

2.0 Street Trees and the Urban Environment

2.1 Benefits of Street Trees

Street trees are a vital urban and suburban element that can transform the character of streets and provide numerous environmental, aesthetic, cultural and economic benefits. In the long term, they often create a very real 'sense of place' and dramatically enhance the public domain. The benefits of street tree planting can be viewed in the following categories:

Environmental Benefits

- Carbon sequestration and storage. A single mature tree can absorb carbon dioxide at a rate of 21 kg/year and release enough oxygen back into the atmosphere to support 2 people's needs.
- Shading of pavement, cars and buildings, thereby reducing urban temperatures. Shading of asphalt pavements can also extend its life.
- Removal of gaseous pollutants by absorbing them with normal air components through the stomates in the leaf surface. (eg. Sulfur Dioxide, Ozone, Nitrogen Oxide), plus capture and removal of particles such as dust from the air.
- Acting as natural pollution filters. Their canopies, trunks, roots, and associated soil, filter polluting particulate matter out of stormwater flows and also slow and reduce the flow of runoff, reducing the amount of pollution that is washed into drains and catchment areas. Trees also take up and utilise nutrients like nitrogen, phosphorus, and potassium that can otherwise pollute streams.
- Intercepting and reducing raindrop impact and runoff and thereby reduce erosion of exposed soils and siltation of creeks and drains.
- Providing habitat, roosting and food sources for urban fauna.

Economic Benefits

- Improving economic performance by increasing the attractiveness of businesses and tourism areas. It has been shown that people typically linger, shop and dine longer in tree-lined streets.
- Reducing energy consumption, through shading and reductions in the "urban heat island" effects.
- Shops, apartments and housing in well-planted areas usually attract higher rents and sale prices.

Social and Psychological Benefits

- Calming traffic, slowing speeds, and providing a buffer between pedestrians and cars. They are also useful in delineating and signifying curves in a street.
- Improved sociological benefits with studies showing strong correlation of well planted areas with reduced social services, domestic violence, and strengthened community ties.
- Creation of feelings of relaxation and well-being. Hospital patients, for example, are shown to recover quicker and with fewer complications when in rooms with views of trees. Workers and students are also shown to be more productive when their environments have views to trees.
- Improving comfort and general amenity as street tree canopies can shade pedestrians, diminish traffic noise, screen unwanted views and reduce glare.
- Defining precincts and links with history. Tree lined streets can provide orientation, and contribute to the overall urban character.

- Providing a human scale that contrasts with apartments and larger buildings that can otherwise dominate some streets.
- Providing seasonal interest and natural beauty through foliage and their interesting leaf patterns, flowers, bark, fruit and canopy.



Figure 2.1 - Warby Street, East Bowral with a mix of small native trees appropriate to the scale of the street and verge. (Photo - Arterra)



Figure 2.2 - Hoddle Street, Burrawang with mature small trees appropriate to the scale of the street. A mix of evergreen and deciduous trees provide year round interest. (Photo - Arterra)



Figure 2.3 - Bundaroo Street, Bowral with large deciduous trees growing around ABC wire providing substantial amenity and benefits for the local community. (Photo - Arterra)

2.2 Concerns About Street Trees

Although trees present a myriad of benefits we have to recognise that they may also present problems, costs and risks if poorly planned, planted or managed. A tree is a dynamic living organism and can be a potentially large 'structure'. Every species is genetically determined to achieve certain proportions, within the limits imposed by its immediate environment. A tree's mature size has to be accounted for when planning any new planting and when designing new structures that are close to existing trees.

The Wingecarribee LGA has a varied population of residents mainly living in small and large lot suburban housing or on rural farmland. The community as a whole also includes business owners and employees who may visit and engage with the area and its trees every day. As such, Wingecarribee encompasses many people with an extremely diverse range of interests and attitudes towards street trees.

The most common causes of problems and concerns with street trees are:-

- cracking and lifting of pavement and walls;
- clogging of pipes and services;
- obstruction of views;
- obstruction of pedestrian and vehicle access and street signage;
- obscuring of street lighting or traffic signals;
- dropping of leaves and fruit;
- attraction of animals and birds that may cause mess and irritation;
- shedding of larger branches;
- excessive shading or blocking of sunlight.

Many of these common issues can be adequately addressed without tree removal. Appropriate and timely maintenance and pruning can often alleviate most concerns, and appropriate repair, realignment or redesign of nearby infrastructure can also be undertaken with little impact to the tree and the tree can continue its valuable contribution for many decades.

It is also important that people recognise, and are informed about, the need for change. As trees age they will typically require increasing maintenance and then eventually will require removal and replacement. In a natural ecosystem this happens gradually and with little problem or impact to people. In an urban environment an aging or hazardous tree cannot be left until it completely fails.

Tree removal can be traumatic and emotional. Often trees have been there for many decades - people have grown up with them and become attached to their presence, their size and their aesthetic appeal. The trees may also represent associations to past events and historical places. For these and many other reasons, some parts of the community often have unrealistic expectations of trees being retained for very long periods. There will come a time, however, when the benefit of keeping an individual tree is outweighed by the risk to life or property and the monetary cost of maintaining it. In summary, when managing and establishing any 'urban forest' the needs of the 'many' may often have to override the desires of the 'few'.

Street trees can also evoke a very negative perception within the community. Based on feedback from some residents and related surveys, the three main concerns raised are damage to public infrastructure such as footpaths and drainage, leaf and branch drop on cars, houses and footpaths, and their

potential to cause allergies and irritation. Each of these are discussed in more detail below.

Damage to pavements and structures

Many old and established trees (often the more vigorous and larger growing species) can, and have, caused footpath and kerb uplift and cracking. In adhering to the principle of the 'right tree for the right location' any future pavement damage can be significantly minimised by planting trees that are less likely to cause these issues.



Figure 2.4 - A large tree in a narrow verge on Holly Street, Bowral increases the likelihood of damage to infrastructure and trip hazards in pavements. (Photo - Arterra)

Another important factor is site preparation, planting and the establishment techniques used for new tree planting. To minimise pavement damage, the use of expanded planting pits, and in-road blisters or kerb extensions (where possible) should also be considered. Also maximising the size of the planting 'cut outs' in the pavement and the use of flexible pavements and other devices such as the "Tripstop™" jointing system will assist in minimising future issues.

Other factors that commonly contribute to negative interactions between trees and structures include:-

- The nature of the prevailing soil type, structure and depth;
- The tree species and its genetic dispositions that influences its ultimate size and shape;
- The design and age of the nearby structures;
- The construction materials used, quality of installation and methods adopted;
- The age of the adjoining structure (as with trees, most structures have a 'useful life span' and have to be maintained and then replaced within set time frames); and
- The type of previous land use (eg. industrial sites where soil contamination and/or layers of fill can impede normal biological processes).

Whilst roots are opportunistic they do not act 'aggressively' as often believed. Root growth occurs via extension at the very end of the root tip and it can only occur when there is sufficient soil oxygen and moisture. They will not grow if there is too much water, not enough oxygen, or if the spaces in the soil are too small or compacted. Knowledge of root growth characteristics can be used in the design of infrastructure in proximity to trees. Equally important is the provision of sufficient space for the growth of healthy trees. If sufficient space is not provided

at the time of planting, roots will typically occupy the spaces directly under the pavement surface, increasing the risk of pavement lifting within quite short timeframes.

Tree roots are also storage organs and they do have the potential to generate new roots after being cut. In most cases, a tree will generate new roots when the roots are cut cleanly, but if roots are torn or crushed then they are most likely to decay and die leading to a potential loss of tree stability and ingress of unwanted pathogens.

Leaf, fruit and branch droppings

All trees, including evergreen species, drop leaves. Likewise nearly all trees will at some time during the year drop fruit, flowers and bark. Strategies that can be employed to reduce the impact of leaf and fruit litter in our streets will be the coordination of our street sweeping resources to target problem areas and seasons.

Species that are known to develop excessive fruit production or very fleshy fruits or leaves that become slippery on decomposition will typically be avoided for selection, particularly in paved or heavily trafficked commercial areas.

Likewise, trees that are particularly susceptible or currently known to shed large limbs on a semi-regular basis will typically be avoided. It must be remembered that all trees can shed limbs from time to time, as a result of mechanical breakage in strong winds, or pest and disease attack. Appropriate preventative maintenance and formative pruning can substantially reduce the risks associated with branch failures.

Allergies

Concern is sometimes raised that particular tree species cause allergies, irritation and respiratory problems. It is important to note there is a difference between an allergic reaction and

an irritation. All flowering plants including grasses produce pollen. Generally species that rely on wind pollination create a greater pollen load to ensure continuation of the species. Pollen in the air can contribute to hayfever, eye allergies and other respiratory problems.

Grass species are by far the most prevalent pollen producers and have a long pollen season. Grasses rely on wind to disperse their microscopic pollens, which are produced in vast quantities. In Coastal NSW the grass pollen season goes from September into January or February depending on prevailing weather. Eye allergy symptoms may be reduced by sufferers wearing wrap around sunglasses and a hat. This has the potential to exclude the majority of pollen grains affecting the eyes.



Figure 2.6 - Leaf and branch drop throughout the year can make managing most larger native trees more difficult than deciduous and exotic trees. Leopold Street, Mittagong (Photo - Arterra)



Figure 2.5 - Autumn leaf drop from Claret Ash on Highland Drive, East Bowral demonstrates the need for periodic cleanups to ensure drainage infrastructure remains functional. (Photo - Arterra)



Figure 2.7 - Fast growing trees that have short life expectancies and readily produce suckers from roots and the base of the trunk can be problematic as street trees. (Photo - Arterra)

2.3 Existing Street Tree Population

Wingecarribee has an excellent commitment to street tree planting however the understanding of the existing street tree population is very limited. This is mainly due to the large geographical area of the region, dispersed urban areas and limited resources. The vast majority of streets are already planted however residents have undertaken much of this planting in small sections and over a long period. Very few historical avenues of medium and large street trees exist across the LGA as a result. Most streets have trees of various size, age and condition that don't consistently address the needs of the community.

Some of the more recently developed areas such as East Bowral and sections of Moss Vale are now dominated by single and mixed species avenues that address the scale of the street and usually provide excellent amenity for residents. Tree quality in these areas is vastly improved as a result of the power lines being underground and therefore they have little impact on tree growth. Many of these avenues are still young and will reach maturity over the next 10-20 years depending on the species.

Generally, field observations of the urban areas indicate that small trees with relatively short useful life expectancies dominate most streets. These include species such as Flowering Cherries, Plums and Peaches (*Prunus* spp.) and Crab Apples (*Malus* sp.) It is likely that the historical conflict between street trees and overhead power lines has contributed to the excessive proportion of small trees.

The planting of shrubs in verges is also often associated with areas where small trees dominate. Shrubs tend to retain their lower branches and obscure site lines for pedestrian and motorists creating unnecessary hazards on our roads and footpaths.

Large conifers are an iconic part of the southern highlands imagery. Mature pine and cypress trees have historically been used as windbreaks for paddocks and large lot residential properties. Many of these larger properties have been subdivided and now form part of the streetscape in some of the older urban areas. Most of the large and healthy specimens are located on the boundaries of private properties and make significant contribution to the streetscape due to their size.

Large deciduous trees such as elms, oaks, liquidambar and poplars frequently occur on urban streets, along railway corridors, in parks and on private properties. These trees contribute significantly to the autumn foliage colour that gives the region a distinct character and supports tourism. Some of these trees are reaching the end of their useful life and will need to be replaced with trees of suitable size and foliage colour to maintain the character of the region. Unfortunately many of these large trees have been planted beneath overhead power lines in the past and are now severely disfigured by clearance pruning.



Figure 2.8 - A consistent avenue of Claret Ash along Highland Drive, East Bowral provides an aesthetically pleasing and consistent streetscape that provides amenity for the local residents. Consistent avenues of trees of an appropriate scale and similar grow habit reduces the need for costly maintenance and repairs to damaged infrastructure. (Photo - Arterra)

Large native tree species occur sporadically through the streets and are either remnant and vegetation that previously existed, or have been planted by local residents. Many of the endemic Eucalyptus species are not well suited to growing in the highly modified urban environment and often fail to thrive as a result. They often cause damage to infrastructure and can create excessive leaf, fruit and branch drop where conditions have enabled them to reach mature sizes.

Species diversity is a critical component in managing a sustainable urban forest. The wider the range of botanical species and families, the lower the likelihood of canopy cover degradation and loss in the event of unexpected pest and disease outbreaks, or from impacts such as climate change and prolonged droughts. Increased diversity also helps to support more diversity of fauna, by providing a variety of food and habitat throughout different times of the year.

The Council aims to achieve a balanced species diversity in its street trees by:-

- Implementing the relevant tree species selection and planting guides included in this Street Tree Master Plan for all new street tree planting;
- Selecting the tree species for planting depending on their suitability for the specified street, aesthetic, functional and biological attributes, past performance and the potential to contribute to the wider environment, using the philosophy of the “right tree for the right location”;
- Assessing Development Applications to ensure that any proposed tree selection is compatible with the landscape character for particular urban areas;
- Considering the known pest and disease impacts when selecting new tree species and managing tree replacements.

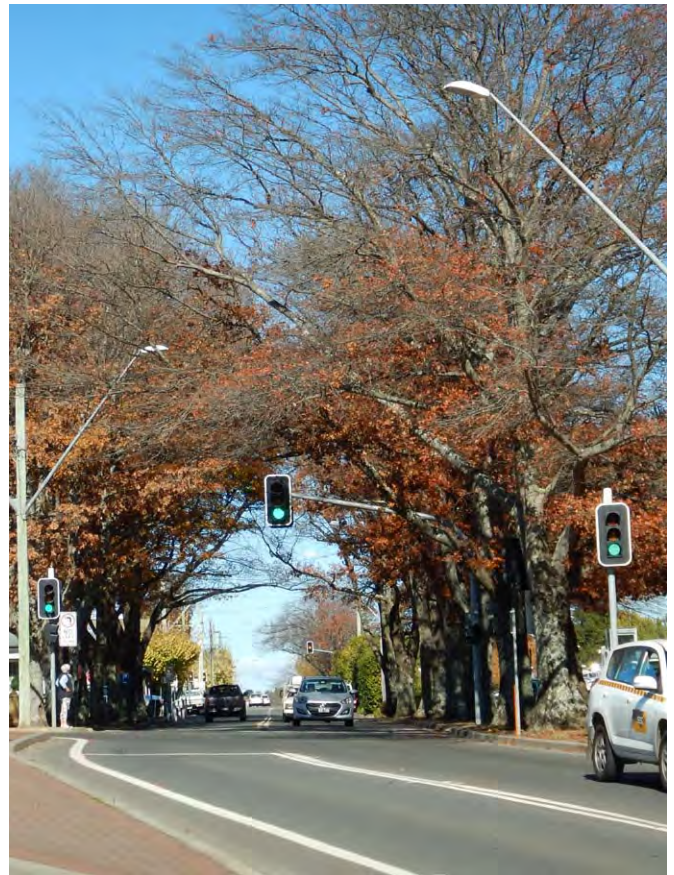


Figure 2.9 - An established avenue of Pin Oak on Station Street, Bowral creates a pleasant experience for pedestrians and motorists. Suitable replacement planting for ageing trees should be planned well in advance so that the benefits of established avenues can be passed on to the next generations. (Photo - Arterra)



Figure 2.10 - Flowering Cherries on streets like Oxley Drive, Mittagong provide an impressive floral display in Spring however these small and relatively short lived trees provide limited amenity and environmental benefit compared to larger trees with longer life expectancies. Larger trees should be planted wherever possible. (Photo - Arterra)

2.4 Current Street Tree Issues

Overhead Power Lines

Approximately 70% of all streets across the LGA are impacted by overhead power lines, which greatly affects tree planting on at least one side of the street and sometimes both. The character and form of the street trees is significantly compromised especially when combined with clearance pruning requirements for bushfire prone land, which also affects many of the urban areas.

Numerous large trees have been planted beneath powerlines in urban areas in Wingecarribee LGA over the years. These trees are now creating unnecessary maintenance issues for Endeavour Energy, are often severely disfigured as a result of the clearance pruning and contribute little to the amenity of the streetscape. In most instances removal of the disfigured tree would improve the appearance of the streetscape. Replacement of these trees should be subject to the same selection process as all other streets and in some instances no street tree planting would be more appropriate where medium or large size trees can be planted on the opposite verge. This is a significant issue that distresses the local community and increases the maintenance costs for the energy provider.

One solution to this problem is to select very small tree species, which is viable for narrow streets, however with wide streets and verges these small trees are often out of scale with the surrounding streetscape.

The installation of Aerial Bundled Conductors (ABC) allows for reduced line clearance resulting in less pruning and in turn less impact on the tree canopies. Only approximately 6% of Wingecarribee streets have any ABC installation, which allows for larger trees to be planted beneath and minimises disfiguring pruning. This is a relatively low percentage but generally in line with most other Councils.

In addition, the lack of in-road planting to avoid overhead wires is extremely low with only three streets across the entire LGA having any sort of in-road planting.

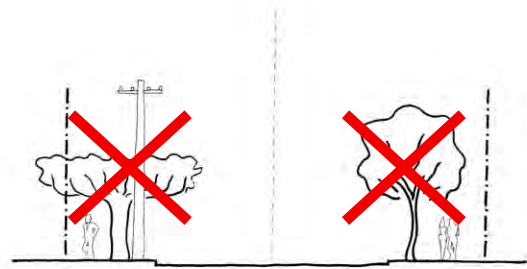


Figure 2.12 - Typical street section with large trees under powerlines and small tree on opposite verge. This often results in disfigured trees and small trees that have limited environmental benefit.

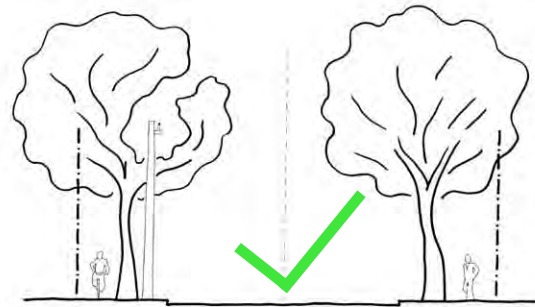


Figure 2.13 - Typical street section with medium size trees on both verges and ABC. Allows large trees to be planted and managed around existing infrastructure.

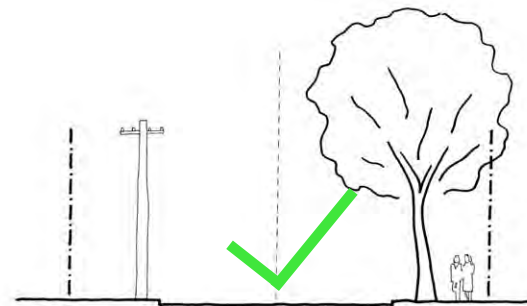


Figure 2.14 - Typical street section with no street tree under powerlines and medium size trees on opposite verge. Allows larger tree on opposite verge to contribute to streetscape while removing the conflict between trees and existing services.



Figure 2.11 - Clearance pruning for powerlines can significantly disfigure large trees and create disproportionate maintenance costs. These trees often detract from the aesthetic appeal of a street and should in most cases be removed. The Pin Oak in Helena Street, Mittagong is an example of a large tree disfigured by clearance pruning. (Photo - Arterra)



Figure 2.15 - The use of conifers near powerlines can result in disfigured trees that have limited potential to regain an aesthetically pleasing shape. Henderson Avenue, Mittagong is an example of a Himalayan Cedar pruned around powerlines. The gap in the canopy will remain with the tree for the rest of its useful life or until it is removed. (Photo - Arterra)

Over-reliance on Small Tree Species

The main concern at the moment is the dominance of very small tree species on many streets. Typically small trees have relatively short useful life expectancies requiring more frequent replacement. Most of the benefits of trees are exponentially increased, the larger the tree is. It is therefore important to try and establish the largest but still appropriate tree, within the reasonable limits of the surrounding infrastructure and resident tolerance. A number of flowering cherries have died as a result of soil born diseases such as root rot in recent years. This could have a severe impact on the street tree populations of Prunus species if it spreads further.



Figure 2.16 - Small trees planted in wide grass verges provide limited amenity and environmental benefit. Kamilaroi Crescent, Braemar is an example where trees with the potential to grow large and live longer would greatly improve the amenity and environmental benefit that the street trees will offer in future decades. (Photo - Arterra)

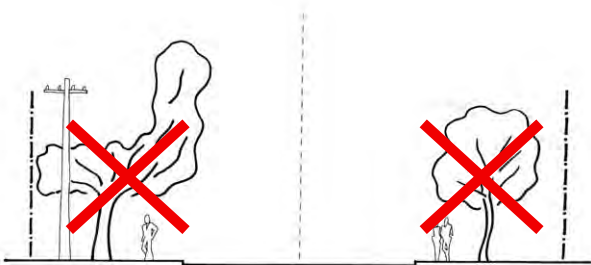


Figure 2.17 - Typical street section with wide verges and powerlines offset near property boundary. Large trees planted under powerlines and small trees on opposite verge.

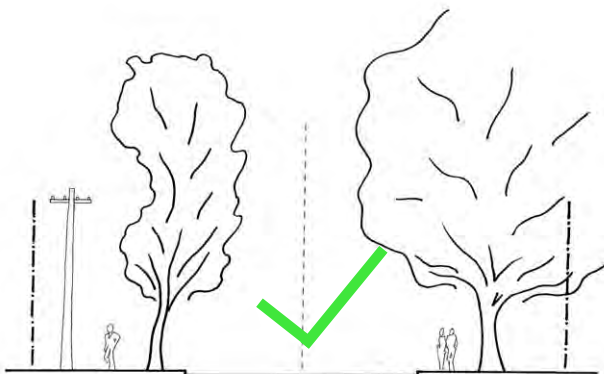


Figure 2.18 - Typical street section with wide verges and powerlines offset near property boundary. Fastigate trees planted away from powerlines and medium or large trees on opposite verge. Appropriate species selection and placement of trees in the verge can significantly reduce ongoing maintenance and improve public amenity.

Wide Streets and Streets with a Lack of Canopy Cover

There are a number of streets that have extremely wide carriageways for the amount of traffic that they carry. In-road planting in these streets would provide an opportunity to plant larger trees. Similarly, there are multiple examples where streets have wide verges and could be provided with excellent canopy trees, particularly if ABC is implemented concurrently.



Figure 2.19 - Bong Bong Street, Bowral with no street trees. The main street of Bowral provides little amenity and appeal for residents and tourist. (Photo - Arterra)



Figure 2.20 - Victoria Street, Mittagong has a wide carriageway with opportunities for in-road planting that could significantly improve the amenity of the street to pedestrians. (Photo - Arterra)



Figure 2.21 - Barrengarry Street, Robertson is an example of where larger street trees could be planted and grow without being compromised by above ground electrical wires. (Photo - Arterra)

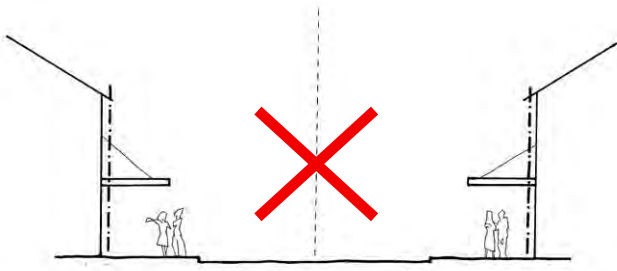


Figure 2.22 - Typical street section with buildings and awnings on both verges. This is typical of the main streets in Bowral, Mittagong and Moss Vale.

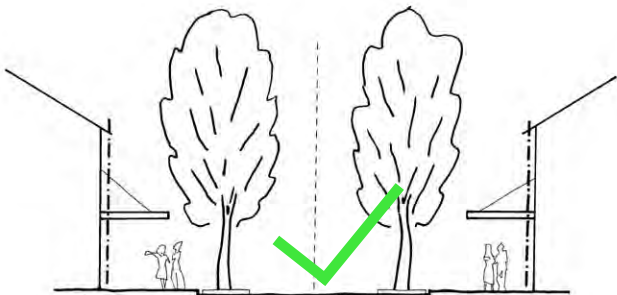


Figure 2.23 - Typical street section with buildings and awnings on both verges and fastigiate street trees planted in-road. A limited number of street trees planted in strategic locations would have a significant impact on the appearance of the street.

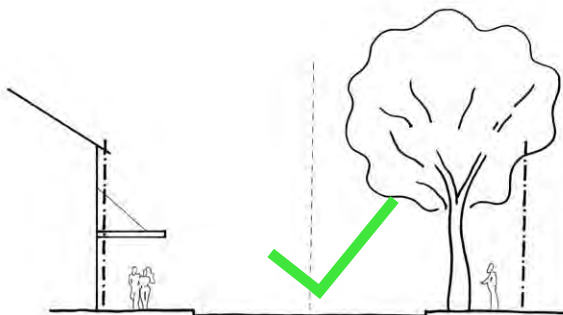


Figure 2.24 - Typical street section with building and awning on one side and medium size street tree on opposite verge. A larger tree planted on the opposite verge can provide substantial benefits where tree planting on both verges is problematic.

Inappropriately Positioned Larger Trees

Conversely, there are a few tree species that have proved to be too large and cause multiple problems when planted near kerbs and footpaths or under overhead power lines. The most problematic species appear to be Golden Elm (*Ulmus glabra* 'Lutescens'), English Oak (*Quercus robur*), Pin Oak (*Quercus palustris*), London Plane (*Platanus x acerifolius*), and Himalayan Cedar (*Cedrus deodara*). These have, or are now causing, many conflicts with above ground infrastructure.

Views

Although not a large problem in Wingecarribee there are areas where views are afforded to residents and street planting, where reasonable, should consider the retention of those views, by using lower trees or very high branching trees with thinner canopies or trees with thinner and narrower canopies.



Figure 2.25 - Trees with strong central leaders or conical habits should not be planted below power lines. The Himalayan Cedar on Elizabeth Street, Burradoo is an example. (Photo - Arterra)



Figure 2.26 - Trees that have the potential to grow large and that are not tolerant of continual pruning should not be planted under powerlines. An example of this is the Kurrajong on Arthur Street, Mittagong. (Photo - Arterra)

Tree Spacing and Resident Planting

Typically, Council has preferred to plant street trees at approximately 1 tree per lot frontage but sometimes there are more trees, which are very closely spaced. Often it is the adjoining resident who is responsible for this, but in some cases it may have been intentional planting by the Council or a developer. This means that some street trees may be too close together. This can create a visual wall along the street, excessive shade and overcrowding of trees. These trees either become suppressed or malformed when mature.

A far better approach is to space each tree with more concern for the ultimate size to which it will grow. Many streets look better with a little more spacing between the trees, which allows sufficient shade but also a little natural light to reach the pavement. This is also better for street lighting outcomes and views to and from the street and adjoining parks.

This may still work very closely to the policy of one tree per property, but not always. Council officers will assess each planting scenario and determine the final spacing based on a number of factors. Where appropriate, trees will be located near the centre of the adjoining lots to maintain flexibility for future or existing lot access (driveways).



Figure 2.27 - Street tree species selection and spacing is important so that unnecessary hazards for pedestrians and disproportionate maintenance costs are avoided. Twickenham Place, Moss Vale. (Photo - Arterra)



Figure 2.28 - Placing street trees close together often results in trees with poor form and lacking in vigour. It is better to plant fewer trees with sufficient space and resources to grow to their full potential. Braeside Road, Bowral. (Photo - Arterra)

Street Trees and Park Planting Conflict

Planting of street trees in front of park frontages is often unnecessary. Planting larger trees set well within the park and allowing them to contribute to the streetscape is often a better solution. Street trees often become suppressed and malformed as a result of competition by the better and larger trees growing adjacent in the park.

It is recommended to refrain from further street tree planting in front of parks, unless the park trees are set well back and verges are wide enough for successful street tree planting.

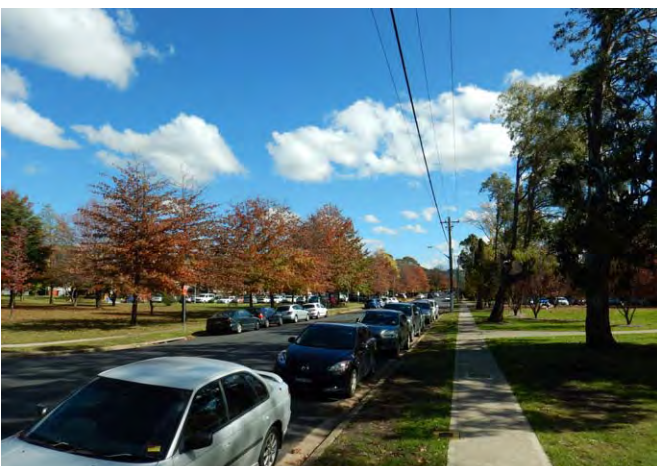


Figure 2.29 - Trees in parks and private gardens will often perform better than street trees due to more favourable growing conditions. Planting street trees adjacent to established trees in parks and gardens should be avoided. (Photo - Arterra)

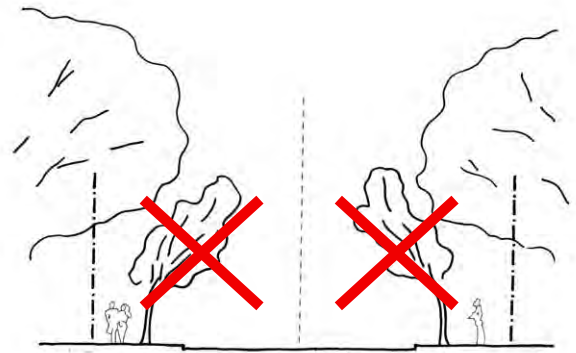


Figure 2.30 - Typical street section with large trees in private gardens or parks and suppressed street trees on both verges.

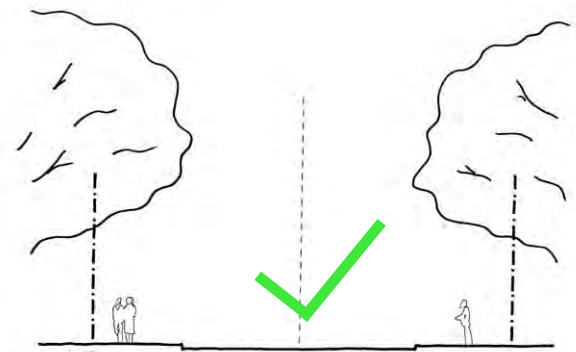


Figure 2.31 - Typical street section with large trees in private gardens or parks and no street trees, allowing trees on adjacent properties to contribute to the character of the streetscape.

2.5 Pests, Diseases and Climate Change

Pests and Diseases

Overseas experience shows that widespread infestations of harmful pests and diseases can have devastating consequences on parts of our urban tree populations.

The impact of pest and disease on the urban forest is only likely to increase. This is due to a range of factors, such as climate change, with increased temperatures, storm events, greater or lower rainfall events, coupled with the increase in international travel and trade with the risk of a pest 'hitching a ride' to the Southern Highlands.

Tree species selection is an important part of managing the risk from pest and diseases. The more diversification, the less risk of canopy cover loss from a major pest or disease event.

Incursion of pests and outbreaks of disease can take tree managers by surprise. Trees once thought to be 'bullet proof' can be severely debilitated by previously unknown pests and diseases. Sycamore Lace Bug and Myrtle Rust are two such examples. Some recently arrived pests and diseases, such as these, will be impossible to eradicate and treatment has proved to be expensive, difficult or limited in its efficacy.

This represents a key challenge to future street planting. To improve biodiversity, reduce the risk of canopy cover loss from pest or disease, we need to ensure the species selected are able to thrive and provide the canopy cover the LGA needs.

The tree species selected for the Wingecarribee Shire Council LGA are known to be resilient to pests and diseases. Due to the affects of climate change the prevalence and distribution of pests and diseases may change and could affect the health and vitality of some tree species in the future. As a result, Council may need to adapt or substitute species on the tree lists to minimise the impact to the Urban Forest.



Figure 2.32 - Decay causing fungi can have a significant impact on the long term viability of street trees. Damage to trunks and branches from mowers, line trimmers and vehicles should be avoided. (Photo - Arterra)

Climate Change

Climate change is the change in the average pattern of weather over a long period of time. There is clear evidence that our climate is changing, due largely to human activities.

Climate change is not just about warming. The science indicates that the climate will be altered in many other ways. For example, there will be changes in rainfall patterns and ocean currents, changes to the intensity and frequency of extreme events such as storms, droughts and floods, rising global sea levels and ocean acidification (AGCCD 2011).

The impacts of climate change are often talked about at the global level. However there are real and tangible impacts at a federal, state and local government level. The Climate Commission, an independent body that provides information on climate change to the Australian people and Government, has produced numerous reports on climate change. Key issues from their report titled *The Critical Decade: New South Wales climate impacts and opportunities* (2011) found that NSW is becoming hotter and drier. Record-breaking hot days have more than doubled across Australia since 1960 and have increased in duration and intensity. The period from 2000-2009 was the state's hottest decade on record.

What does this mean for Wingecarribee and our street trees? The following is a summarised snap shot of the key risks and impacts from climate change on the urban forest.

Higher than average temperatures

- Decline in health for the existing trees species suited to Wingecarribee's current (cooler) climate.
- Increased impact from pests, as their life cycle and reproduction rates increase, coupled with improved ability to survive over winter, will increase the detrimental impact on tree health.
- Increase in the range of pests or other pathogens that can extend their geographical range to include Wingecarribee, effectively increasing urban forest vulnerability.

- Increase in the range of tree species from northern NSW, QLD that may now be more suitable for planting in the changing climate.

Heatwaves

- Premature death of some trees / species, not tolerant to heat or associated water stress. This will be particularly evident in young trees, that have not built up the stored energy or resources required to survive such events.
- Trees' leaves are scorched, leading to decline in tree health.

Long-term drought and decreased rainfall

- Increase premature tree deaths, and detrimental impacts to tree health, particularly in the older and younger trees.
- Impact on the number of new trees able to be planted in the event of water restrictions.

Flood and increased rainfall intensity

- Heavy rains can lead to tree stability issues, and health impacts where inundation occurs over longer periods.
- Disease impacts may also worsen, with inundation improving the environment for pathogens that cause root rot or decay in trees.

Extreme weather events

- High winds and heavy rains can lead to increased branch and whole tree failures. Importantly, this can impact trees that are in otherwise perfect health and condition.
- Increased risk, claims and litigation, from any damage caused by tree failure.
- Increased community concern about large canopy trees, due to perceived risk impacts. Desire by many to remove trees, which only worsens urban heat island and climate change impacts. (City of Sydney, UFS 2013)

Climate Change

Over many decades thousands of scientists have painted an unambiguous picture: the global climate is changing and humanity is almost surely the dominant cause. The risks have never been clearer and the case for action has never been more urgent.

Our Earth's surface is warming rapidly and we can already see social, economic and environmental impacts in Australia. Failing to take sufficient action today entails potentially huge risks to our economy, society and way of life into the future. This is the critical decade for action.

Climate Commission, 2011

	2008	2030	2070	2100
SYDNEY	3.3	4.4	9	14

Figure 2.21 - Numbers of days expected to exceed 35° in the coming decades (Source: Climate Commission - *The Critical Decade New South Wales climate impacts and opportunities 2012*. - originally from CSIRO, and cited in Garnaut, 2008)

2.6 Tree Removal, Replacement and Implementation Strategies

Council aims to continue existing street characters and tree planting as much as possible, unless there are specific issues or problems to address or there are clear opportunities for streetscape or canopy cover improvements. Generally speaking, Council will not consider leaf, fruit, sap or bark drop or bird and bat droppings as valid reasons to prune or remove a street tree. These are natural processes associated with normal tree growth and wildlife.

Council will seldom remove a healthy street tree. If a certain type of tree is proposed for a street within this Plan, it does not mean that Council will remove the existing street trees in the short term to implement any new species. This will only happen gradually over time, as trees need replacing or if a specific opportunity exists to plant a new tree in an otherwise vacant area.

As such, existing street trees, regardless of species will normally be left to grow for their natural life and will only be removed once they have become a safety issue, an unacceptable hazard or ongoing remedial tree or infrastructure works are unviable. The exception to this policy may be when major street improvements or upgrade works are required or there is a specific plan to revitalise a street or area. Even then, unnecessary tree removal will be avoided where possible.

Street Tree Removals and Replacements

Council will aim to maintain and conserve the overall canopy coverage within the LGA. Council will remove street trees in the following circumstances.

- The tree is dead or dying
- The tree is assessed as being hazardous due to recognisable structural or health defects and where remedial or selective pruning cannot eliminate the risk, or where such pruning will leave the tree unacceptably disfigured or poorly formed
- The tree is causing public infrastructure damage which is considered significant and cannot be overcome by other reasonable and practical measures
- The tree is causing significant damage to significant private structures. It will typically be a requirement to positively establish that the tree is causing the damage and that the damage is significant and that continued and future damage cannot be overcome by other reasonable and practical measures.
- Any other reason, at the discretion of Council's staff which can be justified by either technical or legal grounds according to particular circumstances.

In regard to the above, significant damage is a relative term, and will usually be assessed with respect to the likelihood of repetitive repairs and the relative costs compared to the amenity value of the individual tree. For example repairs or replacement of footpath pavements or kerbs once every 10-15 years due to tree root growth would generally be considered acceptable. However, the replacement of a footpath every 2-3 years and a tree that will continue to substantially increase in size would indicate that the tree is generally unsuitable for the location.

The removal of a tree is generally not considered justified when damage is restricted to minor works such as unit paving, fencing or footpaths and driveways or to deteriorating sewer or drainage lines where reasonable and practical repairs can

be carried out. This is a principle largely upheld by the NSW Land and Environment Court.

Where a street tree is removed, Council will normally install a replacement tree at, or very close to, the removal site. They will follow the spacing and placement guidelines outlined in this document and may locally adjust the placement as needed. The replacement species shall be as outlined for that particular street in the Master Plan. Where a choice of species is provided the species selected will take into consideration the localised environmental, functional and aesthetic aims and the reason for the previous trees removal. The species selected shall be at the sole discretion of the Council.

Where practicable and feasible the Council will notify the affected residents of planned tree removals and replacements in accordance with the table below:

Removal Activity	Consultation
Minor Street Shrub Removal (including trees up to 5m)	<ul style="list-style-type: none"> • No prior notification • Notice to 3 adjacent properties stating reason for removal
Standard Street Tree Removal	<ul style="list-style-type: none"> • 14 days prior notification to adjacent properties and those opposite • Notice attached to tree • Proposed tree removal included on Council's website
Emergency Removal	<ul style="list-style-type: none"> • No prior notification • Advice on Council's website

Proposed New Street Tree Planting Strategy

The implementation of any new street tree planting needs to be carefully planned and considered. New street planting will typically not be installed under the canopy or within very close proximity to larger and overhanging trees (either street, park or private). The resulting habit and condition of the newly planted tree is severely compromised, often resulting in a substandard tree form and future maintenance issues. Council officers prior to the finalisation of any planting program will assess this sort of conflict.

2.7 Dealing with Large and Problematic Trees

A tree is a dynamic living organism and can be a potentially large 'structure'. Although trees present a myriad of benefits we have to recognise that they may also present problems, costs and risks. To deal with these, Council will follow a systematic process to evaluate the issues. Refer to the following flow charts that outline the 3 step process to dealing with any trees that are potentially causing problems for the Council or the community.

We need to address trees that were planted, often long ago, and perhaps without adequate thought for their ultimate proportions. Despite the best intentions, trees can also present a variety of forms and habits even within the one species type and within the one street. Although it is generally considered that the social, environmental and economic benefits trees contribute to our wider environment usually outweighs many of the more minor negative aspects - when the issues become severe we have to weigh up the importance of keeping the tree versus its potential removal.

Often many of the common issues associated with street trees can be adequately addressed without tree removal. Appropriate maintenance and pruning can often alleviate most concerns, and appropriate repair or redesign of infrastructure can also be undertaken with little impact to the tree and the tree can continue its valuable contribution for many decades. The issue of problematic streets trees, however, can be complex and many layered.

The following street tree assessment flowcharts provide an outline of the Council's systematic approach to making an assessment regarding any particularly problematic street trees. It is divided into 3 basic parts:-

- First we must assess the trees' wider significance;
- Second we must consider how long the tree may continue to safely contribute to the street and
- Finally we must consider the available options and practicality of designing around the existing tree.

The assessment of the trees should be based on an educated arboricultural assessment. Decisions to either remove or retain a problematic tree shall be made by Council, following advice and consideration from either their in-house or an independent Arborist (minimum AQF Level 5).

For particularly complex or very high-profile trees Council shall engage the services of an independent and qualified consulting Arborist (AQF level 5).

Assessments of problematic trees :-

Step 1 - RETENTION VALUE

This involves the allocation of a "retention value" or significance rating for the tree, so that the tree is rated as either a High, Medium or Low Retention Value tree.

Step 2 - SAFE USEFUL LIFE EXPECTANCY AND THE NATURE OF PROBLEM

Following on from Part 1 we must then consider the realistic useful life expectancy of the tree and the feasibility of retaining the tree if rectification and disturbance works should occur around the tree. The nature of the problem, in relation to the street tree, is then also broken down into one of three categories for further analysis, including:-

1. Overhead wires;
2. Growing area size; and
3. Private property damage

Step 3 - HAZARD ABATEMENT

This assessment process is broken into two charts, referring to the two main problems associated with Council street trees. These include a flowchart for:-

- A. Trees under overhead wires – which helps to make a decision with regard to ABC installation, or removal and replacement of the tree with a more suitable species.
- B. Growing Area Size – which helps analyse whether the size of the tree pit or surrounds be increased to reduce damage to kerb and pavement or whether the tree should be removed and replaced with a more suitable species or in a better location or with a different planting detail.

In both of the final flowcharts, new in-road planting may be a solution that Council should also consider, which may address multiple issues and be a better long-term outcome.



Figure 2.33 - Large trees that are reaching the end of their useful life require increased maintenance to reduce potential hazards. These trees on Station Street, Bowral contribute significantly to the amenity of the area and replacement planting should be planned years in advance. (Photo - Arterra)

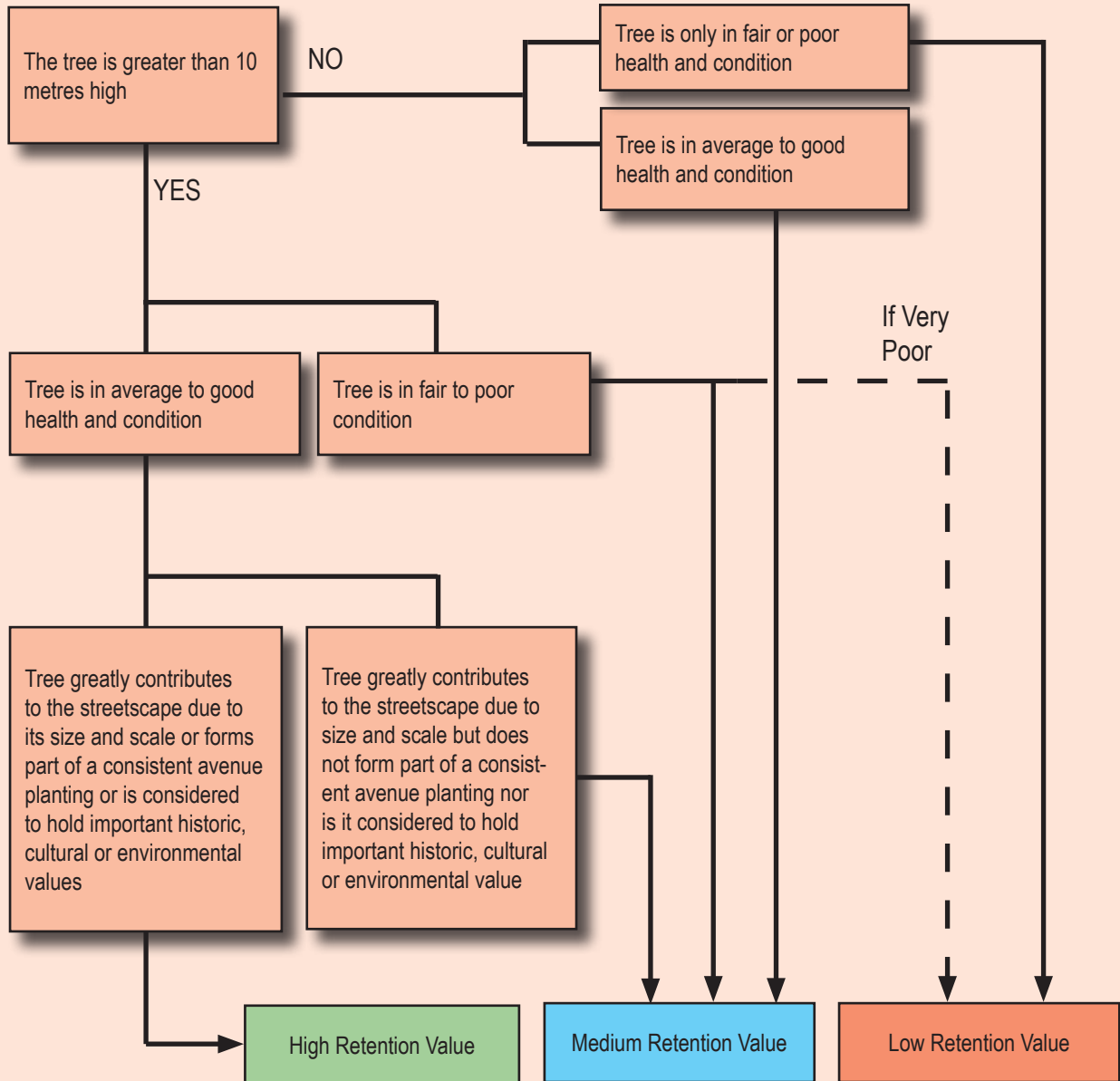


Figure 2.34 - Large disfigured trees under powerlines create significant maintenance issues that often can only be managed through regular reductive pruning. Throsby Street, Moss Vale (Photo - Arterra)



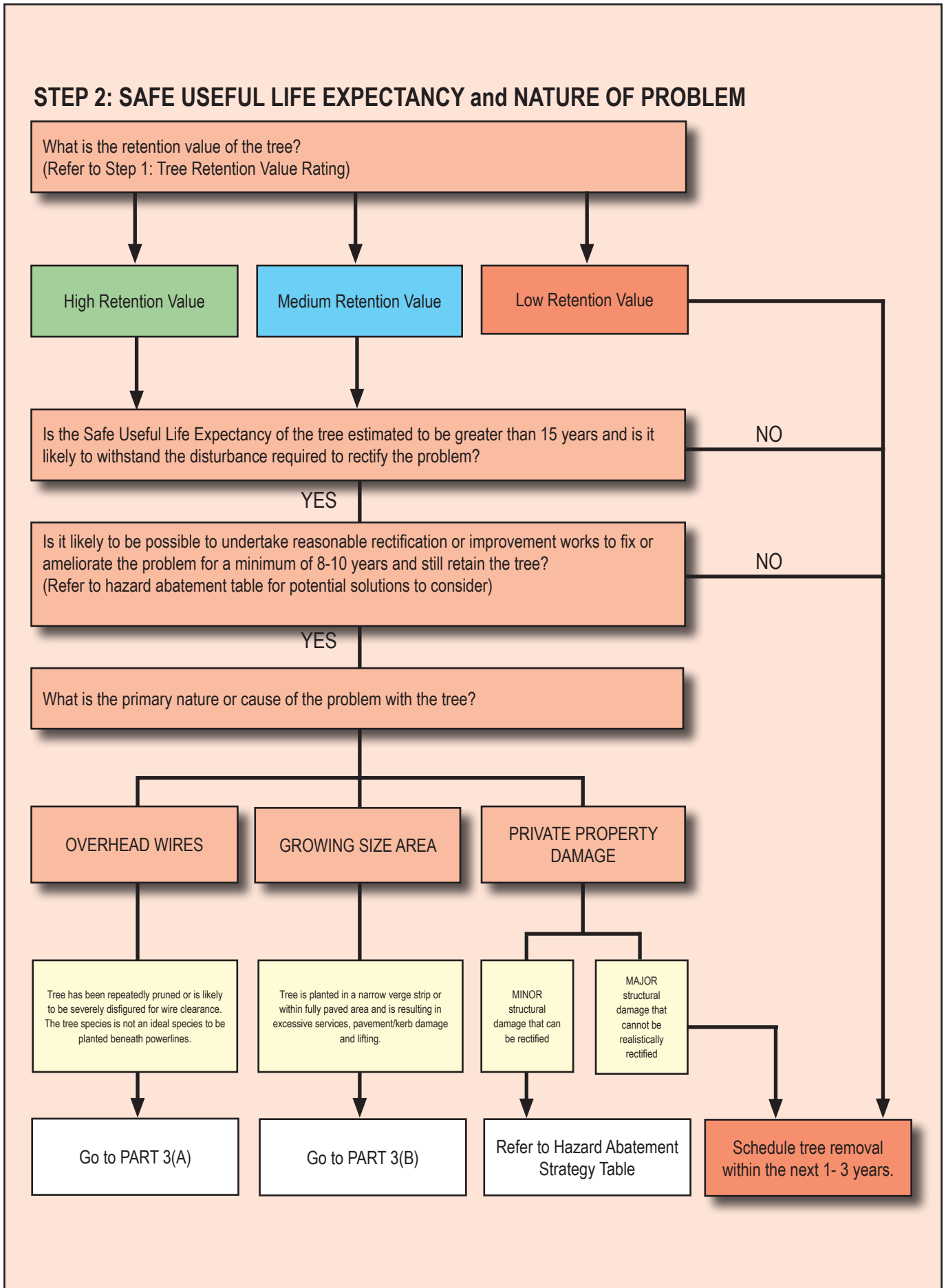
Figure 2.35 - Some interaction between trees and infrastructure is inevitable and needs to be accepted however the planting of large trees in narrow verges will create substantial maintenance issues and should be avoided. Holly Street, Bowral (Photo - Arterra)

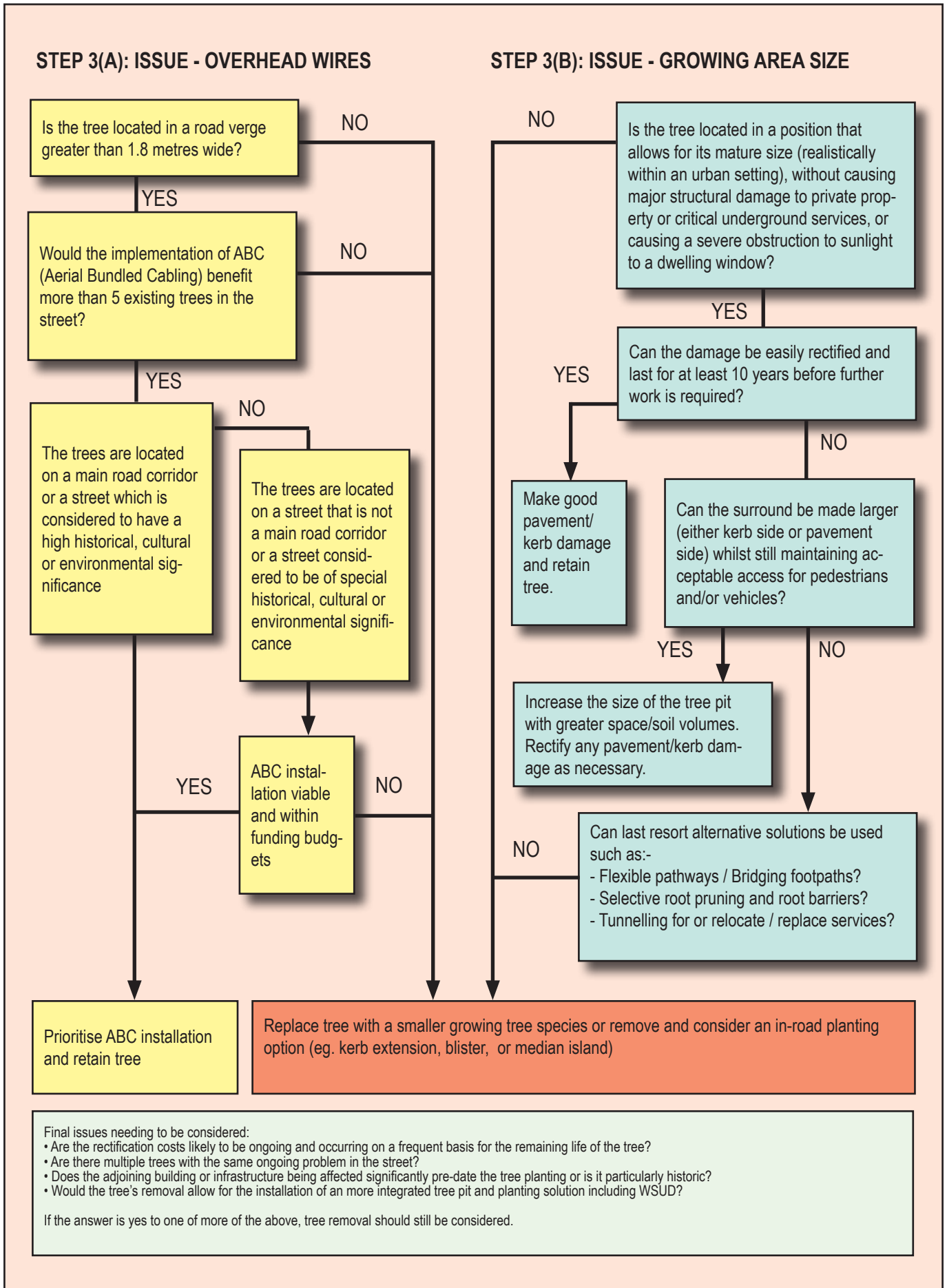
STEP 1: TREE RETENTION VALUE RATING



IMPORTANT ADDITIONAL NOTE :
 A tree's value may be moved to the next lower Retention Value for the following reasons:

- It is an exempt species under the Council's Tree Preservation Order
- It is a recognised invasive weed species
- It has serious structural defects or major decay present, is hazardous or is in irreversible decline
- Is obviously causing unacceptable damage to significant private property structures or to critical infrastructure. (Refer to Part B -Section 7.3 for further definition and explanation)





2.8 Tree Hazard and Issue Abatement Strategies

The table below outlines some of the common tree impacts and hazards and the issues raised regarding street trees. It outlines Council's approach to resolving these issues.

Table 1 - TREE HAZARD AND ISSUE ABATEMENT STRATEGIES FOR TREE RELATED ISSUES	
Identified Issue	Description of Approach / Issue Abatement Strategy
Excessive Leaf or Fruit Drop	Council to maintain a regular and ongoing program of street cleaning targeting areas and seasons where fruit and leaf drop may cause unacceptable issues. Council may consider a gradual change over to more suitable species if such a change is recommended under this Strategy, subject to financial and other work priorities.
Wildlife	Wildlife (including birds, bats, bees, spiders, snakes, ants, termites and other insects and caterpillars) that cause problems for residents are not tree issues and will not be considered as a reason to remove or prune a street tree. Where possible and feasible, the management of wildlife issues will be carried out by appropriately trained wildlife/animal officers or pest controllers.
Sap Drop / Sooty Moulds	Falling sap and/or sooty mould from street trees is typically not considered a reason for street tree removal or pruning. These problems are usually seasonal in nature and best managed by protective covers, relocation of parked cars or increased cleaning regimes.
Leaf and Bark Litter Blocking Drainage	Council to maintain a program of street cleaning targeting areas and seasons where fruit and leaf drop may cause unacceptable issues. Council to maintain a regular program of stormwater pit cleaning, particularly in areas where blockage may cause unacceptable inundation.
Monitor trip points	Enlarge tree pit/ planting areas to remove uplifted pavement. Where no other practical method can be employed to prevent this occurring, a regular trip point inspection program will be instigated and pavement replaced or repaired as necessary.
"Tripstop™" jointing system	Install pavement jointing system that helps prevent creation of trip hazards even when minor displacement of concrete footpaths occur due to roots.
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 redirected away from trees/tree roots. It may also be beneficial to reduce the newly directed pathway width.
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.
Wall cracking and displacement - Bridging Footings	Repair and or replace damaged masonry walls with a pier and beam style of footing that may be able to bridge existing major roots and allow trees to be retained with minimal root loss.
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 can reasonably be foreseen or damage by tree roots can be proven, barriers in specific cases may be installed to deflect roots away from structures or services. These are typically very site-specific and are not encouraged except as a last resort.
Tunnelling for services	Tunnelling (directional boring) rather than open trenching for underground service installation, will greatly reduce public risk as well as reducing injury to tree roots. If located deeply, root contact with the pipelines 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 earthenware pipes with PVC or polyurethane will significantly reduce the potential for tree root entry.
Preventative tree maintenance	Trees in public areas should be regularly inspected and maintenance activities, such as dead-wooding and formative pruning carried out as prescribed. Pruning should always be undertaken in accordance with AS 4373-2007.
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 geotextile 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.

Table 1 cont. - TREE HAZARD AND ISSUE ABATEMENT STRATEGIES FOR TREE RELATED ISSUES	
Identified Issue	Description of Approach / Hazard Abatement Strategy
Powerline Clearances	Pruning for powerline clearance is the responsibility of Endeavour Energy. Only approved Contractors are allowed to work within 3m of power lines. Council can initiate formative pruning to set up form and branching habits that keep tree canopies clear of power lines for much longer and then facilitate easier training of canopies around wires when ABC may be achieved. Trees that are excessively disfigured by clearances pruning should be removed and replaced with more suitable species.
Insulated (ABC) cabling	Replacement of uninsulated overhead powerlines with insulated and bundled cables will reduce both the clearances needed and the pruning costs and severity. This work may also be implemented as part of Development Consents related to adjoining property redevelopment.
Undergrounding of 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 tree health, loss of public amenity and of urban forest economic contributions.
Tree Hazards and Failures (both perceived and real)	Council to maintain a documented program of preventative inspection and maintenance of street trees over 6m tall in Urban Areas. (Refer preventative tree maintenance above) This should be done on a rotational basis for each Urban Area identified under this Plan. Councils shall also initiate a website page that describes typical tree hazards and educates residents that the risks from tree failures are typically very low, but that Council will take all concerns seriously and if necessary undertake inspections using a qualified arborist for any trees specifically identified by a resident as causing concern.

2.9 Mature Tree Pruning and Ongoing Management

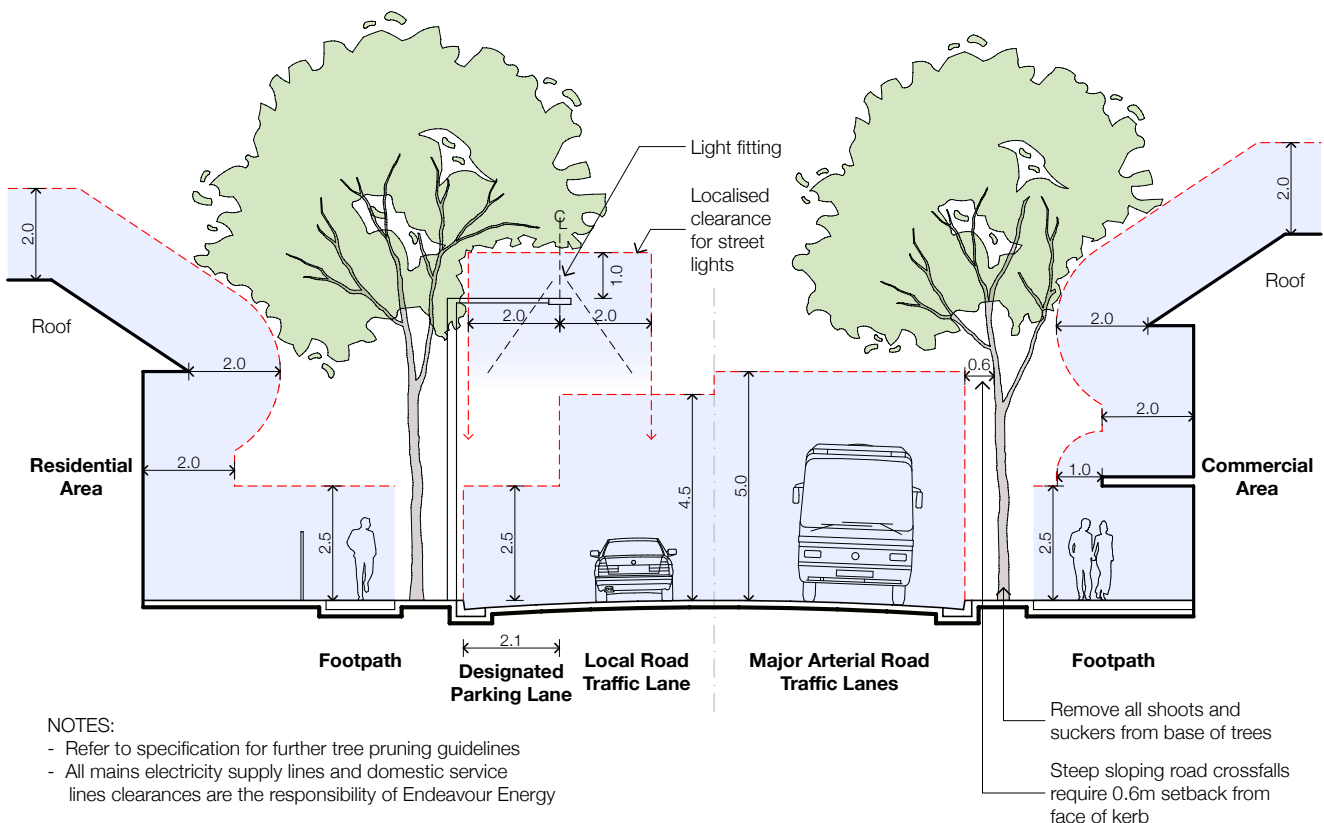
Property Clearances, Views and Solar Access Pruning

The Council will prune trees to maintain a reasonable and safe clearance between trees and pedestrians, vehicles and private property. Council has developed specific guidelines with regard to tree pruning for clearances and to maintain views and solar access. Refer to the diagram below that graphically illustrates the proposed clearances and offsets for mature tree pruning. This is a guideline illustration only and actual clearances required will depend on individual site constraints.

Council will not typically prune a tree for the provision of views or creation of unreasonable solar or digital receiver access. Council will avoid pruning practices which disfigure the tree or are detrimental to its healthy and safe condition.

When planting new street trees Council will consider the impact the mature tree may have on surrounding residents views and will, as far as practicable and reasonable, avoid planting overly large trees that will block pre-existing solar or digital receiver access.

If an existing tree is removed, any replacement tree will normally be similar in scale and form and will be planted in close proximity to the original tree. It will be allowed to reach its natural potential.



- NOTES:
- Refer to specification for further tree pruning guidelines
 - All mains electricity supply lines and domestic service lines clearances are the responsibility of Endeavour Energy

2.10 Bushfire Risk and Asset Protection Zones

The majority of the Wingecarribee Shire Council LGA is classified as bushfire prone land with many of the urban areas surrounded by vast areas of state forest and National Park. The approximate extent of bushland across the LGA is shown in Figure 1.8. Most streets on the edge of the urban areas form part of Asset Protection Zones. The planting of trees within these zones may increase the risk of fire damage to persons and property and may limit access for emergency services during a bushfire. Careful consideration should be given to planting of street trees on the urban periphery to manage bush fire risks.

A number of factors need to be considered when planning street tree planting in fire prone areas including the characteristics of tree species and the placement and spacing of trees along a street.

Trees with the following characteristics may reduce the impact of bushfires on urban areas, including trees with:-

- high moisture content in their leaves,
- an open branching pattern,
- a clear trunk to at least 2m from ground level,
- smooth bark on trunk and branches,
- wide, thick and fleshy leaves.

The placement of street trees in bushfire prone areas can reduce the risk of fire damage if the trees are:-

- spaced so that the canopies do not touch when mature,
- a safe distance from buildings, driveways, water supplies and powerlines.
- not planted near shrubs or small bushy trees that could transport a ground fire into the canopy.

The planting of street trees in some streets may increase the bushfire hazard and as such, not all streets that have sufficient space will be planted with street trees. This will be assessed on a case by case basis.



Figure 2.36 - Some streets form an important part of Asset Protection Zones for private properties and public assets. Tree planting in these streets should often be avoided to maintain acceptable levels of risk from bushfire damage. Bowral Street, Welby is an example of where street tree planting may compromise an important asset protection zone. (Photo - Arterra)