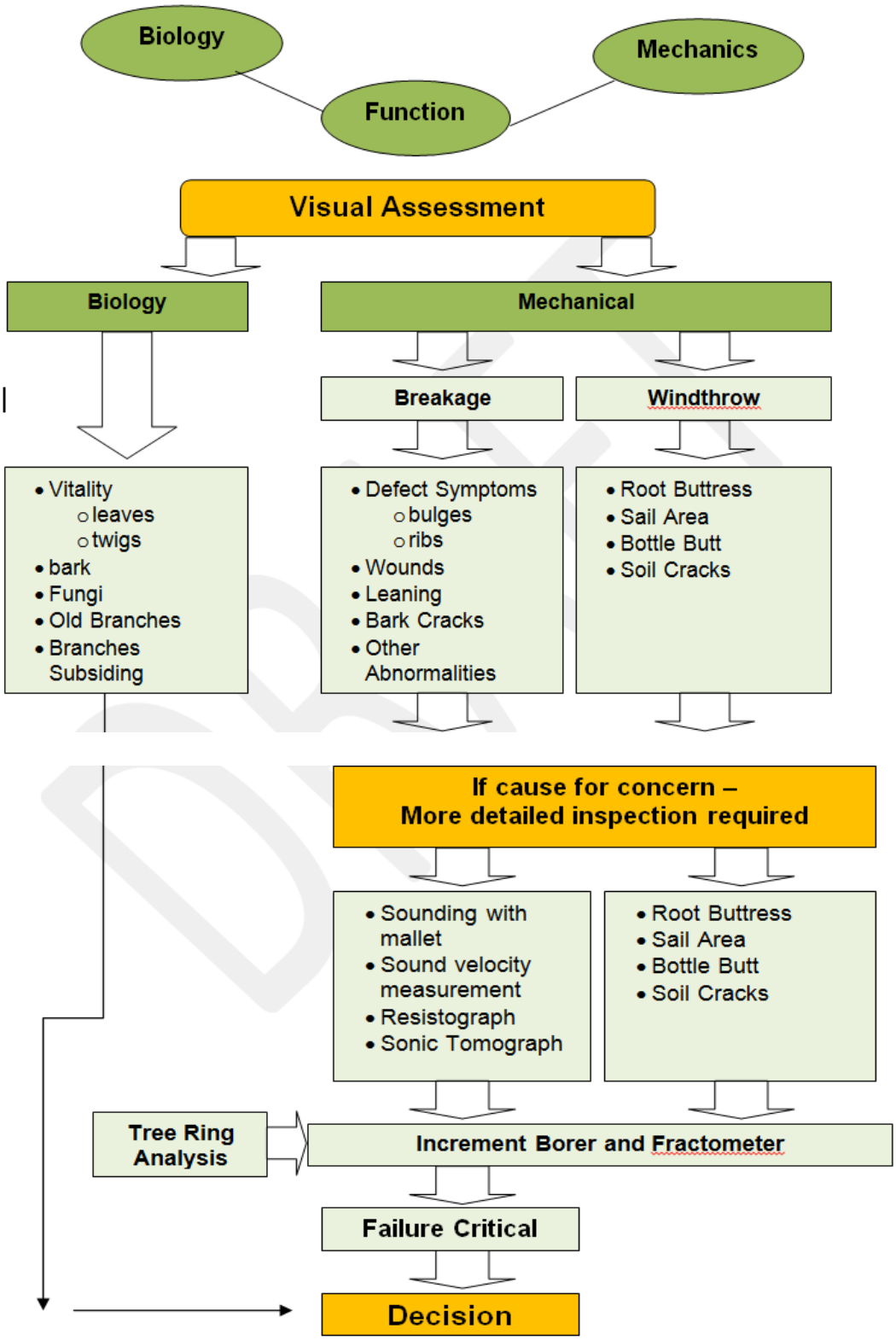
Retention value	Recommended action
	diminished due to their SULE. • These trees should not be considered as a constraint to the future development of the site.
"Very Low"	• These trees are considered potentially hazardous or very poor specimens, or may be environmental or noxious weeds. • The removal of these trees is therefore recommended regardless of the implications of any proposed development.

Ref Morton (2011)

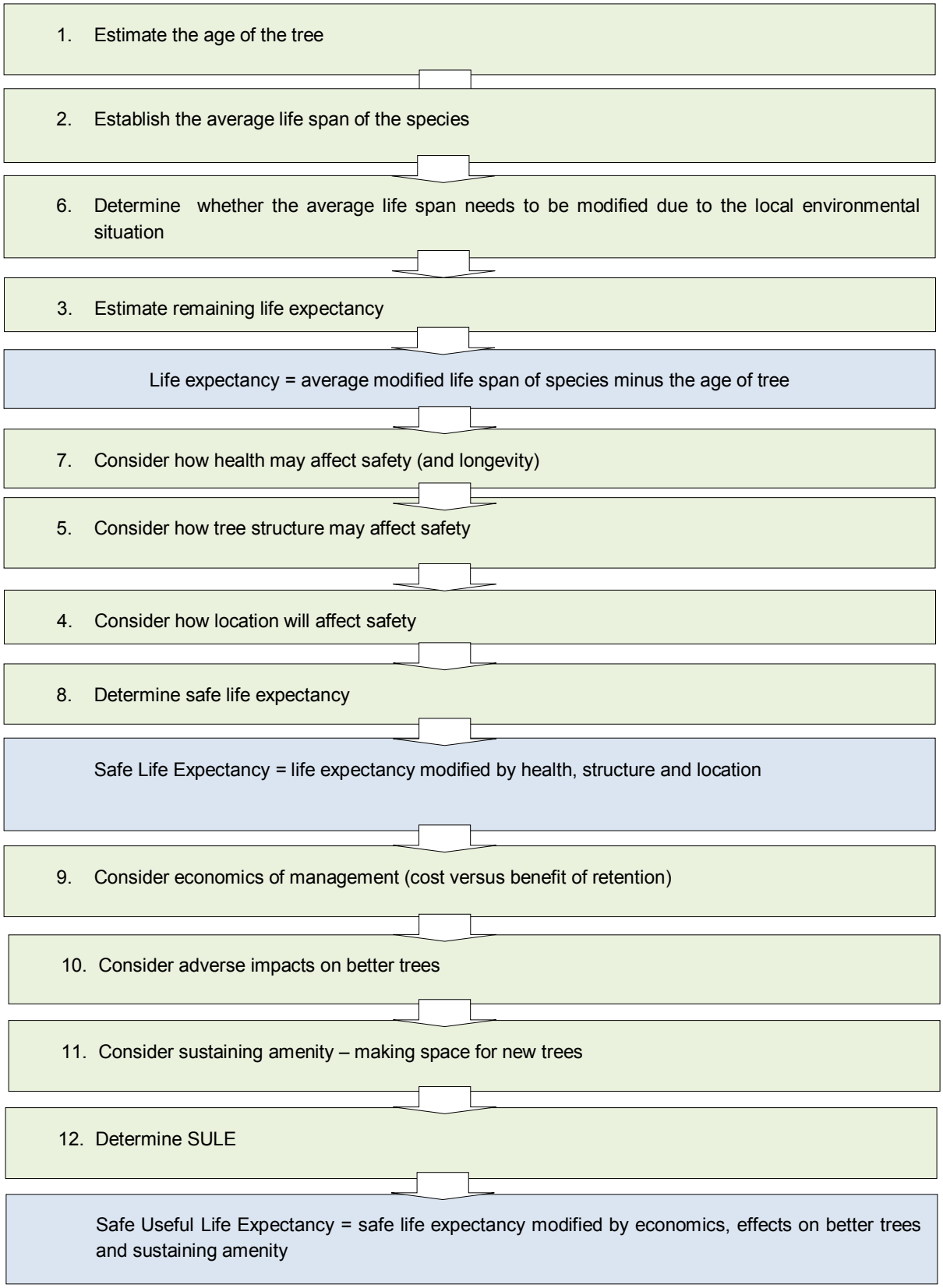
Step 6 – Transfer Retention Values to the Site Analysis Plan

The Retention Value of trees on development sites can be transcribed on a scaled site plan and colour coded. Together with Tree Protection Zones, this information assists in identifying the constraints imposed by trees to site layout and design. The site analysis informs the design of proposed developments.

APPENDIX 2 – VISUAL TREE ASSESSMENT (VTA) PROCEDURE



APPENDIX 3 – USEFUL LIFE EXPECTANCY (ULE) ASSESSMENT PROCEDURE



APPENDIX 4 – USEFUL LIFE EXPECTANCY CATEGORIES - U.L.E

(Ref – J Barrell 1995)

	1. Long	2. Medium	3. Short	4. Removal	5. Moved or replaced
	Trees that appeared to be retainable at the time of assessment for more than 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 15 - 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 5 - 15 years with an acceptable level of risk.	Trees that should be removed within the next 5 years	Trees which can be reliably moved or replaced.
A	Structurally sound trees located in positions that can accommodate future growth.	Trees that may only live between 15 and 40 years.	Trees that may only live between 5 and 15 more years.	Dead, dying, suppressed or declining trees through disease or inhospitable conditions.	Small trees less than 5m in height.
B	Trees that could be made suitable for retention in the long term by remedial tree care.	Trees that may live for more than 40 years but would be removed for safety or nuisance reasons.	Trees that may live for more than 15 years but would be removed for safety or nuisance reasons.	Dangerous trees through instability or recent loss of adjacent trees.	Young trees less than 15 years old but over 5m in height.
C	Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention.	Trees that may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting.	Trees that may live for more than 15 years but should be removed to prevent interference with more suitable individuals or to provide space for new planting.	Damaged trees through structural defects including cavities, decay, included bark, wounds or poor form.	Trees that have been pruned to artificially control growth.
D		Trees that could be made suitable for retention in the medium term by remedial tree care.	Trees that require substantial remedial tree care and are only suitable for retention in the short term.	Damaged trees that are clearly not safe to retain.	
				Trees that may live for more than 5 years but should be	

	1. Long	2. Medium	3. Short	4. Removal	5. Moved or replaced
E				removed to prevent interference with more suitable individuals or to provide space for new plantings.	
F				Trees that are damaging or may cause damage to existing structures within 5 years.	
G				Trees that will become dangerous after removal of other trees for reasons given in A) to F).	

APPENDIX 5 – DETERMINING LANDSCAPE SIGNIFICANCE RATING

Morton (2011)

Rating	Heritage value	Ecological value	Amenity value
1. SIGNIFICANT	The subject site is listed as a Heritage Item under the Local Environment Plan (LEP) with a local, state or national level of significance or is listed as a Significant Tree.	The subject tree is scheduled as a Threatened Species as defined under the *Threatened Species Conservation Act 1995 (NSW)* or the *Environmental Protection and Biodiversity Conservation Act 1999.*	The subject tree has a very large live crown size exceeding 100m² with normal to dense foliage cover, is located in a visually prominent position in the landscape, exhibits very good form and habit typical of the species.
	The subject tree forms part of the curtilage of a Heritage Item (building /structure /artefact as defined under the LEP) and has important association with that item.	The tree is a locally indigenous 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.	The subject tree 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.
	The subject tree is a Commemorative Planting having been planted by an important historical person (s) or to commemorate an important historical event.	The subject tree is a Remnant Tree, being a tree in existence prior to development of the area.	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 era or style of landscape design associated with the original development of the site.	The tree is a locally-indigenous species, representative of the original vegetation of the area and is a dominant or associated canopy species of an Endangered Ecological Community (EEC) formerly occurring in the area occupied by the site.	The subject tree has a very large live crown size exceeding 60m²; a crown density exceeding 70% (normal-dense), is a very good representative of the species in terms of its form and branching habit or is aesthetically distinctive and makes a positive contribution to the visual character and the amenity of the area.

Rating	Heritage value	Ecological value	Amenity value
3. HIGH	The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence.	The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value.	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% (normal); the subject tree is visible from the street and/or surrounding properties and makes a positive contribution to the visual character and the amenity of the area.
4. MODERATE	The tree has no known or suspected historical association, but does not detract or diminish the value of the item and is sympathetic to the original era of planting.	The subject tree is a non-local native or exotic species that is protected under the provisions of this Development Control Plan.	The subject tree has a medium live crown size exceeding 25m²; the tree is a fair representative of the species, exhibiting moderate deviations from typical form (distortion/suppression etc) with a crown density of more than 50% (thinning to normal); and The tree is visible from surrounding properties, but is not visually prominent – view may be partially obscured by other vegetation or built forms. The tree makes a fair contribution to the visual character and amenity of the area.
5. LOW	The subject tree detracts from heritage values or diminishes the value of a Heritage Item.	The subject tree is scheduled as exempt (not protected) under the provisions of this Development Control Plan due to its species, nuisance or position relative to buildings or other structures.	The subject tree has a small live crown size of less than 25m² and can be replaced within the short term (5-10 years) with new tree planting.
6. VERY LOW	The subject tree is causing damage to a Heritage Item.	The subject tree is listed as an Environment Weed Species in the Leichhardt Local Government Area, being invasive, or is a known nuisance species.	The subject tree is not visible from surrounding properties (visibility obscured) and makes a negligible contribution or has a negative impact on the amenity and visual character of the area. The tree is a poor representative of the species, showing significant deviations from the typical form and branching habit with a crown density of less than 50% (sparse).

APPENDIX 6 – DETERMINING TREE RETENTION VALUES

	Landscape Significance Rating						
SULE	1	2	3	4	5	6	7
Long - greater than 40 years	High Retention Value						
Medium - 15 to 40 years			Moderate Retention Value				
Short - 5 to 15 years				Low Retention Value			
Transient - less than 5 years				Very Low Retention Value			
Dead or Hazardous							

Ref:-Morton 2011

Modified from

Couston, Mark & Howden, Melanie (2001)

APPENDIX 7 – DEFINITIONS

Terms	Definitions
Aerial Bundle Conductor (ABC)	A type of overhead low voltage electrical cable. Insulated cables are wrapped around a steel cable strung between overhead poles. This minimizes the risk of open conductors touching and reduces the clearances for pruning around trees.
Amenity	The quality of being pleasant or attractive, having desirable or useful features and making a contribution to physical or material comfort.
Australian Qualification Framework (AQF)	A quality assured national framework for education and training. It provides nationally recognised and endorsed qualifications through a competency based training system.
Branch Bark Ridge	An enlarged protruding area of bark tissue on the upper side of a branch crotch (junction).
Branch Collar	A swelling at the base of a branch, at the junction with another branch or the trunk, resulting from overlapping tissue of the two.
Canopy	The crown of a tree, comprising all of the foliage and branches
Canopy Area	The total volume of a tree's canopy.
Canopy drip-line	The extent of the canopy projected to the ground plane.
Canopy Spread	The diameter of the crown/canopy.
Climbing Spikes or Spurs	Devices designed to assist climbing trees for the purpose of sectional dismantling (cutting down trees in sections, starting at the top). Climbing spikes create small wounds in the vascular tissue of trees that are injurious. The use of climbing spikes are only permitted where a tree is completely dead and proposed to be dismantled or removed, or in emergency situations to rescue an injured tree worker from a tree.
Complying Development	Development that meets set standards as specified by the local authority or State Government.
Consulting Arborist	A suitably experienced person with a minimum qualification of Australian Qualification Framework (AQF) Level 5 in Arboriculture.
Dead Tree	Tree is no longer capable of performing any of the following processes or is exhibiting any of the following symptoms: processes – photosynthesis via its foliage crown (as indicated by the presence of moist, green or other coloured leaves); osmosis (the ability of the root system to take up water); turgidity (the ability of the plant to sustain moisture pressure in its cells); epicormic shoots or epicormic strands in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a lignotuber); Symptoms – permanent leaf loss; permanent wilting (the loss of turgidity which is marked by desiccation of stems, leaves and roots); abscission of the epidermis (bark desiccates and peels off to the beginning of the sapwood).
Deciduous	A plant that sheds all of its leaves at one time during the year.

Terms	Definitions
Decline	The progressive degeneration of the health of a tree.
Development Application	An application made in accordance with the Environmental Planning and Assessment Act 1979 requesting permission to carry-out proposed development (ie building works).
Dying Tree	A Tree showing signs of significant, immediate and irreversible overall decline.
Endangered Ecological Community (EEC)	An ecological community threatened with extinction as defined under the Threatened Species Conservation Act (NSW) 1996.
Endemic (species)	A species only found within a particular area or region and nowhere else.
Environmental Weed Species	An invasive introduced plant species, which is capable of establishing, self-sustaining and expanding populations in natural and semi-natural habitats.
Epicormic Growth	A sprout or shoot arising from a dormant bud beneath the bark of a branch, usually growing in response to injury or environmental stress (fire, drought etc.).
Exotic (species)	An introduced species, not native to the Australian Continent.
Flush cutting	The practice of severing a branch parallel with the trunk, removing the branch collar and resulting in a larger wound than necessary. Whilst this was formerly common practice, it is injurious to trees and detrimental to tree health and structure. Pruning of this nature is therefore prohibited.
Formative pruning	The selective pruning of a young tree to promote good form and branching structure typical of the natural growth habit of the species. The main aim of formative pruning is to identify and remove any growth defects or other structural problems that may have long term implications early in the development of the tree.
Habit	The nature and appearance of the branching framework of a tree or plant.
Hazard	A situation or source of danger or risk that poses a level of threat to life, health property or environment.
Heritage Conservation Area	An area which has distinctive character of heritage significance which is desirable to conserve, as defined in the Local Environmental Plan.
Heritage Impact Statement	A statement to demonstrate that the heritage significance of the relevant item, property or relic has been established, assess the impact that the development will have on its significance and identify the measures proposed to minimise such impact.
Heritage Item	A building, work, relic, artefact, tree or place listed in a nominated Schedule of the Local Environment Plan.
Imminent Danger	An immediate threat of harm.
Locally-indigenous (species)	A species native to the local area.
Lopping	Lopping is the cutting of branches at an intermediate point between the branch junction and the foliage, leaving a stub.
Minor Works	Crown thinning by a maximum of 10% of the existing canopy in

Terms	Definitions
	any 12 month period or tree related works consistent with a tree management plan prepared by a Consulting Arborist and approved by Council in writing before Works commence.
Native (species)	A species native to the Australian Continent.
Natural Target Pruning	A pruning technique that involves identifying the correct angle and alignment for proper pruning cuts by forming “targets” between the commencement of the cut at the outer edge of the Branch Bark Ridge (BBR) and the end of the cut at the point where the lower part of the branch meets the branch collar.
Noxious Weed	A plant that has been declared Noxious under the meaning of the *Noxious Weeds Act 1993.*
Nuisance Species	A plant that has one or more negative attributes, such as an extensive and damaging root system, toxic or allergenic properties.
Pollarding	The pruning of branches back to just above the same point every two to three years to control the size of a tree. Pollarding is not synonymous with lopping and topping. This is a specialist pruning practice that is generally not acceptable for the majority of tree species and is therefore prohibited without prior consent.
Poisoning	The deliberate or accidental application of toxic materials (including herbicides or other harmful chemicals) to the foliage, vascular tissue, root zone or other part of a tree in order to cause the death or destruction of a tree.
Prescribed Tree	a tree of more than six (6) metres in height and having a trunk diameter of more than 200 millimetres when measured at a height of 1.4 metres from the ground, growing on privately owned land; or a tree that is or forms part of a Heritage Item or is within a Heritage Conservation Area; butexcludes any tree listed as an exempt species as outlined within Part C1.14.2 of Development Control Plan 2013.
Pruning	The selective removal of branches, severed at the branch collar near the junction with another branch in accordance with Natural Target Pruning techniques as specified in AS4373:2007.
Quantified Tree Risk Assessment (QTRA)	A systematic methodology for evaluating risk of harm and establishing priorities for managing risks associated with trees by an assessment of potential targets, probability of failure and impact potential.
Remove (a tree)	To cut down or sever the main stem of a tree, resulting in its destruction.
Retention Value	The relative value of a tree for preservation in the context of a proposed development, based on an evaluation of its sustainability in the landscape (ULE) weighed up against its significance in the landscape (sum of its amenity, ecological and heritage value).

Terms	Definitions
Ring-barking	The deliberate act of creating a concentric wound around the circumference of the main stem/trunk in order to disrupt the flow of moisture and nutrients between the roots and leaves and cause death of the tree.
Root Control Barrier	A material (usually in sheet form) inserted vertically through the soil profile to deflect root growth.
Root Plate	The conglomerate of structural (woody) and fibrous roots that radiate out from the tree trunk, often extending beyond the drip-line and usually confined to the top metre of soil (i.e. a relatively shallow but broad 'plate')
Useful Life Expectancy (ULE)	A systematic method (developed by Jeremy Barrell) of estimating the sustainability of the tree in the landscape, calculated based on an estimate of the average age of the species in an urban area, less its estimated current age. The life expectancy of the tree is further modified where necessary in consideration of its current health and vigour, condition and suitability to the site.
Selective Crown Thinning	The selective removal of branches that does not alter the overall size, form or branching habit of a tree. Crown thinning is aimed at reducing canopy density through the removal of lower order (tertiary) branches whilst retaining the main structural and framework branches intact.
Significant Tree	A ‘Significant Tree’ means any ‘tree’ that is either, listed as a Heritage Item, located within a property that is listed as a Heritage Item and/or that is assessed as being significant against the criteria in Appendix 5.
Soil Volume	The total amount of soil material or growing media available for unobstructed root growth.
Structural Root Zone (SRZ)	The portion of the root plate comprised primarily of structural woody roots (integral with the soil profile) providing the main mechanical support and anchorage of a tree, calculated in accordance with AS 4970:2009, expressed as a radial dimension in metres from the centre of the trunk.
Structural Soil	A growing media for plants consisting of a mixture of materials designed to provide load bearing capacity for pavements whilst also providing basic requirements for root growth (aeration, moisture holding capacity and nutrients).
Threatened Species	A species threatened with extinction as defined under the *Threatened Species Conservation Act (NSW) 1995.*
Topping	The removal of the top portion of the tree including the leading stem.
Trade Arborist	A suitably experienced person with a minimum qualification of Australian Qualification Framework (AQF) Level 3 in Arboriculture.
Transplant	The removal of a tree from the ground, with root system intact, and relocation to a new position and replanting in the ground.

Terms	Definitions
Tree	A woody, perennial and long lived plant that has a self-supporting trunk (or trunks) with lateral branching initiating at some distance from the ground and supporting a definitely formed canopy.
Tree of Landscape Significance	A Tree that rates as 1, 2 or 3 when assessed against the criteria contained in the table in Appendix 5 of this Technical Manual.
Tree Protection Zone (TPZ)	A specified area at a given distance from the trunk set aside for the protection of a trees root system and canopy during land development works to ensure the long term viability and stability of a tree, calculated in accordance with AS 4970:2009.
Tree Worker	A suitably experienced person with a minimum qualification of Australian Qualification Framework (AQF) Level 2 in Arboriculture.
Urban Forest	The Urban Forest is the conglomerate of trees growing within urban areas on public and privately owned lands, including those growing within parks, reserves, streets and institutional land.
Visual Tree Assessment (VTA)	A systematic method of tree assessment (developed by Claus Mattheck & Helge Breloer) using biological and biomechanical indicators to evaluate overall vitality and structural integrity of a tree.
Water Sensitive Urban Design (WSUD)	Environmentally sustainable water resource management in urban areas. The integration of water cycle management into urban planning & design, sensitive to natural ecological and hydrological cycles.
Wilful Damage / Wilful Destruction	Wilful damage includes deliberate vandalism or deliberate injury causing harm, including the actions of poisoning using herbicides or other chemicals, ringbarking, lopping or topping or other improper pruning of a tree, breaking or tearing-off branches or roots, attaching objects to the trunk or branches using fastening devices that injure the tree, using climbing spikes, spillage of harmful chemical or petrochemicals within the root zone, stripping and removal of topsoil or bulk excavation within the root zone, filling or stockpiling bulk materials over the root zone or surrounding the trunk or any other physical damage to the tree or its parts.
Work	Any physical activity.

APPENDIX 8 – BIBLIOGRAPHY/REFERENCES

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