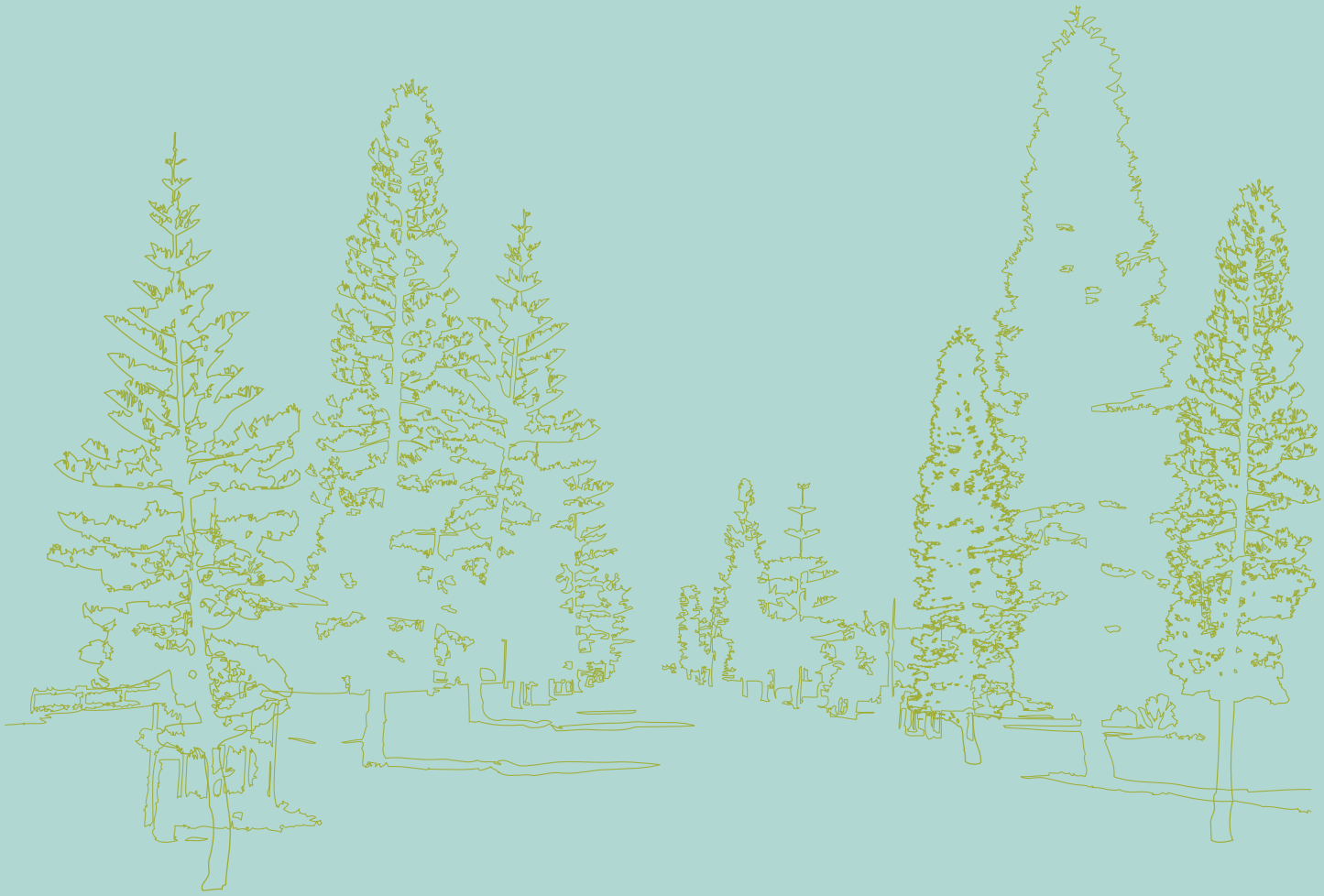


YAMBA

Street Tree Master Plan

clarence VALLEY COUNCIL

Contents

Chapter 1

Introduction

1.1 PRINCIPLES OF THE MASTER PLAN

The Street Tree Master Plan for Yamba is designed to provide a 'blueprint' for the long-term planning and management of street trees to ensure a sustainable tree population that contributes to the amenity and visual character of Yamba. Long term planning is needed to ensure that trees are appropriately selected, planted, maintained and removed, and replaced when required to ensure that the important values that trees provide to urban areas are sustained. These are defined further in Council's Urban Tree Management Strategy.

The key elements of the plan include:

- Identify the existing streetscape character of the area and the current opportunities and constraints affecting street trees
- Design of streetscapes informed by these opportunities and constraints
- The selection of appropriate trees species, suitable to the environmental conditions and the functional requirements of the site
- Specifications for tree planting and establishment maintenance for a variety of street configurations
- Strategies for removal and replacement of street trees over the long term

The Yamba Street Tree Master Plan is to be a pilot master plan for other towns in the Clarence Valley. The principles and objectives therefore need to not only address the specific local issues of Yamba and West Yamba but they will need to also address issues that are found in all towns and cities with an appreciable urban forest.

The principles and objectives are therefore to be divided into two parts, local issues and opportunities and general issues that are relevant to the other towns. These principles and objectives are further described and supported by the Clarence Valley Urban Tree Management Policy and the Urban Tree Management Strategy. Implementation of Council's Urban Tree Management Policy will assist with the strategic implementation of the master plans and strategy.

1.2 STRUCTURE OF THE DOCUMENT - HOW TO USE THIS PLAN AS A PILOT

How To Use This Document - Step By Step Tree Selection

The information in this document is structured to make the decision making steps and a process of street tree selection easily qualified and clearly understood.

Chapter 2 - Background
Explains the objectives of the master plan and the current issues in a Yamba and West Yamba.

Chapter 3 - Street Tree Master Plan Overview and Audit
What an urban tree must contend with, limitations of the data, qualitative assessment of the criteria and terminology defined and explained.

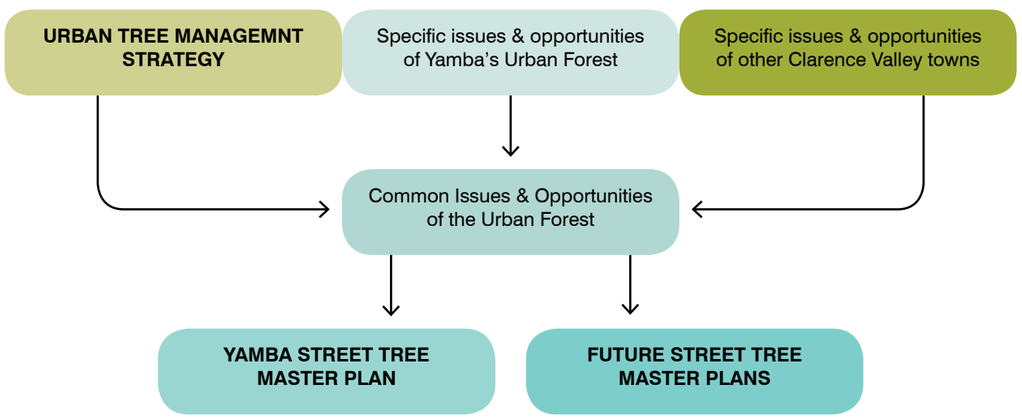
Chapter 4 - Yamba Street Tree Master Plan - Issues and Objectives
Identifying the issues of the urban forest in Yamba and strategies that respond to this.

Chapter 5 - Street Tree Strategy and Selection
The tree species list is filtered through the defined criteria to determine their value rating as a vigorous street tree and how they are implemented.

Chapter 6 - Technical and Tree Installation
Specifications and recommendations for management and maintenance.

Chapter 7 - Definitions

Chapter 8 - Appendix
Master Tree Matrix Schedule
Street Tree Selection Matrix - Master Schedule
Yamba Street Tree Audit Schedule



Project Process	Project Outcome
Yamba street tree audit	Determine constraint issues and opportunities
Develop pilot Yamba street tree master plan principles	Review by council
Consultation with community for input	Review and adjust master plan objectives
Determine selection criteria for the trees of Yamba eg. shade, formative pruning, drought resistant etc	Selection criteria established
Identify all the possible tree species suitable for Yamba That meet the selection criteria and community requirements	Master Tree List
Develop CVC street tree policy to incorporate Master Plan and Street Tree Strategy	Confirm action plans and work implementation
Documents to be finalised and reviewed every five years	Working Street Tree Strategy and pilot master plan template applied in other towns

1.3 OBJECTIVES OF THE MASTER PLAN

The specific master plan objectives are based on council's input that identified main issues and opportunities for Yamba. The master plan site analysis also informs how these can be addressed.

1. View Corridors

- Ensure a community consulted strategy is based on a balance of ecological restoration goals and retention of important and iconic views

2. Management of the *Araucaria* Forest

- Develop a planting and replacement strategy that includes site suitability, views, safety and design intent

3. Streetscape and Off-street Parking

- Guide the management of future works to ensure tree health and public benefit is maintained, as well as accommodating pedestrian and vehicle flows

4. Tree Planting in Public Open Space and Reserves

- Ensure the appropriate selection of tree plantings from suitable list are in accordance with council's Plans of Management

6. Tree Planting in New Subdivisions

- Determine management options and suitability of tree selection in identified priority locations
- Provide guideline and conditions for tree planting in public areas associated with new developments

7. Street Tree Planting Design and Hierarchy

- Develop a street tree implementation strategy based on defensible performance based goals and site based spatial opportunities

8. Tree Replacement and Priority Areas

- Identify and determine the staged priorities for the tree master plan implementation and incorporate within action plans
- Undertake staged and progressive removal of inappropriate street tree species

1.4 THE COMMON OBJECTIVES OF THE CLARENCE VALLEY URBAN TREE MANAGEMENT STRATEGY AND THE URBAN FOREST

The objectives common to all areas, often addressed in Clarence Valley Urban Forest Strategy that can be applied to future master plans include:

1. Tree Selection Criteria and Planning - a non subjective approach

- Develop plant selection criteria for key town centres (right tree, right place)
- Develop a master list of trees appropriate to the local conditions within key town centres in line with the selection criteria
- Develop Character Statements for key town centres
- Review species performance on a regular basis and revise the master list accordingly
- Prepare species profile sheets to demonstrate how the species fits the selection criteria

2. The Value and Benefits of Urban Trees

- Define and advocate the amenity,environmental, ecological, social, economical and cultural values of the urban forest
- Develop planting plans (master plan) for major town centres and parks to enhance & reinforce local character (prepare statements defining local character & key factors in design)

3. Tree Diversity and Health

- Increase diversity of the tree population to assist with correct tree installation for the site and reduce the risk of canopy loss due to pest and diseases.
- Identify opportunities for new planting within parks and streets by undertaking an audit of streetscapes in main town centres
- Ensure biological diversity in tree species to minimise losses in the event of disease or pest epidemic

4. Trees and Services

- Reduce the conflict between services and trees by having options for tree planting adjacent to or beneath services
- Undertake staged and progressive removal of street tree species incompatble with existing services
- Consider appropriate soil volumes and soil quality to accommodate the ultimate size of the tree
- Develop guidelines for the placement of trees within streetscapes in consultation with utility authorities & road management authorities (RTA, STA) [RTA Landscape Guidelines]
- Investigate options for replacement of overhead cables with Aerial Bundle Conductors (ABCs) in key locations

5. Community Consultation, Perception and Opinion

- To be used in the public consultation process, with the list being qualitative to help council achieve a non-objective approach for more effective and defensible implementation

6. Tree Protection, Preservation and Vandalism

- Identify management practices that reduce the risk of tree clearing on private and public land, encourages tree retention and minimises the vandalism of public trees

7. Tree Management and Adaptation to Climate Change

- Direction towards substantially increasing the diversity of trees to create an urban forest more adaptable to a changing climate

8. Canopy Cover Objectives for the Urban Forest

- Measure the current extent of canopy cover (as a percentage of total urban area) and set targets for future canopy cover in key town centres in order to work toward optimal levels
- Development of canopy cover goals particularly in built up areas with an aim to creating socially sustainable and liveable streetscapes

9. Tree Implementation, Maintenance and Care

- Best practice management of the urban forest
- Develop an annual tree planting program to take advantage of seasonal weather conditions which maximize growth and minimise losses
- Prepare specifications & details for tree planting for a number of different scenarios (grassed areas, pavements etc)

10. Tree Asset Management and Risk

- Database records of the tree population and minimising hazard risk
- Prepare an associated budget for new and replacement planting as part of the capital works program
- Identify trees for removal and replacement by undertaking an assessment of Safe Useful Life Expectancy (SULE) based on Visual Tree Assessment (VTA) procedures
- Ensure planting of trees in streetscape areas comply with the STMP as a condition of Development Approval
- Remove inappropriate species that do not comply with the STMP on a staged programmed basis

Chapter 2

Background

2.1 CURRENT URBAN FOREST ISSUES WITHIN YAMBA [EAST AND WEST]

Yamba is a key coastal holiday town in the Clarence Valley located on the Clarence River outlet. The urban forest of Yamba is iconic, dominated by the historical and recent planting of *Araucarias*. Yamba is the second largest town in the Clarence Valley and is rapidly growing. It comprises of two main development areas. The historic town centre is sited at the river entrance and flanked by the ocean and West Yamba, a newer release area principally developed for permanent residences.

Yamba and West Yamba have very different characters to the other key towns studied in the Clarence Valley Street Tree Strategy. The urban forest of both areas of Yamba is less extensive, has less canopy cover than Grafton and Maclean in particular. The history of its development and the role of Yamba is different to the up river towns, differing civic goals, geomorphology and environmental exposure, resulting in a town with a very different landscape character.

Both development areas are very different, as a result of development history, grid layout, geomorphology and tree cover. While it is fortunate that the extensive remnant of vegetation at the Clarence Estuary Nature Reserve has been retained, it does isolate West Yamba from the main township to the east. Apart from the physical differences in landscape character, this isolation has resulted in a very different development type.

The issues for Yamba's trees are considered the most complex and diverse of the Clarence River Valley towns. As a consequence it is a very good case study for a pilot street tree master plan. Yamba has a large component of the tree cover within the private domain or in public reserves. The trees in the public domain are limited in diversity and many trees are ageing. There is also pressure from redevelopment on these trees, particularly for new driveways and of course for views both from the private domain but also from public parks and reserves.

The urban forest and tree cover of Yamba (including West Yamba) was assessed by ASPECT Studios and Earthscape Horticultural Services on 2 and 3 February 2011. The appreciation that follows and supporting plans and diagrams give a record of the current status and illustrates the issues relating to trees. These issues will then inform the future planning strategy and opportunities for Yamba.

2.1.1 Yamba (East)

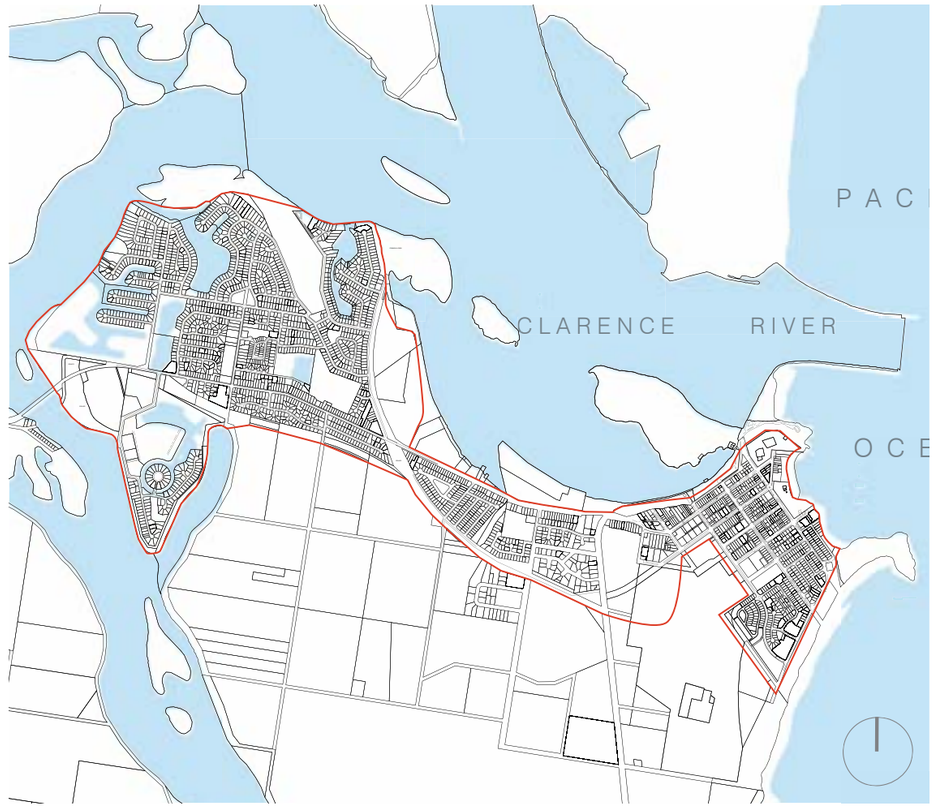
The eastern township of Yamba is located on a coastal headland adjacent to the outlet of the Clarence River. The elevated areas on the headland form a knoll, sloping steeply to the south-west and more gradually to a cliff line escarpment to the north. There are sheltered beaches to the east and an exposed coastline to the south-east. These elevated areas on the knoll provide scenic coastal views to the north, east and south. There are riverine views down the Clarence River to the north-east. There are also views over low lying floodplain and river valley to the west, and to the hinterland in the more distant west.

Aerial view of Yamba and West Yamba. Google Earth.

This part of Yamba has a typical grid like street pattern with streets running in a north-west to south-east axis and north-east to south-west axis. The road reserves in the older parts of Yamba are typically fairly wide, with road pavement widths of up to 8 metres, with 5 to 6 metre wide verges. A few of the streets such as Queen Street and Beach Street incorporate dual carriageways with a central median. Many of the verges are grassed and contain few trees, despite their width. Most of the streets contain kerb and gutter, the central medians generally do not have any defined edges.

The housing is typically small cottages on relatively large allotments, but those areas with significant coastal and riverine views are rapidly changing to incorporate medium and high density housing, including multi-level residential apartments. Many of the coastal lots close to the beach have significantly larger houses with greater site occupancy. Newer areas to the south have been developed as higher density residential houses and villas with much narrower road reserves and smaller allotments, typical of retirement style developments. These are highly manicured with very little street planting or street character. A caravan park is located on the northern side of the town ship, on low lying flat land adjacent to the Clarence River. This reflects the changing nature of the place, originally a quiet seaside village to a coastal holiday and retirement township.

There are a number of parks and open space areas, both along the coastal and riverine belts around the periphery of the township, and in low lying flat areas to the south-west, including the main cricket ground in Lyons Park, Storey Park and a golf course. The main commercial precinct is within the northern end of Yamba Street and central section of Coldstream Street. It contains paved verges with on-street angle parking with a variety of commercial premises mainly servicing holiday makers and tourists. A small industrial area is located in the central low lying area, with newer (1970s) residential housing estates spreading west along the main approach road. These have a more informal layout incorporating a number of cul-de-sacs.



Scope Area of the Yamba Pilot Street Tree Master Plan.

2.2 THE URBAN FOREST OF YAMBA

2.2.1 Public Domain Planting

1. Streetscape Planting

The streetscape planting of Yamba is strongly defined by the iconic mature *Araucarias* along Wolli and River Street, the caravan park, Clarence Street and Pacific Parade. These early planting encircle the centre of town. There have been numerous plantings of further *Araucarias* within the main street grid (where views are not such an issues). This forest of *Araucarias* of mixed ages announces the arrival into Yamba from the outskirts and defines the overall character with the town itself. Some of these trees are very old and have become potentially hazardous. Refer to the Yamba 2011 Street Tree Audit for further information in the appendix.

Apart from the *Araucarias* the remaining streets have an eclectic mixture of cultural plantings, although the planting is incohesive. There are a number of large individual ‘character trees’ such as Broad-leaved Paperbarks (possibly remnant) some Native Figs and Cottonwoods. Many of these larger trees were planted early last century, with enduring benefits from this programme of tree planting.

In West Yamba there is scope for far greater streetscape planting. The development of streetscape planting has been limited due to a lack of developer contributions and requirement to install

street trees. Community perception of street tree planting needs to be determined, particularly as constraints such as views are not an issue, compared with Yamba (east).

2. Public and Crown Reserves

The tree cover in the public reserves, particularly the coastal foreshore is extensive. This planting was a consequence of dune and headland ecological restoration goals. It comprises of Coast Banksia woodland that has been very effectively regenerated or revegetated. Most of this regeneration has been implemented on the ocean and headland side. The revegetation has started to encroach on view corridors valued both for tourism and by the residents. This is an issue that needs to have a balance of goals and objectives.

Tree cover in the parks is limited by the ability of resources to manage new tree planting. There are many opportunities for additional tree planting in the public parks that will add to the character, functionality and appeal of these spaces. Many parks also contain remnant vegetation which are a significant asset and should be incorporated within management of the urban forest. They also provide clues for the best selection of future tree planting.

There are a number of individual Plans of Management for Yamba's Reserves that propose strategies for tree management that will all be considered within this master plan.

Significant stands of *Araucaria* and other trees are within the Calypso holiday park These trees in particular announce the arrival of Yamba when travelling into town from the south.

3. Conservation Reserves and National Parks

There are significant extents of remnant vegetation in conservation zones and national parks. The contribution that these areas have to the overall tree cover of Yamba is important and not without threat. Most of the new release area of West Yamba has been defined in the DCP, but its continuing development may deplete the extent of remnant vegetation communities.

2.2.2 Private Domain Planting

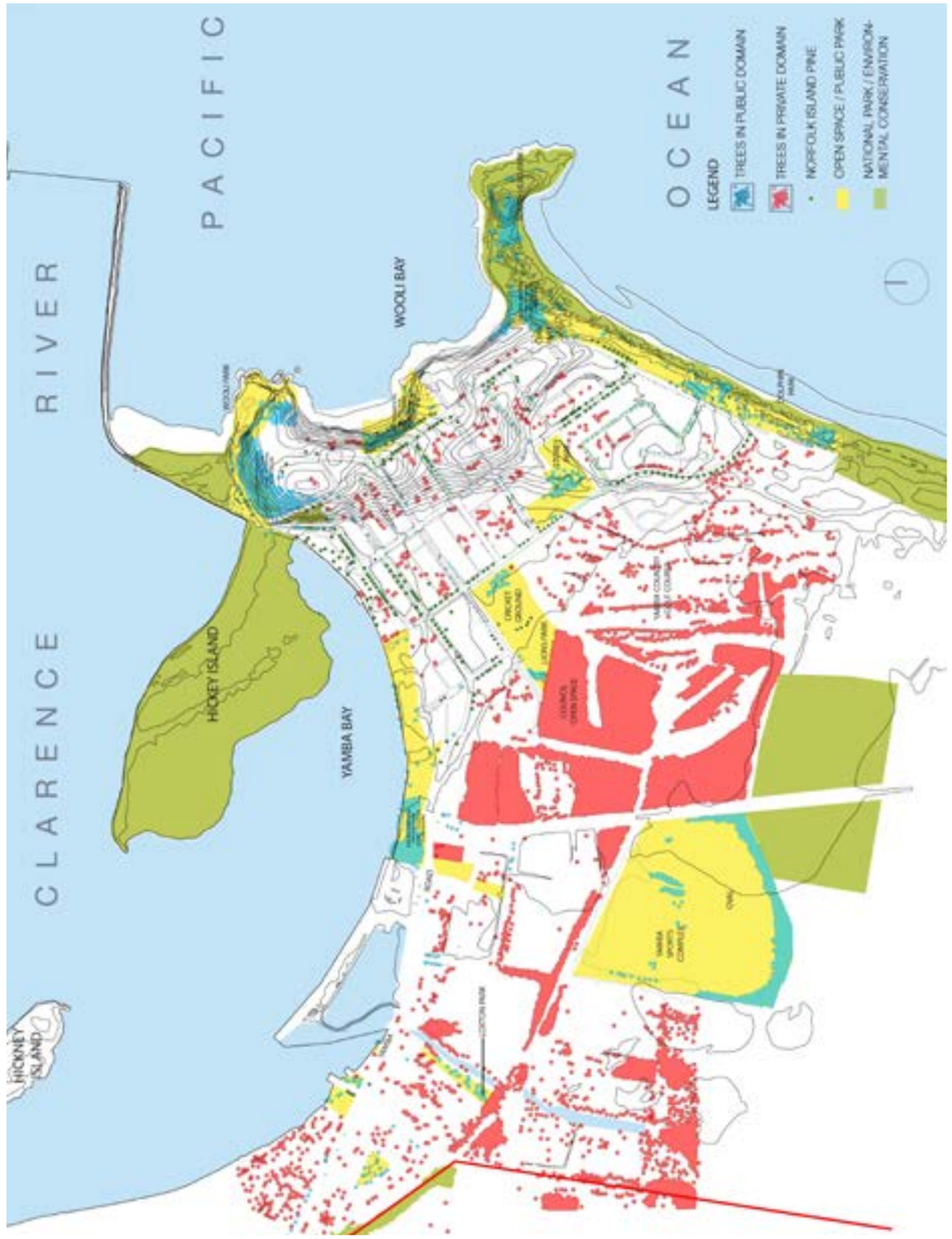
1. Planting within Private Property

Much of the 'urban forest' exists in private property particularly in the common lot boundaries at the rear of properties. In Yamba these trees are mostly found on the lower slopes and flood plain where the access to groundwater is better and views less of an issue for landowners which may inhibit tree planting. Planting along the ridge top and ocean side areas is limited by environmental exposure and for retention of private view corridors.

At West Yamba the private domain planting is most developed on the pre 1990 development areas where thirty years growth has enabled the start of a discernible canopy cover. Ornamental palms are heavily favoured which limits the overall potential of the canopy extent and contribution to the urban forest.

2. Large Landholders and Public Utilities

Large extents of remnant and intact vegetation and trees are located within land administered or owned by rural landholders, utilities, tourist/mobile home parks and institutions. While council does not have direct jurisdiction over these lands, council has an important role in the future planning and development of these sites, alongside the relevant state government agencies. These lots are important as they are large and contain stands of remnant native plant communities, some which have a vulnerable or threatened status.



The Urban Forest Cover of Yamba.

The Urban Forest Cover of West Yamba.

2.3 THE GEOMORPHOLOGY OF YAMBA

The topography and soil type have a significant impact on what trees are successful in Yamba. These factors determine the success of both cultural planting and also the evolution and distribution of indigenous vegetation communities. Topography and aspect determines the availability of water, drainage patterns and exposure (sun, salt and wind). These environmental determinants are complex in the study area. They also vary greatly between Yamba and West Yamba. They are key criteria for future tree selection opportunities.

2.3.1 Yamba

Topography and Aspect

The topography of Yamba can be broadly defined as the ridges and ocean foreshore zone and the floodplain lowland that fronts the estuary.

- Ridges and Ocean Foreshore

Along the eastern and northern edge of town this prominent ridge line at the mouth of the estuary is buffeted by the prevailing easterly sea breezes. This landscape feature culminates at Pilot Hill, where exposure determines the type of tree planting that is successful. All tree species are required to be frontline coastal species, resilient to salt winds. There are some microclimates that support second line coastal species both exotic and native. Due to the harsh environmental conditions, trees generally need access to adequate soil volumes to be successful. With exception to the *Araucarias*, most species are dense and low in form for protection particularly from salt. Originally this landscape would have been dominated by Coast Banksia woodland on the headland, with some littoral rainforest in the south western and northern gullies. Extensive dune vegetation is found along the beaches and large remnants of these vegetation communities still exist. They give an accurate precedent for revegetation works over the past 40 years.

- Estuarine Floodplain

This landscape type is common throughout the lower Clarence Valley. Extensive stands of mangroves and salt marsh are located in the intertidal zone. Away from the foreshore zone are extensive freshwater and brackish wetlands that are dominated by Broad leaved Paperbark and Swamp Mahogany forest. These areas are more protected, particularly further away from the estuary foreshore and there is a high water table. These areas can support taller and larger trees and would have had large stands of littoral rainforest interspersed with the other forest types. The golf course and adjacent conservation reserves give a strong indication of the indigenous vegetation types.

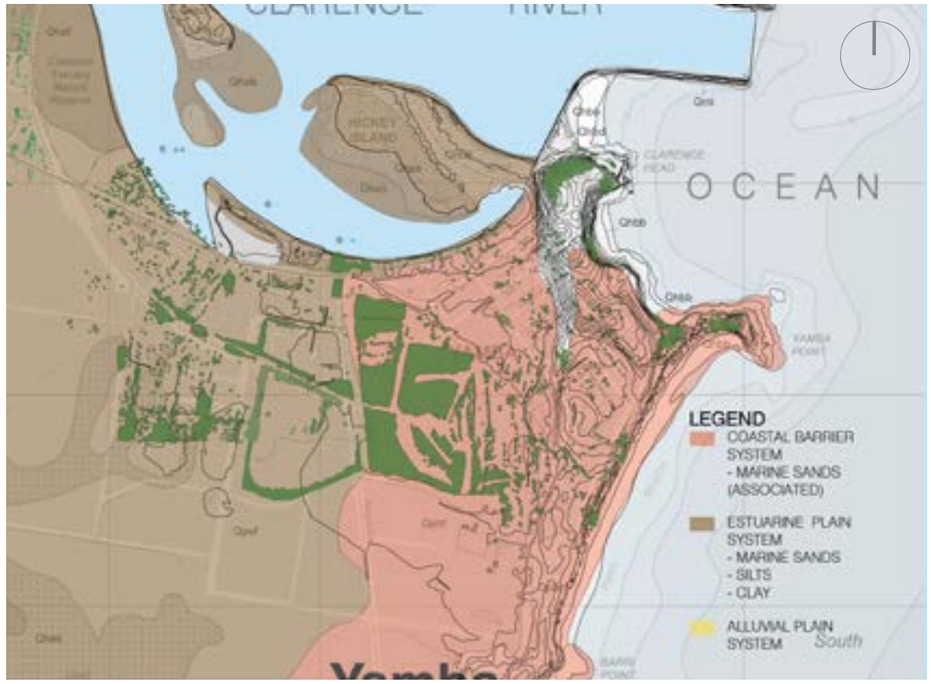
2.3.2 West Yamba

Topography and Aspect

The topography of West Yamba is estuarine floodplain lowland that fronts the estuary. It is an extension of the same landscape character type of the lower areas of Yamba.

- Estuarine Floodplain

This landscape type consists of extensive stands of mangroves and salt marsh and extensive freshwater and brackish wetlands that are dominated by Broad leaved Paperbark and Swamp Mahogany forest. Being further up the estuary away from the ocean it is relatively sheltered from exposure but has its own unique challenges. While many of the environmental reserves and older public reserves still support stands of remnant vegetation, much of the newer development areas have been raised significantly with fill from canal estate dredging and also fill brought from off site. The growing conditions are difficult to determine. There would need to be extensive soil testing to determine the chemical and physical properties of the soil in the newer areas.



Soil map of Yamba. Coastal Quaternary Geology- North and South Coast of New South Wales 1:100000 and 1:25 000 series maps.

2.4 THE DEVELOPMENT PATTERNS OF YAMBA

As with the other Clarence River Valley towns there are distinct patterns and impacts from the incremental development patterns of Yamba.

2.4.1 Pre World War 2

Yamba was gazetted in 1885 and the grid pattern of the streets was imposed over the landscape after clearing of the paperbark forest. Much of the headland would have been cleared for grazing of livestock and for the pilot and lighthouse operations. Extensive areas of mangrove wetland would have been removed and filled for the port facilities. Early in the 1900s the *Araucarias* would have been trial planted possibly as beautification works controlled by Grafton. Most of the earlier planting were associated with the school and other civic buildings behind the estuary foreshore. It is this planting and a continuation of this style that has resulted in the mature *Araucaria* planting.

2.4.2 Post World War 2

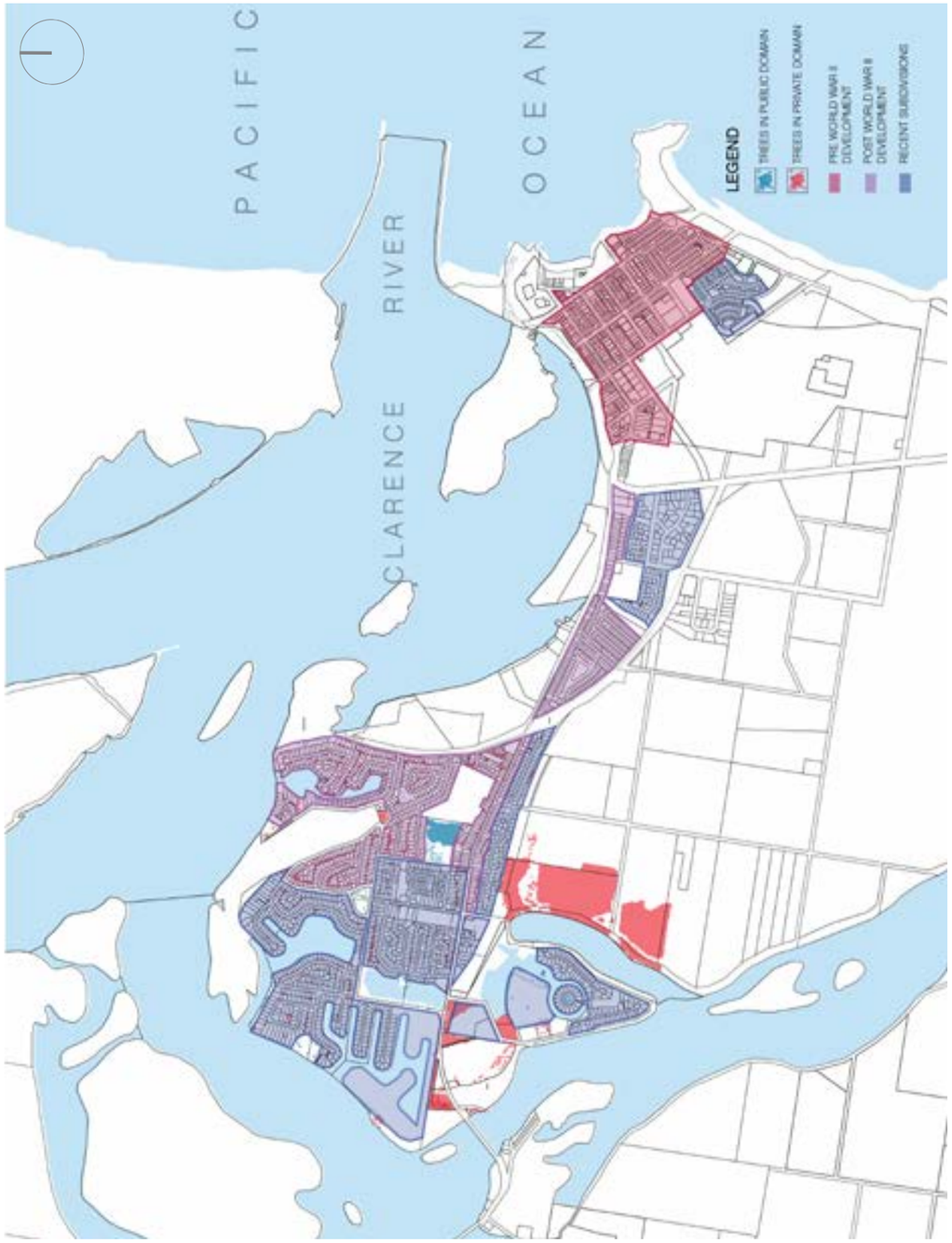
The development of Yamba as a holiday destination and tourist attraction resulted in an expansion of the town beyond the original grid. The ocean side became attractive for holiday houses and for smaller resorts. The *Araucaria* planting continued along the foreshore in avenues and in groups, increasing the *Araucaria* forest on the beachfront. Adequate space and little competition from driveways and parking enabled these trees to reach a significant size.

The private domain planting began in earnest as the increasing population chose Yamba as a place to reside for what are now considered ‘lifestyle’ factors. The erosion of sand dunes was a major problem from early in the 19th century with many houses threatened from wind blown sand dunes. In the 1960s and 70s there was a large programme of dune and headland revegetation. Across most of the east coast were sandmining, grazing and development had created coast erosion problems. The revegetation of the beaches and dunes has been a programme from the mid twentieth century to the present day and has successfully revegetated much of the coastline of Yamba. There have of course been other issues that have resulted from this ecological restoration work.

2.4.3 Recent Subdivisions

There are some recent development areas in Yamba such as the new release area centred on Beachside Way, where tree planting has been an important part of ‘landscaping works’. It has largely been a developer driven initiative and while the tree planting has been successful it does not successfully contribute to the tree planting for Yamba’s public domain. The geometrical street layout of these development results in a poor integration with the rest of the town.

West Yamba is characterised by recent subdivisions from the late in the twentieth century and construction continues in 2011. There is very little street tree planting contributing to the streetscapes at this point in time. This is clearly illustrated in the accompanying diagram and images. This is an important issue that needs to be addressed by this master plan and the Clarence Valley Urban Tree Management Strategy.



Historical development of Yamba.

Chapter 3

Street Tree Master Plan Overview and Audit

3.1 STREET TREE AUDIT 2011

As part of the development of this STMP, a general audit of street trees was undertaken in 2011 in the Yamba township. The results of the audit are shown in Appendix 1. The audit was limited to a general assessment of the dominant tree species in each street, along with collection of key data relating to the general street environment, with the intention of identifying the key species present and their performance and general opportunities and constraints to tree planting.

3.1.1 The *Araucaria* Forest

The dominant visual character of Yamba is defined by rows of mature Norfolk Island Pines, particularly in low lying areas on the northern side of the township along Wooli Street and Harbour Street, but also along the coastal strip to the east along Pacific Parade. This species is very typical of seaside villages all along the east coast of NSW. Some of the original avenues, such as along River Street, have been progressively replaced with Cook Pines, due to problems associated with Norfolk Island Pines. Fewer problems have been experienced with Cook Pines at this stage, but this species also has much lesser visual impact on the streetscape, and canopy projection for streetside amenity.

The majority of the oldest plantings of Norfolk Island Pines, especially along Wooli Street, have reached maturity and are starting to decline. This is partly due to the constant impacts of urban development on the root zone, such as road widening, provision verge parallel car parking bays and vehicle crossovers in verge areas and installation and maintenance of underground services. It is also partly due to the age and maturity of the trees and the available space (both above and below ground) for normal growth and development. Several significant failures have occurred in recent times resulting in damage to private property. The eventual removal and replacement of these trees is a dilemma due to the potential detrimental visual impact on the township associated with their removal as well as the limited available space for replacement planting. Generally, the verge widths in some streets where these trees are growing are now too narrow to support such large trees.

Along the coastal strip on the eastern side of Yamba, rows of Norfolk Island Pines along Clarence Street are in similar condition, with the added threats of compaction to the root zones caused by constant vehicle parking on grass verges beneath trees (due lack of any effective barriers), construction of an increasing number of vehicle crossovers to service new and higher density residential development, construction of off-street parking bays between trees, and deliberate vandalism to improve views of the coastline. There is also a greater percentage of high rise development in this fringe. These are likely to be on-going threats in the long term and will eventually result in the demise of these trees. The eventual loss of these trees will have a significant impact on the visual character of Yamba. However, where verge widths are sufficiently wide the area beneath the trees are free of urban structures and influences (such as the north-eastern end of Pacific Parade), rows of Norfolk Island Pines are performing very well and can be expected to remain in the long term. Coast Banksia is also performing well along the coastal strip, but numerous complaints have been received by council from residents due this vegetation obscuring views of the coastline. View corridors are considered an important constraint to any future tree planting, particularly along the coastal fringe.

Most of the residential streets in Yamba east have no defined streetscape character, as a result of having little or no street tree planting and little tree planting within building setbacks of residential properties. This may be due primarily to the desire to maintain uninterrupted views to coastal and riverine areas, but also appears to be due to lack of any intentional street planting. It could also be a reflection of the particularly harsh growing conditions given the sandy soils and exposed coastal position of the township, particularly on the eastern side of the knoll. Soil conditions and exposure to coastal salt laden winds are significant constraints to the selection of species in Yamba east, particularly in front line coastal positions, although more sheltered positions on the south-west slopes of the knoll may provide for a broader palette of species. The south-west slopes also appear to provide the most opportunity for new tree planting, with most streets having relatively wide verges, less potential for obscuring coastal views and less high rise development. There may also be opportunities for median plantings where these exist or where road carriageways are sufficiently wide to incorporate central medians (such as the western end of Beach Street).

Low lying areas in the central part of Yamba are dominated by stands of Broad leaved Paperbark, the grey green foliage and irregular rounded form providing a contrast with the strong vertical alignment and deep green of the Norfolk Island Pines and Cook Pines. The success of this species is related to its ability to survive in deep sand, subjected to periodic flooding and waterlogging. There are lesser constraints imposed by view corridors and coastal exposure in these low lying areas, but any selected species will need to be tolerant of the underlying soil and hydrological conditions. Generally there are significant opportunities for new planting in these areas, particularly within parks and open space areas and in wide grass verges which are characteristic of many of the streets.

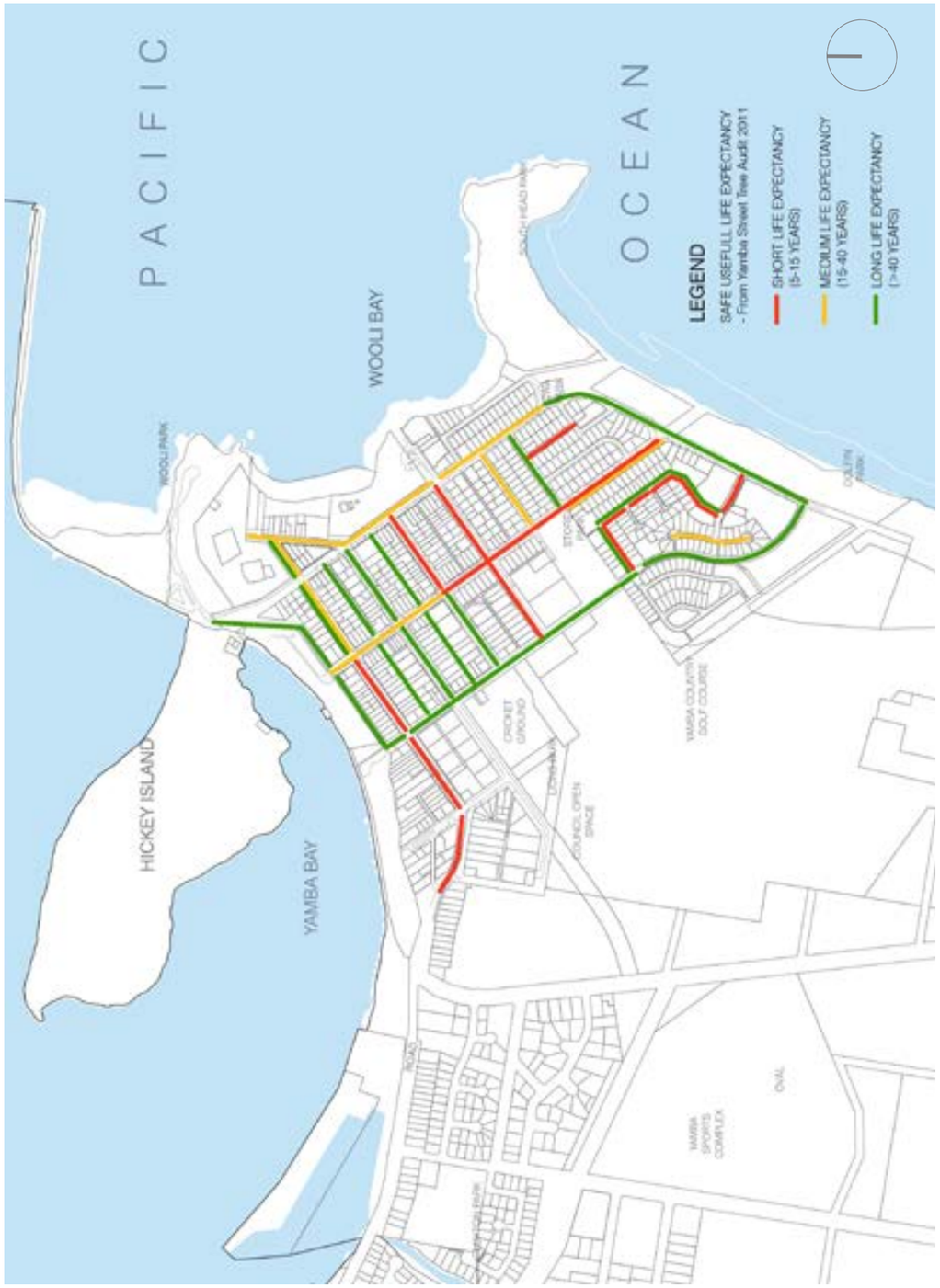
Refer to the appendix for the full street tree audit.

The skyline of Yamba is dominated by the Araucaria forest. In the background to the south is the existing paperbark woodland.

3.1.2 Street Tree Population and Health

The dominant species used for street tree planting in Yamba is *Araucaria heterophylla* (Norfolk Island Pine), followed by *Araucaria collumnaris* (Cook Pine) the latter of which has been used as a replacement for Norfolk Island Pines due to on-going problems with decline and infrastructure damage. Cook Pine is favoured as a replacement tree as it maintains some of the unique visual character that Norfolk Island Pines provide with fewer problems in terms of damage to adjacent infrastructure. Generally the older Norfolk Island Pines are entering senescence and beginning to decline, particularly due to the impacts of increasing urbanisation around them. Many of these trees were planted in the early part of the twentieth century when these pressures did not exist. As previously discussed this leaves council with a significant challenge for the future. However, whilst this species is generally too large for many of Yamba's residential streets, there is some potential for replacement planting of Norfolk Island Pines to occur in Yamba's parks and reserves, and possibly in some streetscape areas with sufficiently wide verges or medians uninhibited by other infrastructure.

Other species are much less populous, but *Cupaniopsis anarcardioides* (Tuckeroo) is showing good performance in a number of new residential and commercial zones. The majority of these trees are relatively young, so it is difficult to speculate on their long term performance. An issue with this species generally is its tendency to develop structural defects (included bark and branch junctions) leading to branch failure. This can be controlled to an extent by regular monitoring and formative pruning to remove such defects as they form. *Banksia integrifolia* (Coast Banksia) is also performing well, although according to council staff this species is relatively short lived and does not make a good street tree. *Melaleuca quinquenervia* (Broad leaved Paperbark) is also performing well on low-lying areas in Yamba, but is not really used for street planting. It does tend to have a fairly extensive root system and can create problems in narrow verges close to pavements and underground services. This species may be appropriate in suitably wide verges in low lying areas.



Yamba Street tree Audit Safe Useful Life Expectancy Rating 2011.

Chapter 4

Yamba Street Tree Master Plan - Issues and Objectives

4.1 CURRENT ISSUES OF THE MATURE URBAN FOREST. THREATS AND IDENTIFICATION OF THE PROBLEM IN YAMBA

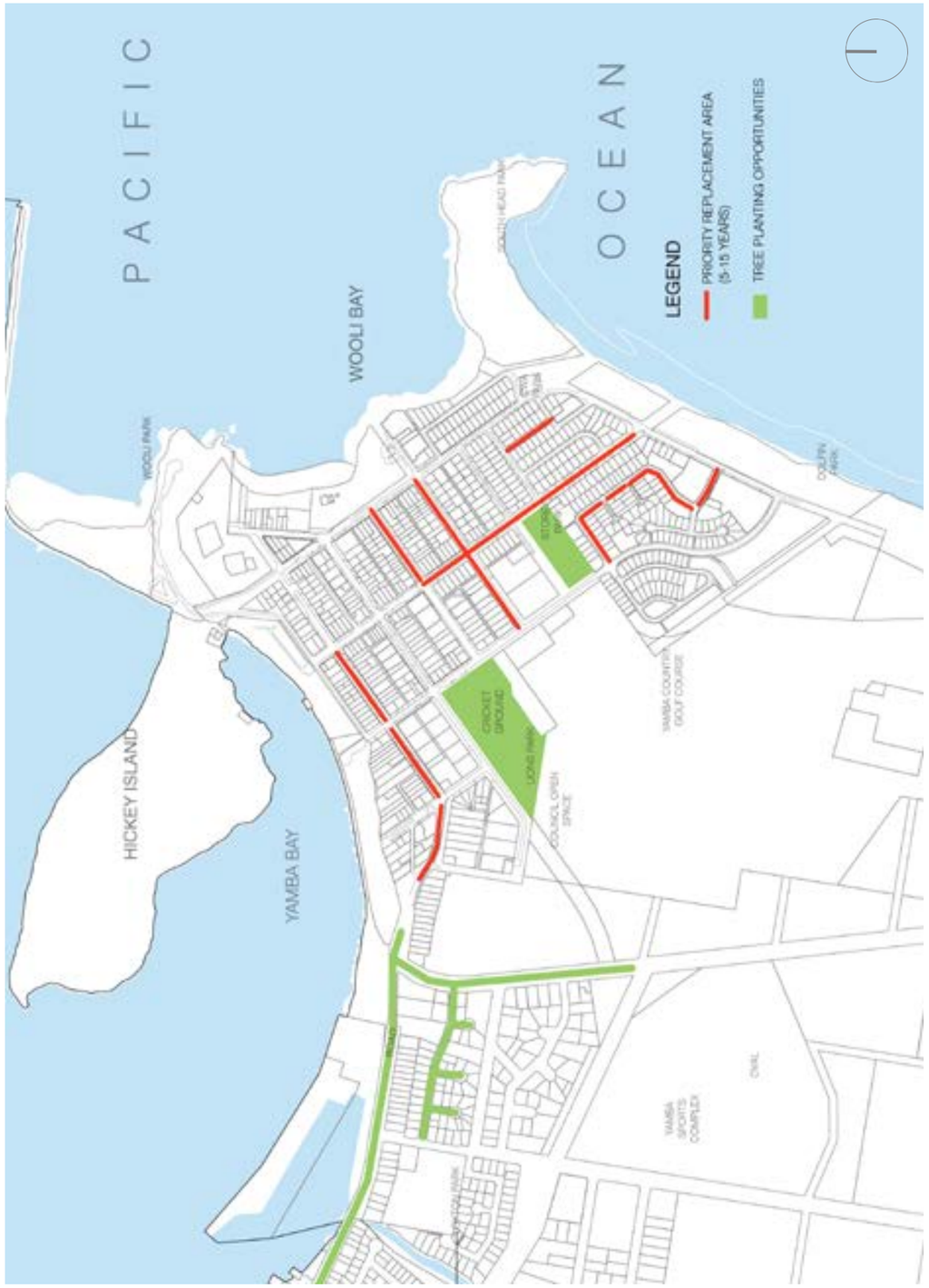
The key threats to the street tree population in Yamba are natural attrition of the tree population, due to decline of older trees and minimal replacement planting pressures on street trees resulting from new and higher intensity residential development, encroachments to verges from parking bays and vehicle crossovers, uncontrolled off-street parking on treed verges and medians and pressure on council to remove trees or deliberate vandalism of trees that may obscure coastal or riverine views. These pressures on street trees are expected to increase as population increases, residential density increases and tourism increases.

4.2 TREE REPLACEMENT AND PRIORITY AREAS

Natural attrition can be combated to a certain extent by on-going replacement planting, but this can only be done effectively following the proper development of council's Urban Tree Management Strategy and Street Tree Management Plan. These elements are critical to ensure the right selection of species are put in the right place. Replacing aged trees, particularly those that make a significant contribution to the amenity and heritage values of a place, such as the Norfolk Island Pines in Wooli Street and Clarence Street, is a difficult dilemma. Typically these trees, which were all planted about the same time, suffer roughly equal pressures from increasing urbanisation around them and start to decline and senesce about the same time. The wholesale removal of these trees is unlikely to be acceptable from a community or political perspective. Unfortunately the removal and replacement of individual trees does not really provide a satisfactory result either. Growing conditions for new trees amongst large old trees is extremely difficult due to competition for light and space. The avenue or row will also ultimately lack visual uniformity due to the diversity in age and sizes of the trees.

A strategy used in Canberra to combat this problem involved staged removal and replacement of 'blocks' of trees, so that the visual impact of the loss of a large stand of trees could be staged over a reasonable time frame, reducing the initial visual impact. This strategy proved to be very successful until a change in the political environment forced its seizure. This type of strategy obviously requires public consultation and support as well as long term planning and political will to carry it out.

In some instances, it may be feasible to commence replacement planting with the same (or alternative species) in areas where sufficient space exists and there is the ability to undertake planting in rows or blocks, such as the north side of sections of Wooli Street. This would need to be done on the understanding that the trees on the south side of the road would be eventually removed (preferably in suitable stages, rather than sporadic removal individual trees). As there are many streets in Yamba that are completely devoid of street trees, new planting undertaken in the near future in these areas could also be undertaken as an offset to removal of trees in other areas, where replacement planting cannot be undertaken instantaneously.



The Priority Areas in Yamba (East).

The Priority Areas in West Yamba.

Wooli Street and Clarence Street are the two highest priorities for replacement planting. These two streets contain the oldest and most significant street trees in Yamba, and also have the shortest remaining Safe Useful Life Expectancy (SULE). Replacement planting is feasible to some extent in other areas of these streets (such as the southern side of Wooli Street, between Claude and River Street), and Queen Street (east end median).

Substantial new plantings could also occur on the south-west slopes of the knoll, as little street plantings currently exist in these areas and there appears to be few constraints to planting apart from overhead powerlines in some areas.

West Yamba, whilst having greater constraints to street tree planting given the narrower verge widths, is virtually devoid of street trees or many trees on residential properties. Main streets in these areas should also be targeted as a priority to improve amenity of these areas.

Lyons Park and Story Park also contain significant opportunities for replacement planting, without affecting views, but planting in these areas needs to be considered in line with the overall open space management strategy and the plans of management for these individual reserves.

TREE REPLACEMENT AND PRIORITY ACTION PLAN	
OBJECTIVES	**ACTIONS**
Trees are best replaced in blocks	Inform and educate the community about the advantages of block replacement and the disadvantages of incremental infill planting
	Explore offset block replacement of a senescent row of trees if space permits
Ensure ongoing replacement of suitable trees	Develop an annual tree planting program to take advantage of seasonal weather conditions which maximize growth and minimise losses
	Prepare an associated budget for new and replacement planting as part of the capital works program
	Identify individual trees for removal and re-placement by undertaking an assessment of Safe Useful Life Expectancy (SULE) based on Visual Tree Assessment (VTA) procedures

4.3 STREETSCAPE GEOMETRY AND OFF-STREET PARKING

Increasing urban development in Yamba will ultimately result in an increased demand for both off-street & on-street car parking facilities. Retrofitting of parallel and angled or perpendicular parking bays can result in significant damage to the root systems of trees, leading to accelerated decline and reduction in useful life. Construction of vehicle cross overs results in a similar impact. Site planning associated with new development should take into account any existing street trees and avoid encroachments of new pavements to Tree Protection Zones. This information can be incorporated into the council's Development Control Plan (refer to UTMS). In addition, minimising the width of crossovers (many are double-vehicle width crossings) should be considered. Where possible, casual on street parking should be consolidated into strategic areas to minimise impacts on street trees. Rollback type kerbs, flush and chamfered kerbs, that provide no barrier to vehicles parking on verges should also be avoided.

Constant vehicle parking of this nature leads to severe compaction of the root zone and contributes to stress on trees, leading to their decline. L-type kerbs or other physical barriers are critical to avoid compaction and physical damage. As an example, the median in at the eastern ends of Queen and Beach Street enable unrestricted vehicle access, leading to ground compaction, erosion and physical damage to trees. L-type kerbs or other barriers along with defined parking bays would minimise this damage.

Typical minor street in Yamba with generous verge width and overhead service on one side only.

4.3.1 Street Verges

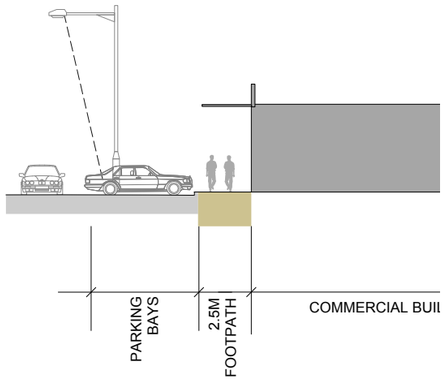
Yamba is fortunate to have wide verges for street tree planting. These verge widths are particularly important to allow enough soil rooting volume particularly in the exposed coastal environments where there are greater challenges to successful tree growth. While there are areas of overhead power lines that limit the use of large trees (in combination with coastal exposure, salt and maintenance of views), street tree planting in this zone requires sufficient soil volume.

The average street width in Yamba is approximately 5 metres. Most streets regardless of size, including boulevards, secondary streets and minor streets, enable street tree planting opportunities. Verges exceeding 3 metres are the most useful for street tree planting. This verge width does not necessarily correlate with the street hierarchy.

With a greater understanding of what trees require for good structure, appropriate space needs to be provided to allow for their canopy and healthy root formation. This will avoid the potential of poor root development and the associated problems that result in the decline of the tree's health, evident with the recent parking bay installments in Clarence Street. By preventing and restricting damage to tree roots and formation the tree has greater potential for optimal health and longevity. This conversely will reduce maintenance costs and also the potential for trees to become hazardous.

The width of the street verge generally determines the tree's health. Trees in wider verges (particularly those with a drainage ditch) are generally healthier than trees in narrow verges. While this seems logical, it can be demonstrated by the health of Melbourne's trees in the broad median strips compared with the same species in the narrower street verges, planted at the same time. The trees of the older parts of suburban Grafton also illustrate the best profile possible for a street tree verge, up to 8 metres wide, permeable grassed surface, with no gutter and a centrally located drainage ditch. This scenario is what is now termed as Water Sensitive Urban Design (WSUD) an initiative that is attempted to be retrofitted into streets.

The minor lanes of Yamba such as Convent Street have little opportunity for public domain street tree planting. The lanes 'borrow' tree planting from the private domain.



Narrow verges in the commercial streets require clear pedestrian circulation and awnings. Tree planting opportunities are best in the parking lane in these situations.

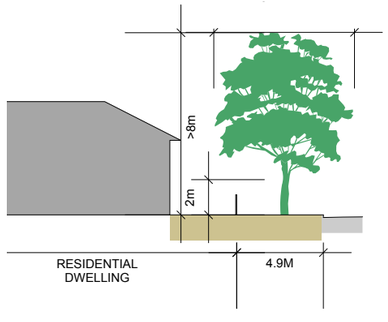
4.3.2 Narrow Verges <2 metres

- These streets generally not enough space for a nature strip or verge
- There is sufficient space for trees to grow and for services allocation
- The Disable Discrimination Act advises that a minimum clear path of travel of 1200mm should be allowed in a footpath, further constraining tree planting opportunities
- A space of 600mm for tree planting is inadequate assuming a clear path of travel is provided
- A tree that is required to attain a clear stem of approximately 2000mm will also not have a canopy width that allows for a building facade potentially at the property boundary
- Narrow lanes and minor streets may not suit tree planting as part of the streetscape character
- Often there are also overhanging trees from the private domain
- If the road carriageway is wider than required, there may be opportunities in the parking lane or in kerb extensions and islands at street corners

4.3.3 Wide Verges > 2 metres

- These streets will have space for a tree planting verge
- The majority of streets are in this category, including the newer release areas of West Yamba
- For streets greater than a verge width of 3.6 metres the footpath would ideally be at 1600mm
- It would be best practice for footpaths to be a porous pavement over structural soil to minimise the lifting of pavement by street tree roots
- Yamba (and many of the Clarence Valley towns) are fortunate with having sandy and alluvial soils tree roots can generally spread downwards
- Tree root barriers should only be used in the carriageway to enable trees to access sustainable adequate soil volumes
- Tree holes should be as generous as possible and ideally planted with a hardy native understory plant at the perimeter of the tree holes
- The balance of turf to planting in a verge is determined by cost, maintenance regime and capacity and the degree of 'permeability' that a street needs to have - to allow sufficient crossing points at the verge
- A tree hole with a minimum width of 800mm in a 2 metre wide footpath increasing to 2 metres in a 3.6 metre wide verge. The tree hole defines the edge of the pedestrian clear path of travel
- A tree with a greater canopy size can shade the footpath / streetscape and provide a valuable role in creating a livable street
- The canopy size should also be relative to the scale and width of the street, the hierarchy of the street and scale of adjacent buildings

The new release areas have wide street verges and no conflict with overhead powerlines. There are opportunities for trees of a minimum size.



A typical verge cross section of greater than 2 metres allows trees of a larger scale to be planted to achieve canopy cover and amenity goals. These dimensional 'minimum size' criteria are used to determine tree suitability in the tree selection matrix.

4.3.4 Parking Lanes and Medians

- Can provide opportunities for large soil volumes
- Provides opportunities for passive irrigation and WSUD. Ideally these planting are flush with the road allow WSUD goals to be incorporated and passive irrigation, increasingly important in a changing climate
- Trees in the parking lanes can help with traffic calming by reducing the perceived carriageway width
- Most services are in the footpaths and not the roads
- Tree canopy can shade the footpath and the road carriageway helping achieve canopy cover objectives for shading the streets
- Trees can often coexist with powerlines in the verge, assuming the correct tree is selected to reduce maintenance
- Tree root barriers may be necessary in the carriageway side of a parking lane tree pit
- Tree holes should define the car parking bay, 2.5 metres for parallel parking and approximately 6 metres for 90 degree parking. The tree hole should be a minimum of 2.5 metres square with the parking lane ideally being porous to allow trees to reach the require size to attain streetscape design objectives

Recent streetscape upgrade in South Grafton. This median planting has a generous soil volume with flush kerbs for potential stormwater infiltration. Tree barriers provide protection for the tree from vehicles. This is a good tree planting precedent.

An ideal street cross section with drainage median and flush planting within the parking lane. This section demonstrates how a typical street can become part of the urban forest, not simply a line of street trees.

4.3.5 Beneath Power Lines

- Trees beneath power lines are limited by size or species that can be formatively pruned
- Provides the opportunity for greater street tree diversity by determining the size of the species, where another species is able to be used on the non powerlines street side
- Species used should still be able to have a clear trunk height of 2 metres for ease of pedestrian access
- Shrubs or small trees with little amenity should not be used

Street tree planting that is unsuitable for beneath powerlines. While height is a key selection criteria item for trees beneath powerlines, some trees can be formatively pruned around overhead services.

4.3.6 Verges in New Development Areas

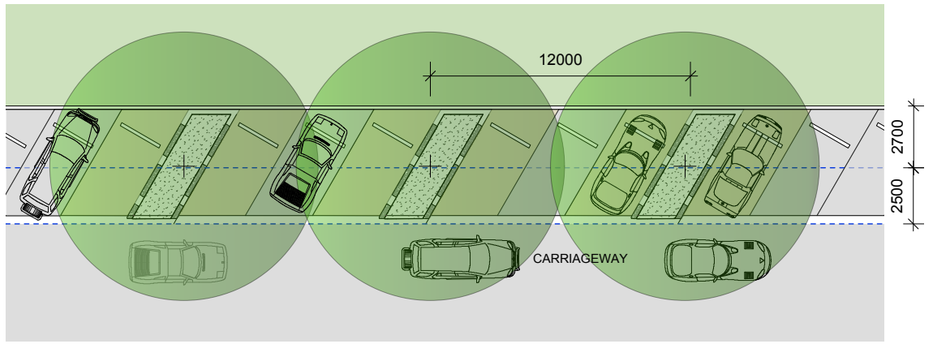
- Take advantage of no overhead services, by planting larger trees
- Create a better streetscape character and amenity by increasing street tree planting and in the public domain generally
- Here there are no footpaths on the street verge, street trees could extend the character of the private property landscape. An eclectic mix of trees could be used, including trial species
- On the footpath side trees, could have a more consistent and rhythmic street layout approach to street corners, parks and other ‘irregularities’
- Possibility of supplying residents with appropriate street trees to help foster a civic responsibility to the tree and assist with its health and care. Guidelines should be included for giving defined options for where the tree can be planted. Tree species should reflect the performance criteria of the tree matrix. Therefore enough options of a suitable tree should be possible for selection by residents

- Diversity objectives will be achieved
- New inlet kerb and gutter for street tree pits and other WSUD devices for future developments to ensure that trees can be sustainably watered through passive irrigation
- Utilise the street parking lanes for tree planting

4.3.7 Angled and 90 Degree Car Parking

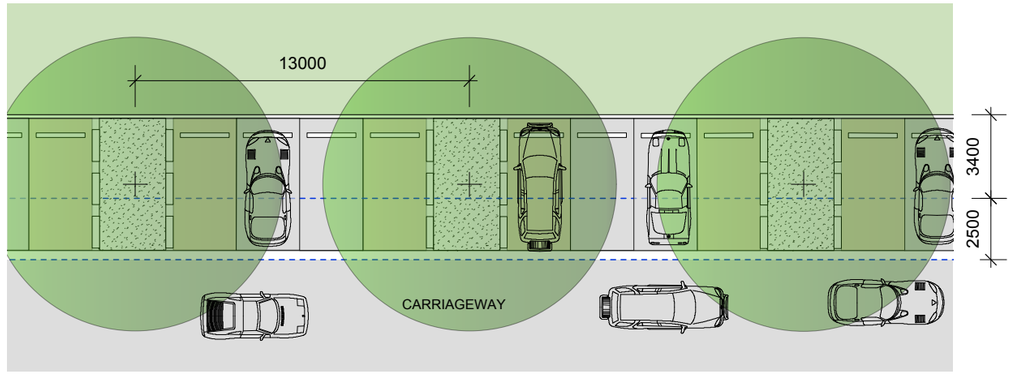
The concrete off-street parking bays and widening of driveways has resulted in fewer opportunities for tree planting. These bays have been created to create additional parking opportunities in summer, but also appear to have been added to create 'private' parking spaces within the public domain. The constraints that this puts on tree planting opportunities is obvious. However, there is the potential for porous pavements to enable off-street parking to be formalised and reduce erosion, while still enabling a soil root volume for adjacent large trees. The provision of these spaces should however be measured on who benefits, private or public users.

There are a number of strategies and opportunities to facilitate parking within the public domain as well as enable trees to coexist or create opportunities for tree planting:

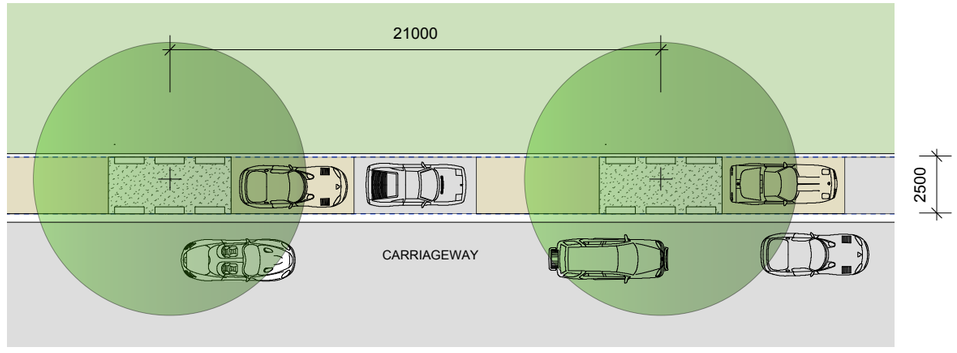


Scenario 1. *60 degree parking showing tree planting pit minimum 2 metres wide and flanked by porous paving on structural soil. A large tree of 12 metres canopy size can have touching canopies with the next trees and three car spaces between trees. This arrangement would encroach 2700mm into an adjacent reserve or verge. .This is the preferred parking arrangement of Clarence Valley Councils traffic engineers.*

Much of the car parking in Yamba is parallel parking, by creating 90 degree parking, there is some encroachment into reserves (by approximately 3 metres), however more efficiency in parking is possible as well as enabling 'hit and miss' car spaces retained for tree planting. With the use of porous pavements in parking spaces, trees can utilise the volume of soil beneath the tree spaces. Space can also be provided between cars for pedestrian circulation at strategic points in the streetscape, such as opposite street corners.



Scenario 2. *90 degree parking showing tree planting pit minimum 2 metres wide and flanked by porous paving on structural soil. A large tree of 13 metres canopy size can have touching canopies with the next trees and four car spaces between trees. This arrangement would encroach 3400mm into an adjacent reserve or verge. If the impact of this encroachment is not detrimental this gives the best balance between street tree space and provision of parking. While it is not the preferred standard parking arrangement for Clarence Valley Council, there are instances where it may be applicable.*



Scenario 3. *60 degree parking showing tree planting pit minimum 2 metres wide and flanked by porous paving on structural soil.. A large tree of 12 metres canopy size can have touching canopies with the next trees with three car spaces between trees. This arrangement would encroach 2700mm into an adjacent reserve or verge.*

STREETSCAPE GEOMETRY AND OFFSTREET PARKING ACTION PLAN	
OBJECTIVES	**ACTIONS**
Dimensional constraints determine tree site suitability	Consider appropriate soil volumes and soil quality to accommodate the ultimate size of the tree
Minimise potential for conflict between trees and infrastructure (and operational uses)	Investigate options for replacement of overhead cables with Aerial Bundle Conductors (ABCs) in key locations
	Consider use of Structural Soils or Root Control Barriers to mitigate/avoid infrastructure damage
	Review Council's vehicle access crossing widths with a view to be no more than 3 metres for residential properties'
	Maintain appropriate clearances for pedestrian and vehicular thoroughfares, signage and sightlines to ensure public safety

Chapter 4 YAMBA STREET TREE MASTER PLAN - ISSUES AND OBJECTIVES

4.4 KEY PUBLIC VIEWS - BALANCE OF ECOLOGICAL RESTORATION GOALS AND IMPORTANT AND ICONIC VIEWS

The issue of trees and views is one of the most important tree management challenges. The issue of trees blocking views for the private domain is an area that coastal councils have been dealing with for the past 50 years. The reasons for trees and views becoming a priority are due to:

- An increase in private property values
- More retirees and 'lifestyle' residents moving to coastal areas
- An increasing value attributed to views, vistas and scenery
- An increase in vegetation in coastal reserves due to reduced fire frequency, coastal revegetation programmes

The maintenance of view corridors is a dilemma that is difficult to resolve. Ocean and riverine views may have many hundreds of thousands of dollars in value to residential properties and these properties are highly sought after. Deliberate vandalism can never be completely eliminated, particularly given the potential loss or gain in value of adjacent residential property.

There are also conflicts between the goals of ecological restoration and erosion control and the maintenance of view. The process of revegetation has been instrumental in people's awareness of views. When weed vegetation such as Bitou bush is cleared in bush regeneration projects, views are revealed prior to re-establishment of taller growing endemic species. Or people are conscious of new vegetation encroaching on important views as a consequence of revegetation, where previously there may have only been grass.

As with all conflicts, common goals need to be appreciated, understood and well communicated. Balance needs to be found between identifying key views that are for the public benefit. Following input from the community and council officers, the Yamba Streetscape Strategy has identified key public view locations along the foreshore.

The Urban Tree Management Policy provides a framework for the management of these identified viewing areas, and establish criteria for the consideration of additional viewing areas for public benefit. The policy also identifies actions to address issues arising from tree vandalism.

Key public views identified in Yamba.

Chapter 4 YAMBA STREET TREE MASTER PLAN - ISSUES AND OBJECTIVES

KEY PUBLIC VIEWS ACTION PLAN	
OBJECTIVES	**ACTIONS**
Identified view areas are maintained for public benefit	Appropriate management techniques undertaken to maintain identfied view areas
	Estabalish criteria for the asesment of views for key public benefit
Investigate tree vandalism	Take appropriate action in accordance with the Urban Tree Management Policy

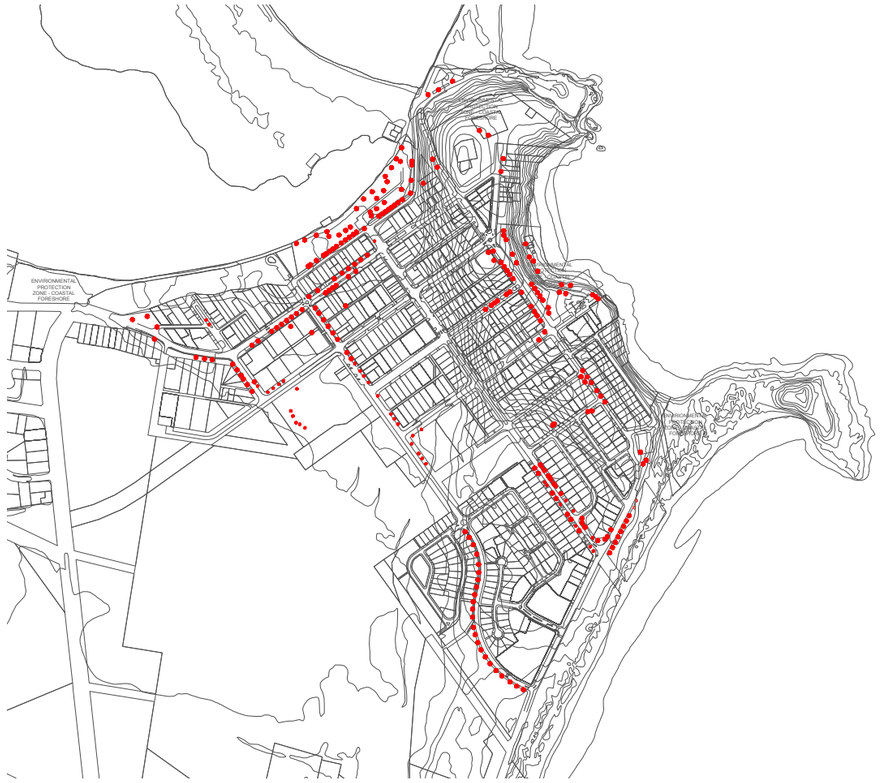
4.5 MANAGEMENT OF THE *ARAUCARIA* FOREST ONGOING PLANTING STRATEGY AND REPLACEMENT

The *Araucaria* forest of Yamba is one of the main defining characters of the landscape, along with the beaches, estuary foreshore and Pilot Hill lighthouse. The *Araucarias* have been planted in a relatively informal manner traditionally, which give an articulated but casual feel in the landscape. These trees have been used formally in some locations, particularly along Dolphin beach and for the more recent street tree plantings within the internal town street grid. *Araucarias* are a significant tree as they are one of the few large trees that can handle full exposure in a difficult coastal environment.

The informal use of *Araucarias*, similarly to the use of palms in groves makes a strong statement, particularly when the trees are of a mixed age. *Araucarias* like palms, can lose their amenity value when used formally. As with palms, *Araucaria cookianum* can look spectacular in informal groves. The groves of trees in New Caledonia illustrate the dramatic effect on a coastal landscape.

Araucaria hetrophylla has been replaced with *Araucaria cookianum* in more recent years as it is deemed to be an easier tree to manage. While this tree is a strong accent and focal tree, it does not provide much canopy cover, as despite its height, it rarely exceeds 5 metre width at maturity. Some of the other goals with planning for the urban forest can be not as well achieved with this tree. Goals such as provision of shade and amenity and microclimate tempering for the streets are not well met with this species. It certainly does have a place in Yamba, however too much use of this tree may result in Cook Pine fatigue, a loss of diversity and an increase risk of pathogenic attack or mass failure.

Chapter 4 YAMBA STREET TREE MASTER PLAN - ISSUES AND OBJECTIVES



Existing Araucaria forest cover in Yamba.

Indigenous Araucaria columnaris forest in New Caledonia. Informal group of mixed ages.

***ARAUCARIA* FOREST ACTION PLAN**	
OBJECTIVES	**ACTIONS**
Continue the use of Norfolk Island Pines where site planning allows to retain Yamba's landscape character	Plant Norfolk Island Pines in areas where they are currently located such as Wooli Bay and Dolphin Park
	Use Norfolk Island Pines where they do not encroach on the key views identified
	Determine priority trees that are a risk or hazard
	Determine other trees that are declining due to recent off-street parking and driveway works. There are a number of these trees along Clarence Street that very stressed due to loss of roots from these construction works. These should be considered to be replaced in the short to medium term
	Continue using *Araucaria hetrophylla* where space and views are not an issue to maintain the existing character of the larger species being a feature in the Yamba landscape
	Continue use of *Araucaria cookianum*, and consider using these planted in formal groups of differing age to take advantage of their columular form in a striking way
	Consider using this genus in West Yamba to help maintain a sense of connection between the two development areas, and to provide a compatible character

4.6 TREE PLANTING IN PUBLIC OPEN SPACE AND RESERVES

The management of trees and parks is an important one. As with town streets these are areas where people congregate and use space for leisure and recreation. Councils across Australia through the Local Government Act have developed Plans of Management (POM) for all open space and reserves, directly under council jurisdiction and also Crown lands. The POM's aim to guide future uses, preserve heritage, ecological or cultural goals.

Yamba has a large area devoted to public open space distributed evenly across the town, The open spaces in the centre of town have more 'programmed' used such as the sports complex and cricket oval. Storey Park is a considerable open space that is an informal green open space that is characterised by low maintenance grass and groups of predominantly remnant trees.

As there is large areas of open land these central reserves can benefit from a consistent tree planting programme. There is scope for these public spaces to include trail plantings of streets for trees, where the merits of tree species can be determined in an environment without the limitations of a streetscape. Tree planting in these reserves can help provide more shade and help define the functions of these parks.

Coastal reserves surround the Yamba peninsula and are the most heavily used, loved and contentious open spaces in regard to trees. Trees in the coastal reserves can interupt private and public view corridors. These reserves are characterised principally by the *Araucaria* forest and the coastal revegetation of indigenous species. Management objectives for this area incorporate actions to balance the preservation of landscape character, ecological integrity, amenity, view corridors and open space recreation .

The distribution of Yamba's public open spaces and coastal reserves.

The distribution of reserves in West Yamba.

West Yamba has a lower representation of open space than Yamba. There are three small parks that fulfil a traditional role as active open space. The remaining parks are essentially nature reserves an important role, although limited to what facilities can be provided. Hakea Park is well placed at the centre of the development with key roads leading to it. There are opportunities for more tree planting to give greater definition to the parks edges and where shelter and shade is required. The streetscapes of West Yamba are important to help contribute to the potential urban forest character of Yamba.

TREE PLANTING IN PUBLIC OPEN SPACE AND RESERVES ACTION PLAN	
OBJECTIVES	**ACTIONS**
Increase the tree planting in parks and reserves	Explore trail planting of species for use in local streetscapes and parks
	Provide large generous shade trees to provide amenity in parks
	Species planted are identfied through approved list
	Explore the opportunity of using *Araucaria* species in local parks (Hoop Pines) to compliment the character of Yamba

4.7 TREE PLANTING IN NEW SUBDIVISIONS

The recent developments of Yamba and West Yamba have few street tree planting to contribute to a future street character and provide amenity. The few new street tree plantings have been installed by private residents and are scattered and potentially inappropriate. The establishment of a street tree planting programme is desirable to allow these areas to develop a future urban forest. This will give these areas the same character currently enjoyed by the older towns of Grafton and Maclean, however there is a different morphology, that requires tree species to be adaptable to these.

The street geometries of these new developments are generally narrower the than the early grid survey of the late 1800's. There are constraints in these areas, (which are included within the Yamba master plan selection matrix), with narrow verge widths being the principal constraint. However some verge widths still provide opportunities for appropriately scaled tree planting. There are also many opportunities in these areas compared with the older towns. No aerial services means that tree height is not limited to seven metres and also pruning is not an imposition on Council.

The street verge is not the only place where tree planting is possible. The street width enables off street parking on both sides on most streets. Parking lane planting would be a beneficial to West Yamba. Off street parking does not have the pressures of the town and can allow for passive irrigation, WSUD opportunities, is away from services, provide street shading and help reduce traffic speed widths. This may be most appropriate on the higher 'hierarchy' feeder streets.

For new release areas yet to be developed it would be desirable for Development Consent conditions for the developer to include new tree planting. This is the most effective means of establishing trees, before resident stakeholders, requires community consultation to install street trees. The cost to the developer above the provision of roads, drainage and services is not high with the added incentive of increasing marketability of houses.

Street trees in the parking lane in residential streets.

Community education and consultation will be particularly important in establishing street tree planting in areas where they do not exist. Effective notification and education is an important first step. Flexibility of tree selection, some degree of choice, allaying peoples 'fear' that trees are unsafe, messy or overshadow lawns, will enable residents to feel some empowerment and reassurance with a tree being planted outside their property. Some residents will happily accept public domain tree planting, if others chose not to have trees installed, it is best not to plant outside these residences. Costly loss of trees due to vandalism is best avoided to minimise waste. There may be the opportunity for incremental planting when people see how a streetscape can be improved with trees. This incremental approach, while not providing the strongest design approach for street trees is consistent with urban forestry goals of systematic planting.

Before a programme of street tree planting can be undertaken, it is worthwhile carrying out a soil testing regime. West Yamba by all accounts is largely comprised of fill, particularly in the newer areas. To avoid expensive street tree failures, a soil chemical and physical analysis can determine if any corrective measures are required at tree planting.

TREE PLANTING IN NEW SUBDIVISIONS ACTION PLAN	
OBJECTIVES	**ACTIONS**
Increase the tree planting in streets in new development areas	Assess the community perception to planting trees in new developments
	Notify residents of Councils intentions when implementing street trees
	Explore the option of developer contributions or consent controls to assist with implementation of street trees
	Explore the option of street tree planting in parking lanes in certain streets
	Verify existing soil conditions with extensive testing to determine any necessary rectification
	Convince developers of the importance of street trees for marketability of properties

Chapter 5

Street Tree Strategy and Selection

5.1 INTRODUCTION

It is accepted that specie selections matrix are the most effective way of organising tree species characteristics, tolerances and susceptibilities. This information can then be interpreted and utilised for species selection in particular streetscape situations. This helps determine the relationship between the street and the tree, its adaptability to a challenging site. The tree selection matrix can be used manually or adapted to be used digitally and to allow future adjustments.

There are three tree selection matrix lists to group the information for the Yamba Street Tree Master Plans objectives. These include:

- Streetscapes which are the principle component of the urban forest
- Trial trees are included to expand the diversity of the tree species population, through streetscape trialing
- Tree selection matrix to be dynamic, with an update in five years time, when the performance of these trees can be determined
- Park trees which contribute significant blocks of tree planting to the cities greenery. While most of the street trees can be grown in parks, the reverse is not always possible. The park tree list includes species that require greater root volumes or are larger in size. Their selection still follows the same criteria as the street trees and conforms to the Clarence Valley Street Tree Strategy and the individual Park Plans of Management

5.2 OBJECTIVES AND STRATEGIES OF STREET TREE SELECTION

5.2.1 The Key Objectives of the Generation of the Tree Matrix List:

- Reduce the risk of decline in Yamba's tree canopy cover due to over representation of a common tree species
- Substantially increasing the diversity of trees to create an urban forest more adaptable to a changing climate
- To identify an expansive list of possible street trees
- Identify a number of species possibilities for any given street application

5.2.2 The Tree Selection Criteria Can Be Utilised to Achieve the Following:

- To be able to assess the performance of tree species of varying taxa, provenance, form and structure and size to increase the diversity of Yamba's street tree and reserve population
- To demonstrate the adaptability of tree species that are alternatives to species that are proving inadaptable to climate change or are over represented in the cities street tree population
- To generate street trees lists that are applicable to specific street types hierarchies within Yamba and West Yamba, for street tree trialling and experimentation and for parks

- Utilisation in the public consultation process if required, with a qualitative list to help council achieve an objective approach for more effective and defensible implementation within the Street Tree Master Plan
- For tree options to be implemented that will enable street character, heritage and design objective criteria to be achieved
- For tree lists to be 'live' and with an active interface to ensure that it is usable and can be updated by council according to changes in streetscape criteria, innovations in planting methodology, changing distribution of street tree diversity goal percentages, developments in tree species and cultivar knowledge and tree performance, research data and tree trialling
- For this work to be expanded, potentially for an interactive application to be able to be applied to any street type and a combination of changing conditions within any street

5.3 ADAPTABILITY AND VIGOUR

What makes a useful street tree for Yamba according to the tree selection matrix?

An adaptable street tree that is vigorous is desirable in Yamba's future urban forest. The scoring of the base criteria shows that careful consideration of the species was considered initially. All the species pass. There are no trees that can be considered as having a low adaptability as they have been culled in the first instance. All trees have a moderate adaptability or higher. The trees can be given intervals of adaptability to help analyse the list and determine which trees can be used in priority tree replacement streets.

5.4 THE TREE SELECTION PROCESS

For selection of a Street Tree Master Plan palette the selection process is not principally determined by subjective values such as personal taste, aesthetic and cultural values, perceptions, design requirements or any site based constraints. In considering the prospective tree species.

Trees were considered that were:

- Not too short lived
- Did not meet the urban forestry criteria, such as drought tolerance, heat tolerance, wind tolerance or a natural resistance to pathogens

As detailed elsewhere in this report it is envisaged this is a live document with updating of this list possible as more data and information becomes available.

Decisions later in the process will consider diversity allocation across Yamba and the other Clarence Valley centres, composition, placement and site opportunities and constraints. Guidelines for these are provided and the consultation process will also determine the exact tree that is used in a particular location.

Chapter 5 STREET TREE STRATEGY AND SELECTION

5.5 A 'LIVE' DOCUMENT

It is a requirement that this document be interactive and flexible for the user. Street tree management and urban forestry is a concept that is still developing, both from practical experience and scientific research. As a consequence, the limitations of the tree selection process are carefully accounted. The document will enable updating as information, data and research become available to the user. Following are some examples:

- Future tree pathogens may affect a particular selected species. If this is unmanageable then the tree species will be taken off the list. Similarly, new cultivars and selections that are more disease resistant may be potentially added
- Climate change results in further extremes in weather and the status and suitability of species needs to be updated
- Reassess on site conditions such as greater incorporation of 'positive' planting innovations such as structural soil beneath porous paving, infiltration, pits, WSUD basins

Formal Review

This will give the opportunity for reviewing the diversity strategy comprehensively. This formal review is suggested to take place in five years time, 2016. The review will analyze the following aspects:

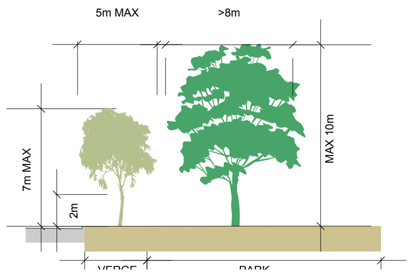
- Master Plan Strategy Objectives - including how prioritisation of work, canopy cover projections and replacement species
- The strategies relationship to the Clarence Valley Street Tree Strategy, Plans of Management, DCP and other Clarence Valley Council's policies
- Changing community perceptions can be incorporated, including any community consultation programme outcomes

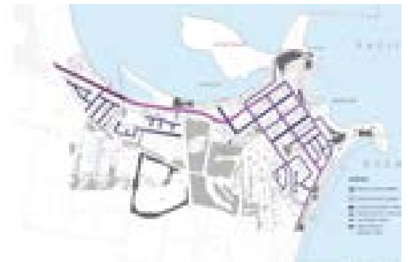
Formal Street Tree Trials

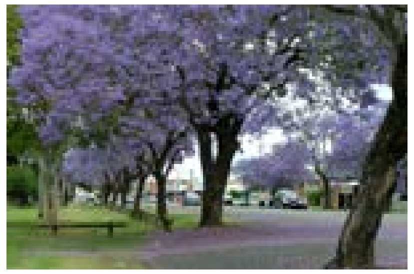
This will enable potential tree species to be tested and reduce risk of trees planted within streetscapes failing. There has been little increase in the diversity of street tree species trialling since the formative street tree planting that gained traction early last century. With the decline in the overall urban forest population and onset of climate induced challengest.

- The evaluation of 'trial' trees after growing in street conditions. Can they be upgraded or downgraded
- The reason for trees either succeeding or failing can be carefully monitored and recorded and to eliminate anecdotal or subjective information. While interactive web pages such as TREENET and AUSTEP can be useful, the inputs into this cannot be qualified easily

5.6 HOW TO READ THE MATRIX







Step 1 — **Tree Species**
Botanical and common name

Step 2 — **Tree Information data**
Botanical and common name

Step 3 — **Base Criteria**
The criteria by which each street tree/ park species must fulfill to be acceptable for planting by CVC

Step 4 — **Street Type Criteria**
Is there WSUD application or powerlines (Yes/No)

Step 5 — **Environment Type Criteria -** Refer to plans
Is it exposed coastal/ sheltered slope or floodplain (Yes/No)

Step 6 — **Street Type Hierarchy** Refer to plans
The street tree list is generated for the particular environment zone/ street type services constraint

Step 7 — **Design and Community Criteria**
This includes objectives such as aesthetics, streetscape character, cultural and heritage

Yamba Street Tree Master Plan Tree Species Selection Criteria- Version 1

Tree Species	*Angophora subvelutina*	*Angophora hispida (Syn. A. cordifolia)*	*Angophora floribunda*	*Angophora costata*	*Alphitonia excelsa*	*Allocasuarina verticillata*	*Allocasuarina torulosa*	*Allocasuarina littoralis*	*Agonis flexuosa*	*Agathis robusta*
Common name	Broad Leaved Apple	Dwarf Apple	Smooth-Barked Apple	Smooth-Barked Apple	Red Ash	Drooping She-Oak	Forest She-Oak	Black She-Oak	Willow Myrtle	Queensland Kauri
Tree Information Data										
Origin	Qld, NSW	NSW	Qld, NSW	Qld, NSW	NT, Qld, NSW	NSW, Vic., Tas., SA. Coastal & Inland	Coastal forests NSW & Qld	Eastern Victoria & NSW. Lighter forests	WA	Queensland, lowlands & tablelands
Growth Rate	Moderate	Moderate	Moderate to Fast	Fast	Fast	Fast	Moderate	Fast	Moderate	Moderate
Height	15	8	20	20	15	9	8	9	8	25
Canopy Widths	12	8	15	15	10	7	10	5	7	15
Type	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen	Evergreen
Biodiversity Potential- Foraging habitat	Flowers, insect-eaters	Flowers, insect-eaters	Flowers, insect-eaters	Flowers, insect-eaters	Unkown	Seed eaters	Seed eaters	Seed eaters	Seed eaters	Seed eaters
Common Availability	Common, advanced	Specialist rare. Common to	Common	Common	Common	Common	Common	Common	Common	Common, Container & advanced
Base Criteria										
Drought Tolerance Rating	5	5	4	5	4	5	5	5	5	3
Heat Tolerance	5	5	4	5	4	5	5	5	5	4
Wind Tolerance	4	5	3	5	5	5	3	3	3	3
Longevity (lifespan rating	5	2	2	4	4	2	2	2	2	5
Pollution Tolerance	4	3	3	3	4	3	3	3	3	3
Pathogen Susceptability and Management	4	5	5	5	3	5	5	5	5	5
Community Health Concerns- Allergies	4	2	2	2	2	2	2	2	2	2
Shade rating	3	3	2	2	4	2	3	2	3	4
Level of Maintenance	3	3	3	3	4	3	3	3	3	3
Tree Litter Drop- fruit, branch or bark drop.	4	5	5	2	5	2	2	5	5	5
ADAPTABILITY TO URBAN CONDITIONS	**41**	**38**	**33**	**36**	**39**	**34**	**33**	**35**	**36**	**37**
Street Type Criteria										
Salt Exposure Tolerance	4	1	1	2	3	3	3	3	3	2
WSUD Suitability - Parking Lanes	2	4	3	3	1	3	4	2	2	3
ADAPTABILITY WITHIN STREET TYPES	**47**	**43**	**37**	**41**	**43**	**40**	**40**	**40**	**41**	**42**
Exposed coastal Refer to Environmental zones	No	Yes	No	No	Yes	No	Yes	No	No	Yes
Sheltered slope Refer to Environmental zones	No	Yes	No	No	Yes	No	Yes	No	No	Yes
Floodplain Refer to Environmental zones	No	No	No	No	No	No	No	No	No	No
Beneath overhead powerlines	No	No	No	No	No	No	Yes	No	No	No
Entry Boulevarde- wide verge. Refer to Street hierachy	No	Yes	Yes	Yes	No	No	Yes	No	No	Yes
Main Boulevarde Wide verge Refer to Street hierachy	No	Yes	Yes	Yes	No	No	Yes	No	No	Yes
Secondary Street- wide footpath Refer to Street hierachy	No	No	No	No	No	No	No	No	No	No
Secondary Street Narrow Footpath Refer to Street hierachy	No	No	No	No	No	No	Yes	No	No	No
Secondary Street Narrow Footpath Refer to Street hierachy	No	Yes	No	No	No	No	Yes	Yes	No	No
Secondary Street Narrow Footpath Refer to Street hierachy	No	No	Yes	Yes	No	No	Yes	No	No	Yes
Minor Street Refer to Street hierachy	No	No	Yes	Yes	No	No	Yes	No	No	Yes
Minor Street New Development Refer to Street hierachy	No	No	Yes	Yes	No	No	Yes	No	No	Yes
Floodplain Park Trees Refer to Street hierachy	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coastal Reserve Trees Refer to Street hierachy	Yes	No	No	No	Yes	Yes	No	Yes	Yes	No

Step 1 — **Tree Species**
Botanical and common name

Step 2 — **Tree Information data**
Botanical and common name

Step 3 — **Base Criteria**
The criteria by which each street tree/ park species must fulfill to be acceptable for planting by CVC

Step 4 — **Street Type Criteria**
Is there WSUD application or power lines (Yes/No)

Step 5 — **Environment Type Criteria -** Refer to plans
Is it exposed coastal/ sheltered slope or floodplain (Yes/No)

Step 6 — **Street Type Hierarchy** Refer to plans
The street tree list is generated for the particular environment zone/ street type services constraint

Step 7 — **Design and Community Criteria**
This includes objectives such as aesthetics, streetscape character, cultural and heritage

5.7 CRITERIA ASSESSMENT METHODOLOGY

5.7.1 Criteria Assessment Explanation

The method for tree selection for the Yamba Street Tree Master Plan was structured for usability and accountability of selection criteria. An extensive and 'live' list is being populated as this is required to develop enough applications when all the essential criteria has been filtered and unsuitable species eliminated. A tree matrix is generated to start determining the usefulness of a particular tree species.

Step 1. Population of a Suitable Tree Species List

The tree list goes through a number of criteria to reach a short list for typical Yamba street types or potentially any of the other street types in the other Clarence Valley town centres. The tree list is defined by certain criteria that are data or information based. This includes tree type, form, provenance etc. This information does not relate to the street tree principles or the value of the street tree at this stage.

Step 2. Performance / Base Criteria

This is the defining filter for determining the suitability of the street tree in Yamba's changing climatic conditions, as well as varied environmental constraints. The suitability is termed the adaptability to the street or reserve conditions. To help with decision making this rating is given a numerical value. There are ten criteria with the value ranking from one to five, one being low and five high. While there is no such thing as the 'perfect street tree' as mentioned elsewhere in this document, a score of 50 points is a highly adaptable and useful species. Ten criteria were selected after lengthy discussion and review. The number of criteria was not selected to round the score off to a neat '50'. If it is deemed after review in five years time (or sooner) these criteria can expand or reduce. The higher the number of criteria the more accurate the scoring. It can be demonstrated that this criteria is strictly performance or adaptability based. As a street tree this species may not be to everyone's aesthetic tastes or provide the streetscape amenity that other lesser scoring trees can provide. In this case, another set of criteria is called for.

These criteria items include:

- Form and Scale
- Pest & Disease (Pathogen) Resistance
- Maintenance
- Availability of Plant Stock
- Longevity
- Ultimate dimensions
- Nuisance and Tree Dropping
- Sun/ Shade

Step 3. Environment and Services Criteria

To this point it has been determined what the most adaptable street trees are for Yamba's streets. Environmental zones determine where trees will be most successful. The exposed coastal environment has very different constraints to the more benign sheltered floodplain. The trees need to be appropriate to these very different situations and character. This criteria includes:

- Microclimate and Environmental Zones
- Overhead Powerlines
- Verge Width and Building Setback

Step 4. Street Hierarchy Criteria

A further set of criteria is applied that determines tree selection for site. This helps guide selection of the 'right tree for the right place'. The street type criteria applies constraints such as street width and geometry, location of overhead power lines and suitability for WSUD applications. This criteria is expected to cover most scenarios in Yamba's streets. Each of these street types also have certain site constraints such as presence of power lines, if it is a narrow / minor street, etc.

Dimensional criteria are the key determinant in this filter. It can now be determined if a species suits any of the street hierarchy types and an applicable sub list of adaptable street trees can be generated. This criteria Includes.

- Dimensional criteria, verge widths and setbacks
- Appropriate scale and street function

Step 5. Design (subjective) and community based criteria for tree selection

At this point the sub-list can have further 'subjective' filters applied. Council can determine the ranking and importance of these objective, such as heritage, biodiversity goals and aesthetics

- Seasonal and colour interest
- Streetscape character
- Heritage and community value

5.8 TREE SELECTION CRITERIA - PERFORMANCE BASED

Appropriate plant selection must be based on a firm set of principles which establish the function and design intent that the selection should conform to, then rigorous selection criteria which enable the species with the most desirable and appropriate characteristics to be selected, no matter what their origin or type.

Soil Conditions

Elevated areas of Yamba appear to be made up of variable depths of sandy soils, probably remnant of old dune systems. These are typically free draining with poor fertility and low moisture holding capacity.

Low lying areas of Yamba appear to be subject to periodic inundation and therefore to species that are adaptable to these soil conditions. (To be confirmed following more detailed analysis of soil mapping).

Planting Tolerance in Paved Areas - Compaction

Species selected for used within highly urbanised situations such as paved commercial zones must be able to tolerate poor and modified soil conditions (compaction, low oxygenation) and conditions typically found in paved areas.

Pest & Disease Resistance

Selected tree species should be resistant to disease and significant pest infestations. A diversity of species is also important in reducing the impact of devastating diseases (such as Dutch Elm Disease) on specific tree species. The loss of dominant tree species may result in a significant impact on the local landscape. A range of species from a variety of plant families is desirable to minimise risk.

Maintenance

The selected species should require minimal maintenance following the establishment period. Species should also be adaptable to pruning and shaping where required, to achieve clearances and appropriate form and habit.

Availability of Plant Stock

Plant stock of the selected species must be commercially grown and available in a suitable size for street planting.

Nuisance

The selected species must have an acceptable level of nuisance created by the shedding of leaves and fruit for a street environment. Those with large or heavy seed pods, excessive leaf drop, or fleshy fruit or flowers, which may lead to slip hazards or other nuisance should be avoided.

Weed Potential

Some species of trees are known to be, or have the potential to be serious environmental weeds due to their ability to self-propagate and invade bushland areas, competing with native species.

Longevity

The planting and establishment of street trees is a significant investment of time and resources by council and the community. Therefore species which are long lived are preferred over those with short lifespans. The lifespan of some species in urban areas is much reduced compared with their natural habitat.

Damage Potential

Species that have large and vigorous root systems may result in significant damage to public infrastructure, including roads, kerbs, footpaths, paved areas and underground services.

Branch Shedding

Although the mechanisms are not clearly understood, some species are known to have a greater propensity to shed limbs and branches than others and should therefore be avoided.

Solar Access and Shading

Solar access is of prime concern for dwellings located on the southern side of streets with an east-west axis. Maximising light in winter is an important consideration. Deciduous trees allow solar access in winter and shade in summer.

Habitat

All trees provide some benefit to fauna and bird life by providing food sources, shelter, protection or nesting sites. Species that are locally indigenous to an area are likely to provide the most benefit. However, these species are not always adaptable for planting in a highly urbanised location. The use of some locally indigenous species would be desirable, but a diversity of species is recommended, particularly those with known performance and characteristics in a street environment.

Chapter 5 STREET TREE STRATEGY AND SELECTION

5.9 ENVIRONMENT BASED CRITERIA FOR TREE SELECTION

Climatic Conditions

Yamba has a mean rainfall of about 1450mm per annum, with the highest rainfall occurring in autumn. Maximum temperatures may reach 42 degrees Celsius in summer to a low of 10 degrees Celsius in winter, but the long term averages are around 19-30 degrees Celsius in summer and 10 to 20 degrees in winter, giving it a fairly typical sub-tropical climate. Given that a warmer, wetter climate is expected to occur with climate change, selected species must be suitable to sub-tropical to tropical climatic zones. Species that tolerate sub-tropical situations but prefer temperate climatic zones, or those that prefer dry inland climates should be excluded from the palette of species.

Microclimate and Environmental Zones

Upper ridge top areas of the knoll at Yamba (East) are very exposed to salt laden coastal winds and this restricts the palette of species that can be used in this area. Sheltered side slopes on the south-western side of the knoll of Yamba (East) do no suffer direct exposure to salt laden winds, but these species selected for this area will need to be semi tolerant to coastal conditions. Low lying areas likewise have less exposure to salt laden winds, but still need species that are semi tolerant to salt laden winds.

The microclimate zones are a key selection criteria for the location of street trees. Shown as three zones in the tree selection matrix it includes the following zones.

ZONE 1 Exposed Coastal Landscape

This is the most challenging environmental zone as it is the most exposed to prevailing salt laden winds. The soils are also generally wind blown sands on top of the sandstone bluff that extends from Pilot Hill to Dolphin Park. These extreme environments result in a smaller selection of trees that can handle these conditions. With the exception of Norfolk Island Pine, most trees that can tolerate this zone are compact and dense.

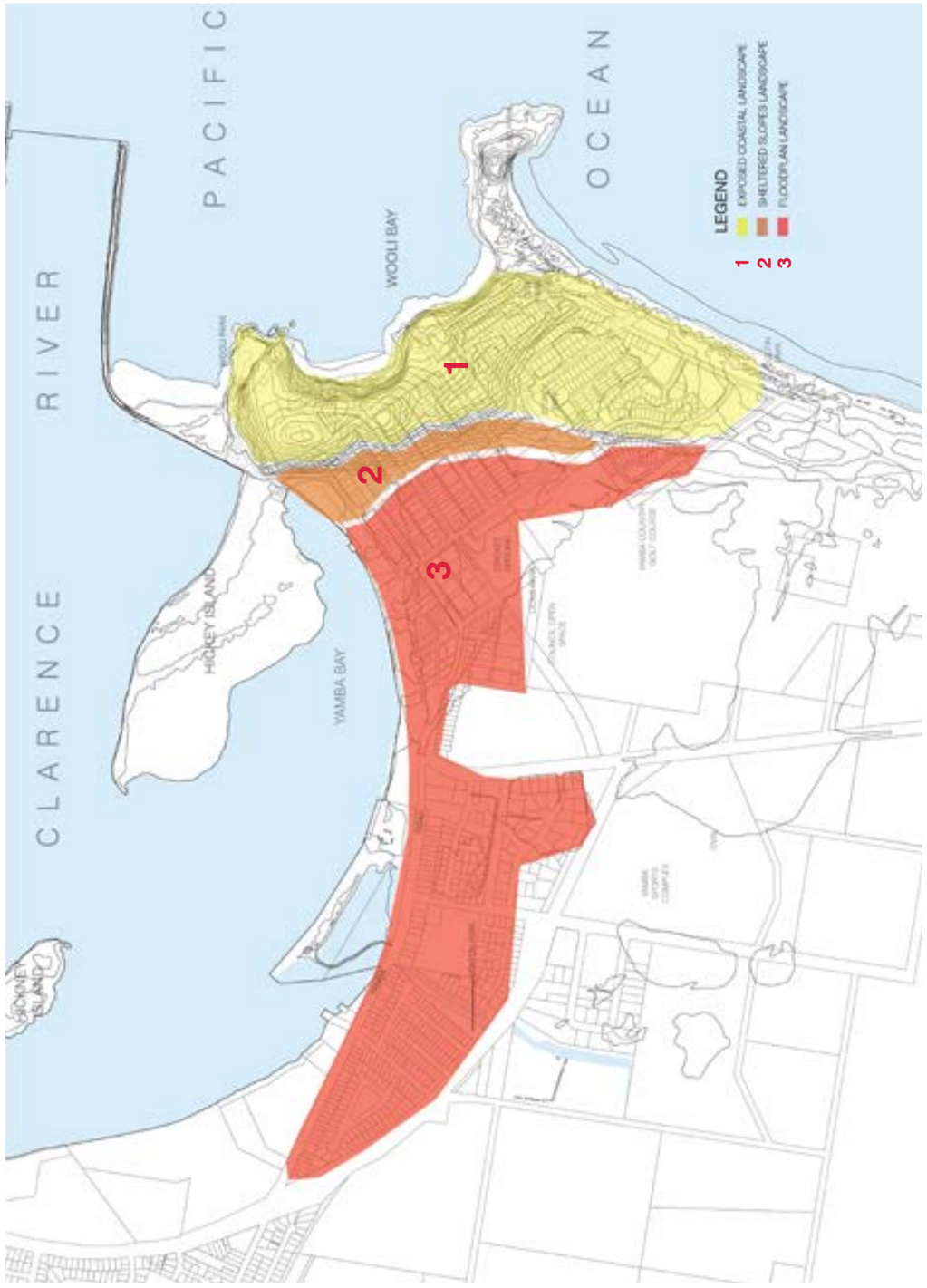
ZONE 2 Sheltered Slopes Landscape

This zone is on the lower contours of the bluff facing south-west towards Yamba boat harbour. While this area is subjected to some salt winds, there is protection from the prevailing north and south easterly sea breezes. Larger leafed species of trees tolerant of mild airborne salt can grow successfully here. The diversity of trees and selections increases.

ZONE 3 Floodplain Landscape

This climatic zone is the most benign with generally deeper soil, a higher water table (much of it is located on cleared or remnant wetlands). This area is more sheltered than the other two zones. While not as favourable for growing trees as Grafton, this zone has the highest diversity of street tree ‘candidates’.

These three zones are all relevant to Yamba East. The Zone 3 is relevant to West Yamba only because it is located wholly within the floodplain zone.



Environmental Zones of Yamba (East) is a key selection criteria in the tree matrix.

5.10 SITE BASED CRITERIA FOR TREE SELECTION

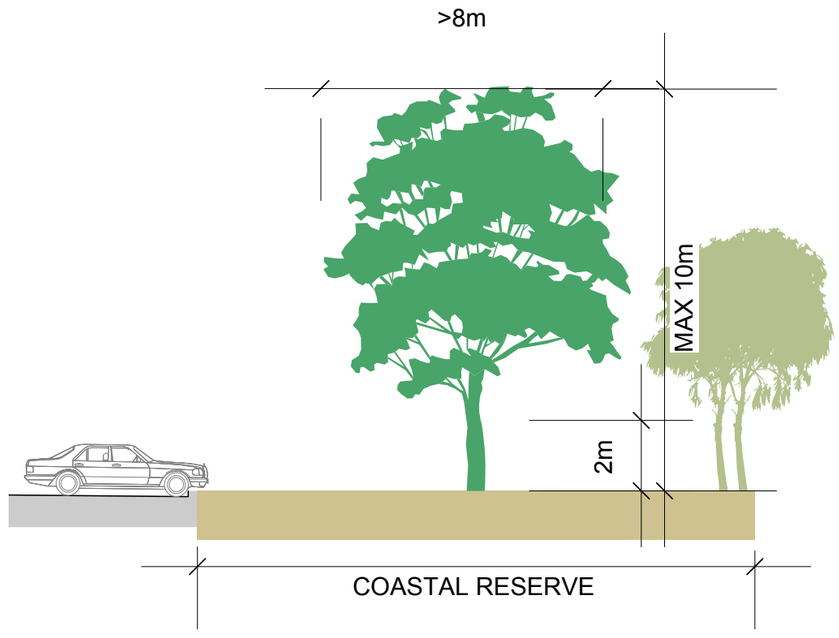
Ultimate Dimensions

The ultimate dimensions of a tree are important in defining its visual contribution to the streetscape. However, the existing constraints within the street (verge widths, extent of pavements, location of underground and overhead services and setbacks to buildings) may limit the size of the tree that can be supported, without causing significant interference with pedestrian and vehicular access, services and conflicts with paved surfaces and footings. The optimum size of the tree will be a balance between these elements. A range of tree sizes has been selected to accommodate a range of street environments.

Typically the maximum size tree selected for the street will be a reflection of the above and below ground space available for future growth and development, to achieve the maximum desirable size at maturity without resulting in significant impacts on surrounding infrastructure and property. Verge and median widths, building setbacks and proximity of overhead and underground services will influence the selection of appropriate species on a street by street basis. Most streetscape verges and medians within Yamba (East) are relatively wide, whereas newer areas in West Yamba are relatively narrow. This will dictate to a large extent the size of street plantings.

In some instance tree planting is inappropriate on narrow or heavily constrained verges. Other options such as planting within the median or roadway may be considered where appropriate. Proximity of the building setback to the boundary/verge may limit the planting of trees due to potential conflict with built structures, blocking solar access or nuisance issues.

The dimensional requirements of the street hierarchy will determine the suitability of the tree for its application. These qualities will be one of the key or base criteria for selection of the street trees within the tree matrix.



The dimensions of the tree, the canopy spread and height determine the suitability for the available verge width. Conversely, a tree that is too small for the available space gives limited amenity to the street and ultimately does not take advantage of an opportunity.

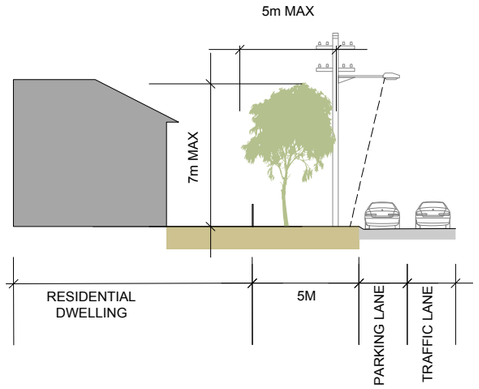
Form and Scale

The selected species must have appropriate and predictable growth habit and form, with a single upright trunk (to minimise conflicts with pedestrian and vehicular traffic) and sound branching structure (to minimise hazards created by inherent defects). Trees with low spreading branching habit, or those with pendulous foliage or branches are generally not suitable for use as street trees, due to the need to maintain clearances for vehicular and pedestrian traffic, and adequate visibility for traffic and signage. Trees with multiple trunks or known branching defects are generally not suitable for street plant.

Overhead Power Lines

Overhead lines may limit the size and/or types of trees grown beneath, due to their branching habit and tolerance to severe pruning. Some planting beneath or adjacent power lines may be considered, but with special attention to the form and branching habit of the selected species.

While this street is constrained in size, the selection of Callistemon is out of scale and does not provide amenity.



Trees beneath powerlines are possible, if the tree tolerates pruning or the tree is small enough to not conflict with powerlines, but still has a clear trunk.

5.11 DESIGN (SUBJECTIVE) AND COMMUNITY BASED CRITERIA FOR TREE SELECTION

Street tree planting can establish a local identity and a sense of community. All of the towns of the Clarence Valley have tree planting that has some historical and cultural associations. The streetscapes of Grafton is an excellent example of a memorable 'local' character being established with the planting of Jacaranda, Poinciana and Leopardwood. The .streetscapes of Maclean have individual specimens of Figs and Araucaria that give a distinct character, Iluka has remnant Callitris and of course Yamba the *Araucaria* forest.

Historical / Cultural Associations

The selection of species may have natural, historical or cultural associations with the locality/ landscape. New plantings should consider the historical context of the locality. Norfolk Island Pines are part of the identity of Yamba (East). The continued use of this species has merit where space permits, but not necessarily in normal residential minor streets.

These urban forest areas are located in the older established parts of these towns. The new development areas of all these towns contrast greatly with the 'heritage' precincts and have little or no street tree planting that will determine a unique character in the future. Developing a complimentary tree planting identity to the older towns will be important to create a robust sense of community and the social sustainability of streets.

Seasonal Colour and Interest

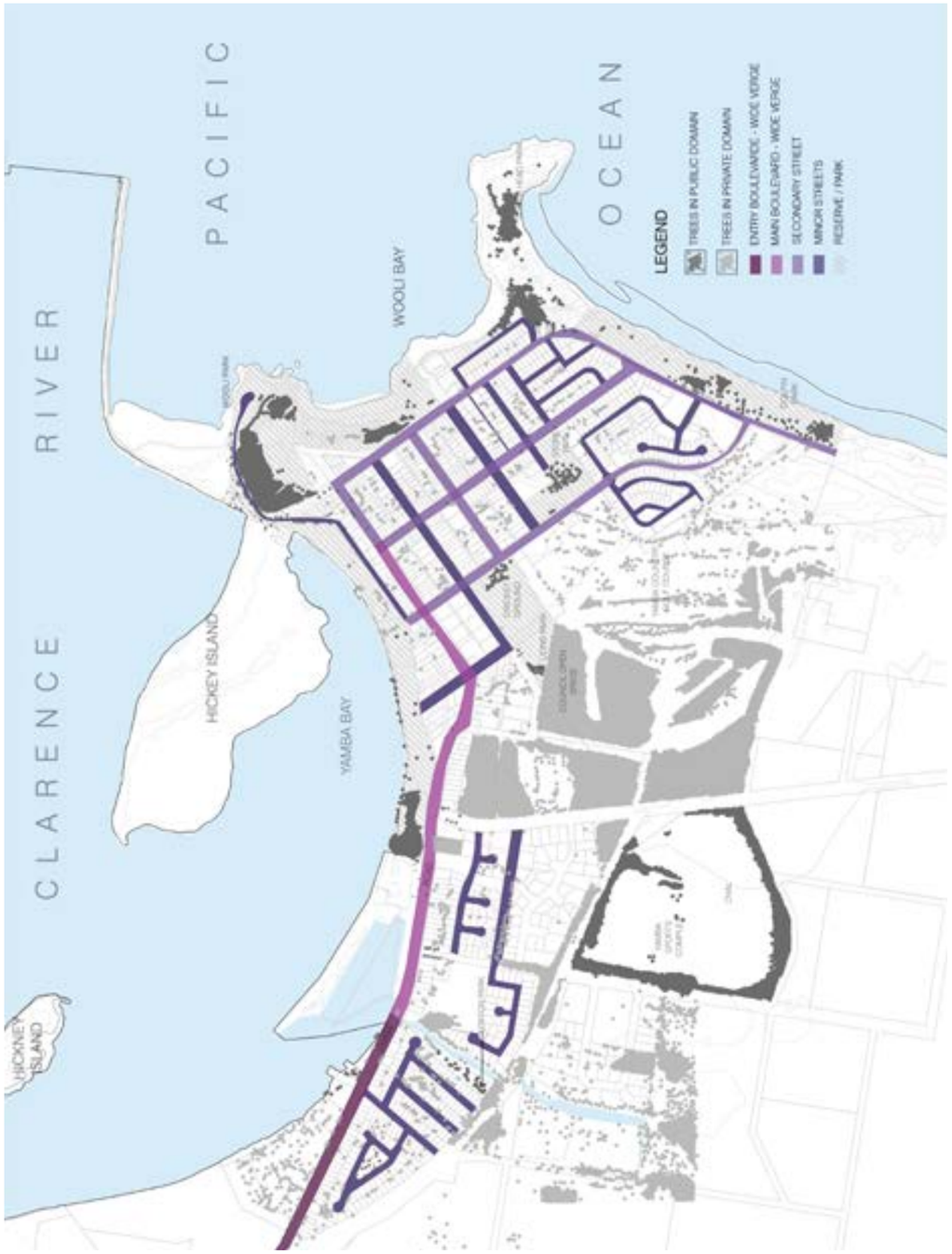
The selection of species should provide for variation and seasonal change. This adds an important dimension to the landscape.

5.12 TREE SELECTION MATRIX - MASTER SPECIES LIST

It is accepted that species elections matrix are the most effective way of organising tree species characteristics, tolerances and susceptibilities. This information can then be interpreted and utilised for species selection in particular streetscape situations. This helps determine the relationship between the street and the tree, its adaptability to a challenging site. The tree selection matrix can be used to manually or adapted to be used digitally and to allow future adjustments.

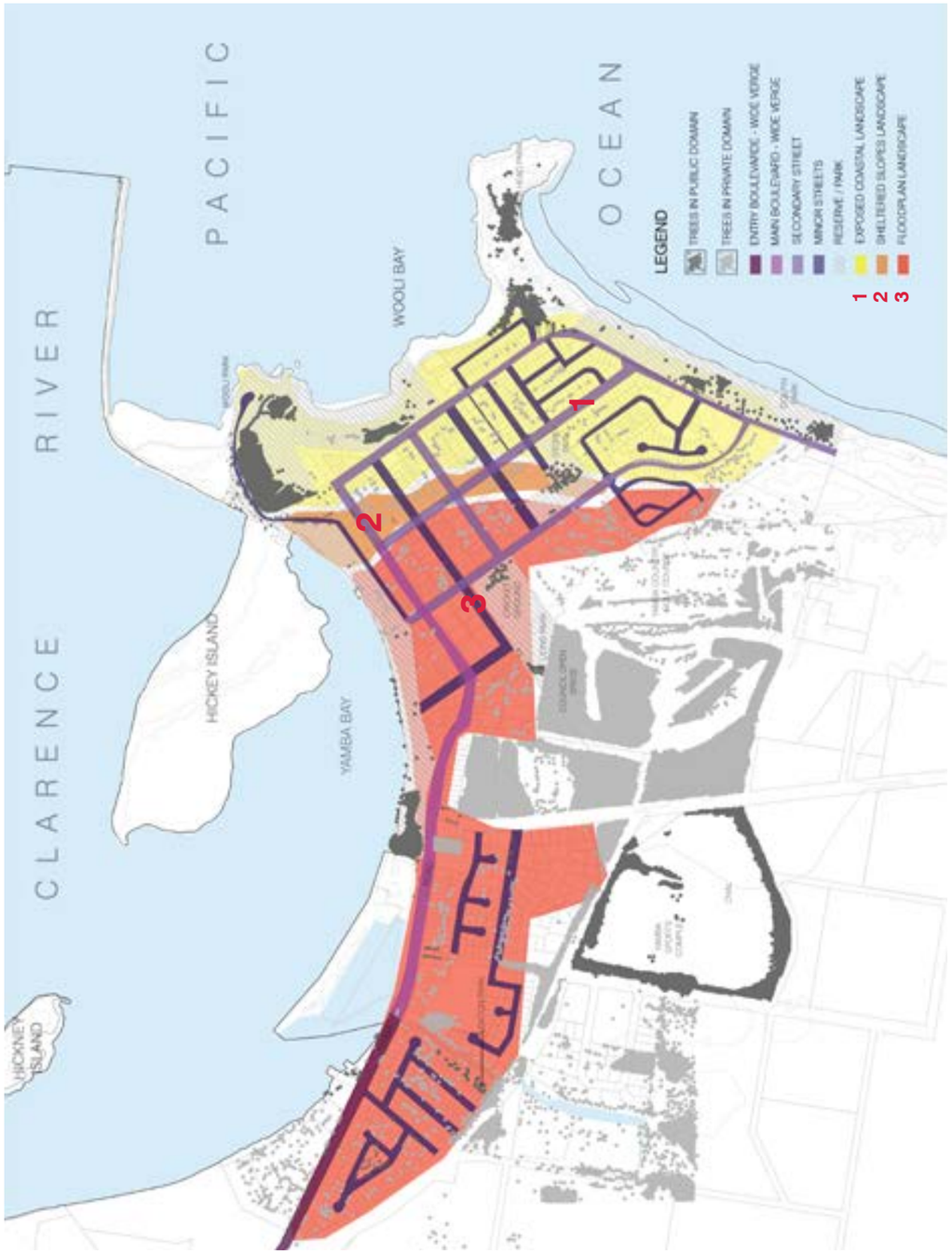
There are three tree selection matrix lists to group the information for Yamba's objectives. These include streetscapes which are the principle component of the urban forest within the public domain. Trial trees are included to expand the diversity of the tree species population, through streetscape trialling. The aim is for this tree selection matrix is to be dynamic, with an update in five years time, when the performance of these trees can be determined.

There is a list of park trees which contribute significant blocks of tree planting to the cities greenery. While most of the street trees can be grown in parks, the reverse is not always possible. The park tree list includes species that require greater root volumes or are larger. Their selection still follows the same criteria as the street trees and conforms to the Yamba's urban forest strategy.



Yamba (East) Street Tree Hierachy.

West Yamba Street Tree Hierachy

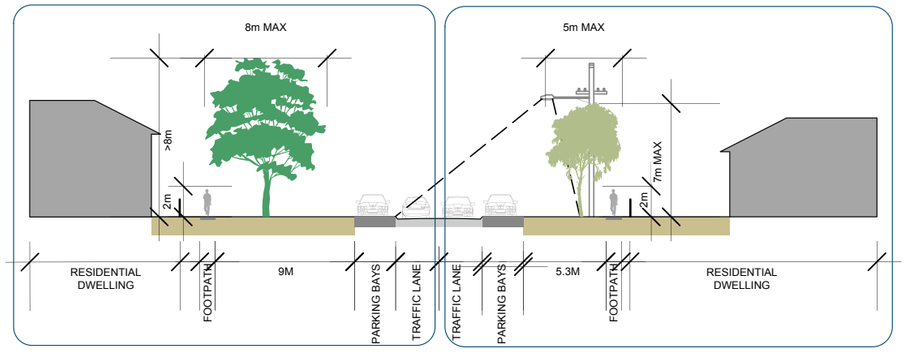


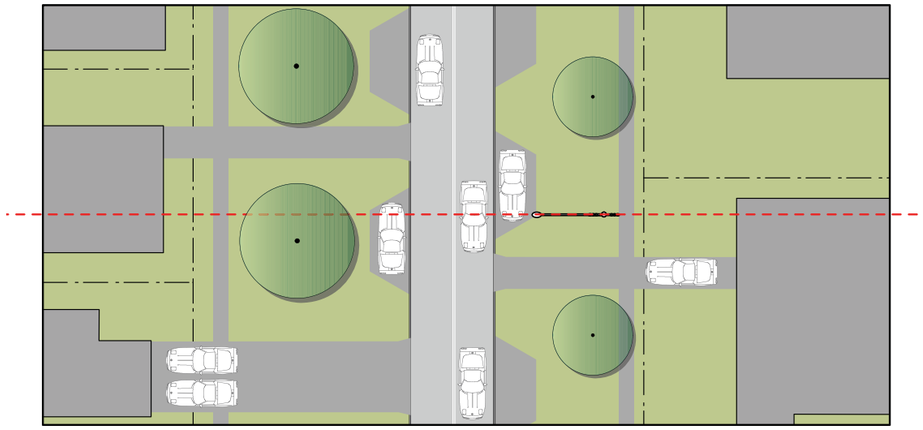
Yamba (east) Street Tree Master Plan- Showing street hierachy and environmental zones 1, 2 and 3.

Refer to street tree selection matrix for tree list for streets. Note that the tree selections for a street changes as an environmental zone changes so that the trees are best suited to the site.

Yamba (west) Street Tree Master Plan- Showing street hierachy and environmental zone 3

Refer to street tree selection matrix for tree list for streets.





ENTRY MAIN BOULEVARDS (E.G. YAMBA ROAD)

Tree Street Selection Criteria Filters

Northern Side (no powerlines)

Verge width greater than 3.6 metres

Higher hierarchy of street - Entry boulevard Yamba

Wide carriageway requiring tree height >10 metres and width > 8 metres

No powerlines

Shade rating - any

Suitable for the floodplain

Objectives:

- The northern (bay) side of Yamba Road presents opportunities for significant entry planting
- Large verges will allow large canopy trees leading up to the marina
- Trees short listed are selected based on suitability as ‘entry’ feature trees. This criteria is based upon generosity of shade, and potential for flowering. Suitability in form or their unique form or consistency of form
- These trees also need to be tolerant of potentially waterlogged soil or a high water table
- All palms should be used informally in groups not as avenues

Potential Tree Selection (no powerlines)

ZONE 3 FLOODPLAIN ONLY

Alphitonia excelsa
Brachychiton discolor
Brachychiton populneus
Castanospermum australe
Casuarina cunninghamiana
Ceratopetalum apetalum
Cupaniopsis anachardioides
Elaeocarpus grandis
Elaeocarpus kirtonii
Eucalyptus microcorys
Ficus obliqua
Ficus rubiginosa
Flindersia australis
Flindersia schottiana
Flindersia xanthoxylum
Grevillea baileyana
Jacaranda mimosifolia
Livistona australis
Magnolia grandiflora
Melaleuca quinqenervia
Podocarpus elatus
Podocarpus falcatus
Stenocarpus sinuatus
Syncarpia glommulifera
Toona ciliata

The top five selections for their adaptability are:

Brachychiton discolor
Brachychiton populneus
Stenocarpus sinuatus
Livistona australis
Ficus obliqua

Southern Road Verge Side (with powerlines)

Verge width less than 3.6 metres

Higher hierarchy of street- Entry boulevard Yamba.

Tree height >7 metres and width less than 5 metres

Or tolerant of pruning

Shade rating greater than 3 out of 5

Tolerance of pavements adjacent greater than 1

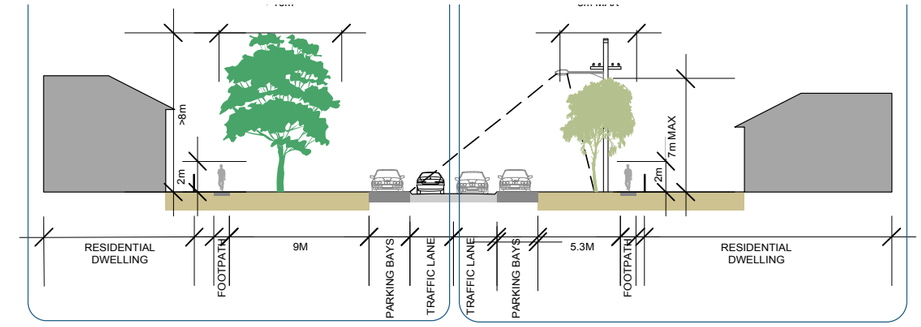
Suitable for the floodplain

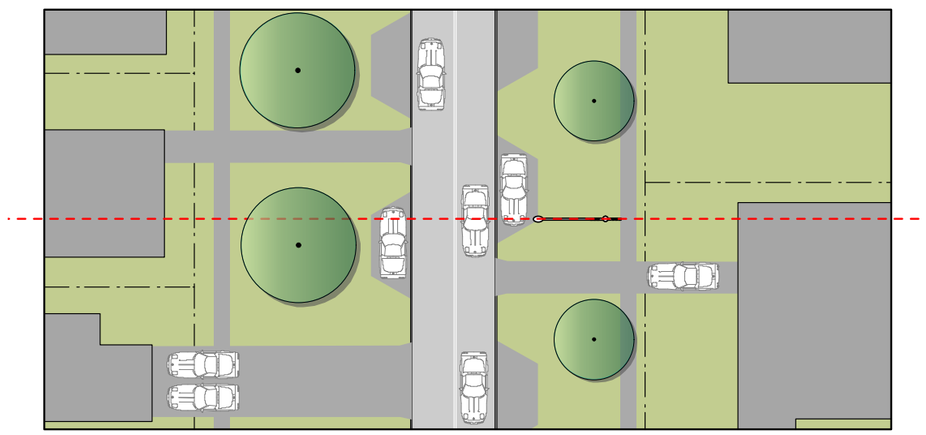
Objectives:

- The southern side of Yamba Road has spatial constraints and is mostly under powerlines
- There are still wide verges so trees are not constrained by pavements in close proximity
- Trees short listed are selected based on suitability as ‘entry’ feature trees. This criteria is based upon generosity of shade, and potential for flowering. Suitability in form or their unique form or consistency of form
- These trees also need to be tolerant of potentially waterlogged soil or a high water table

Potential Tree Selection (no powerlines)

Bauhinia purpurea var alba
Bauhinia variegata
Lagerstoemia indica
Tibouchina macrantha





MAIN BOULEVARDS (E.G YAMBA ROAD/ WOOLI STREET AND YAMBA ROAD WEST YAMBA)

Tree Street Selection Criteria Filters

Southern Road Verge Side (no powerlines)

Verge width greater than 3.6 metres
Higher hierarchy of street- main boulevard of Yamba
Wide carriageway requiring tree height > 10 metres and width > than 8 metres
No powerlines
Shade rating greater than three out of five
Suitable for the floodplain
Suitable as an entry feature tree

Objectives:

- The northern (bay) side of Yamba Road presents opportunities for significant boulevard scale trees
- Large verges will allow large canopy trees leading up to the marina
- Tree options are not constrained to have the characteristics of the entry feature trees
- These trees also need to be tolerant of potentially waterlogged soil or a high water table

Potential Tree Selection (no powerlines)

ZONE 3 FLOODPLAIN ONLY

Acmena smithii
Alphitonia excelsa
Araucaria cunninghamii
Araucaria heterophylla
Brachychiton discolor
Brachychiton populneus
Castanospermum australe
Casuarina cunninghamiana
Casuarina glauca
Ceratopetalum apetalum
Corymbia gummiferum
Cupaniopsis anachardioides
Elaeocarpus grandis
Elaeocarpus kirtonii
Eucalyptus microcorys
Eucalyptus robusta
Ficus obliqua
Ficus rubiginosa
Flindersia australis
Flindersia schottiana
Flindersia xanthoxylum
Grevillea baileyana
Jacaranda mimosifolia
Lophostemon confertus
Magnolia grandiflora
Melaleuca quinqenervia
Melaleuca styphelioides
Podocarpus elatus
Podocarpus falcatus
Syncarpia glommulifera
Syzygium paniculatum
Toona ciliata
Waterhousea floribunda

The top four selections for their adaptability are:

Brachychiton discolor
Brachychiton populneus
Alphitonia excelsa
Ficus obliqua

Northern Road Verge Side (with powerlines)

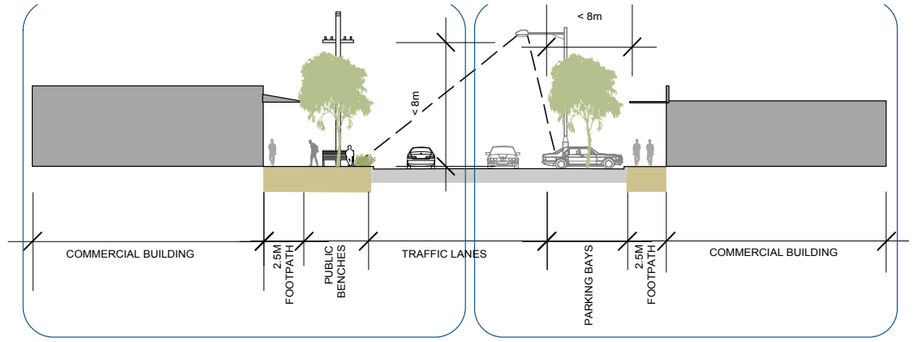
Verge width less than 3.6 metres
Higher hierarchy of street- Entry boulevard Yamba
Tree height less than 7 metres and width less than 5 metres
Or tolerant of pruning
Shade rating greater than 3 out of 5
Tolerance of pavements adjacent greater than 1
Suitable for the floodplain

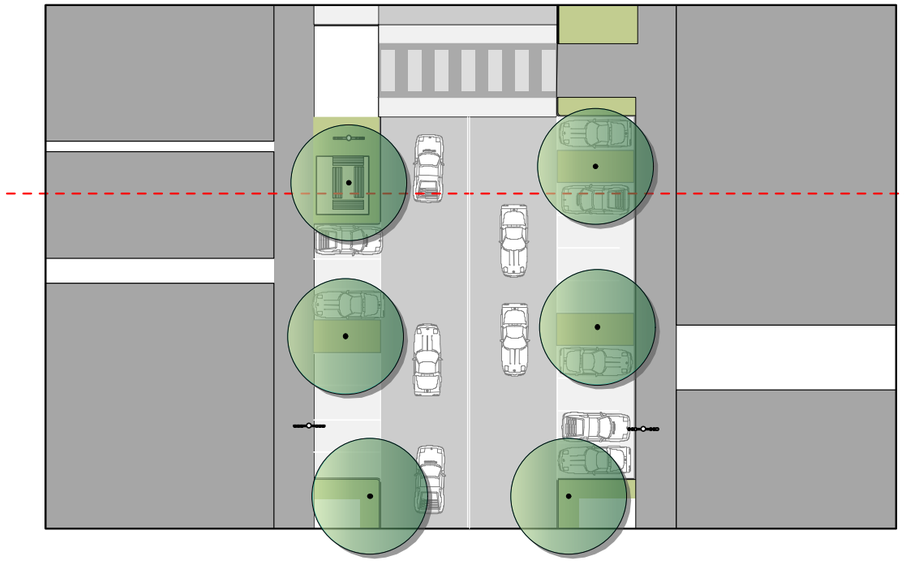
Objectives:

- The southern side of Yamba Road has spatial constraints and is mostly under powerlines
- There are still wide verges so trees are not constrained by pavements in close proximity
- Tree options are not constrained to have the characteristics of the entry feature trees
- These trees also need to be tolerant of potentially waterlogged soil or a high water table

Potential Tree Selection (no powerlines)

Afrocarpus falcatus
Elaeocarpus reticulatus
Glochidion ferdinandi
Melaleuca styphelioides





SECONDARY STREET (COMMERCIAL) NARROW FOOTPATH (E.G YAMBA STREET, YAMBA AND TREELANDS DRIVE WEST YAMBA)

Tree Street Selection Criteria Filters

Road Verge Side (powerlines)
Verge width less than 3.6 metres
Secondary street commercial
Tree height < 8m
Canopy width < 8m
Adjacent paved surfaces rating >3
Powerlines
Shade rating > 3
WSUD Suitability
Suitable for the floodplain

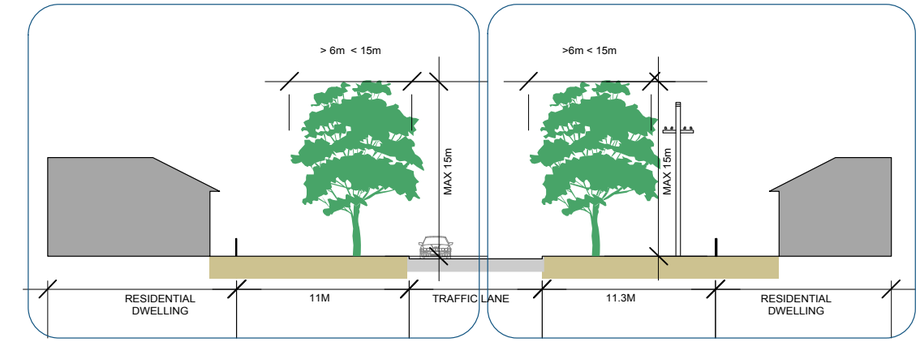
Objectives:

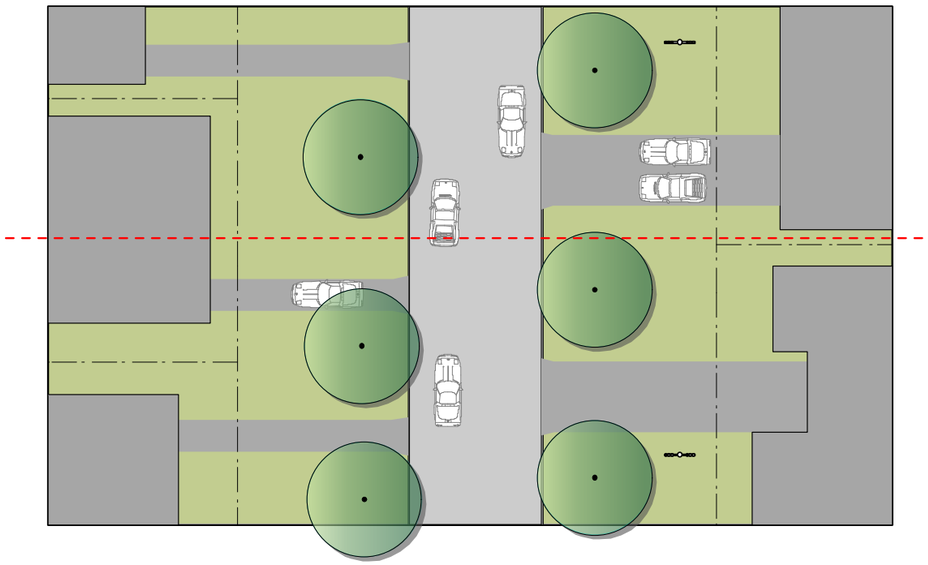
- Trees can be used in landscape blister or preferably in dedicated parking bay tree holes to create a shaded canopy cover along the street
- Avoid corner landscape blisters that block sightlines and can be unsafe
- Trees need to have good amenity value such as the quality of shade
- These trees also need to be tolerant of potentially waterlogged soil or a high water table, particularly if combined with a WSUD tree pit
- Trees need to be tolerant of adjacent paving and have formative pruning to achieve an ultimate clean trunk of 2.5 metres minimum
- Trees are to either be beneath powerlines or be able to be pruned

Potential Tree Selection For Zone 3

Bauhinia purpurea var alba
Bauhinia variegata
Cupaniopsis anachardioides
Elaeocarpus reticulatus
Glochidion ferdinandi
Lagerstroemia indica x L. fauriei cultivars
Tibouchina macrantha

It is desirable for trees to be planted along the length of the streetscape on a commercial street to provide shade for outdoor seating and create a more attractive street. Due to the restrictions of footpath width, pavements, clear access, signage and awnings this is best done with hit and miss planting within the car parking lane.





SECONDARY STREET (RESIDENTIAL) WIDE FOOTPATH (E.G YAMBA STREET, YAMBA AND GUMNUT ROAD WEST YAMBA)

Tree Street Selection Criteria Filters

Road Verge Side (no powerlines)

Verge width greater than 3.6 metres and up to 8 metres
Secondary street residential
Wide verge width requiring tree height >6 metres and up to 15 metres in height
Canopy width is to be > 8m and < 15m
No powerlines
Shade rating greater than three out of five
Suitable for the floodplain

Objectives:

- The wide verges are good opportunities for medium sized trees
- Trees need to have good amenity value such as the quality of shade
- These trees also need to be tolerant of potentially waterlogged soil or a high water table

ZONE 1 EXPOSED COASTAL

Alectryon coriaceus
Banksia integrifolia subsp. integrifolia
Banksia serrata
Cupaniopsis anachardioides
Ficus rubiginosa
Livistona australis
Metrosideros excelsa

ZONE 2 SHELTERED SLOPES

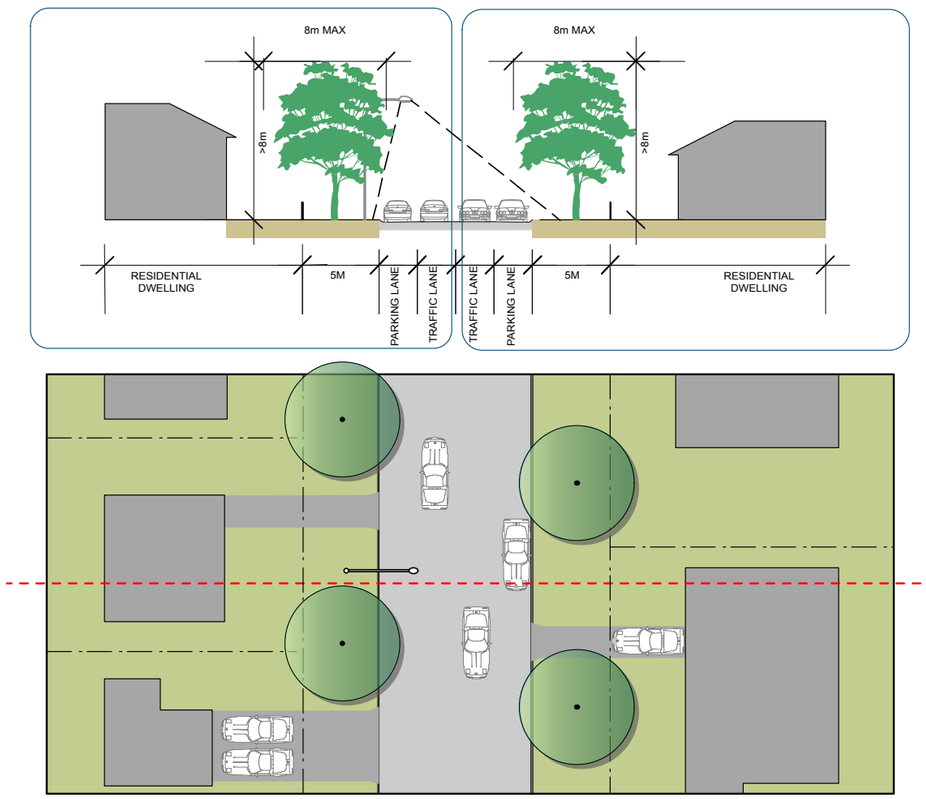
Acmena smithii
Afrocarpus falcatus
Alectryon coriaceus
Alphitonia excelsa
Angophora hispida (Syn. A. cordifolia)
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton populneus
Casuarina glauca
Cupaniopsis anachardioides
Ficus obliqua
Ficus rubiginosa
Glochidion ferdinandi
Livistona australis
Lophostemon confertus
Magnolia grandiflora
Melaleuca quinqenervia
Melaleuca styphelioides
Metrosideros excelsa
Podocarpus elatus
Podocarpus falcatus
Polyscias elegans
Stenocarpus sinuatus
Syzygium australe
Syzygium jambos
Syzygium oleosum
Syzygium leuhmannii
Syzygium paniculatum
Tristaniopsis laurina

ZONE 3 FLOODPLAIN

Acmena smithii
Afrocarpus falcatus
Alectryon coriaceus
Alloxylon flammeum
Alphitonia excelsa
Backhousia citriodora
Brachychiton discolor
Brachychiton populneus
Brachychiton x roseus
Castanospermum australe
Casuarina glauca
Ceratopetalum apetalum
Cupaniopsis anachardioides
Elaeocarpus grandis
Elaeocarpus kirtonii
Ficus obliqua
Ficus rubiginosa
Flindersia schottiana
Flindersia xanthoxylum
Glochidion ferdinandi
Grevillea baileyana
Hymenosporum flavum
Jacaranda mimosifolia
Lagerstroemia indica x L. fauriei cultivars
Livistona australis
Lophostemon confertus
Magnolia grandiflora
Melaleuca decora
Melaleuca quinqenervia
Melaleuca styphelioides
Metrosideros excelsa
Melia azedarach
Podocarpus elatus
Podocarpus falcatus
Polyscias elegans
Stenocarpus sinuatus
Syzygium australe
Syzygium jambos
Syzygium oleosum
Syzygium leuhmannii
Syzygium paniculatum
Tristaniopsis laurina
Waterhousea floribunda

Note:

- While these are the most adaptable trees, larger dimensioned trees may be appropriate in the larger secondary streets
- These trees could also be applicable to the large medians that occur in these secondary streets
- Trees for Zone 3 apply to West Yamba only



SECONDARY STREET (RESIDENTIAL) NARROW FOOTPATH (E.G RIVER STREET EAST, YAMBA AND WITONGA DRIVE WEST YAMBA)

Tree Street Selection Criteria Filters

Road Verge Side (no powerlines)

Verge width greater than 3.6 metres and less than 5m

Secondary street residential

Narrow verge width requiring tree height > 6 metres and up to 10 metres in height

Canopy width is up to 10m

No powerlines

Shade rating greater than three out of five

Suitable for the floodplain

Objectives:

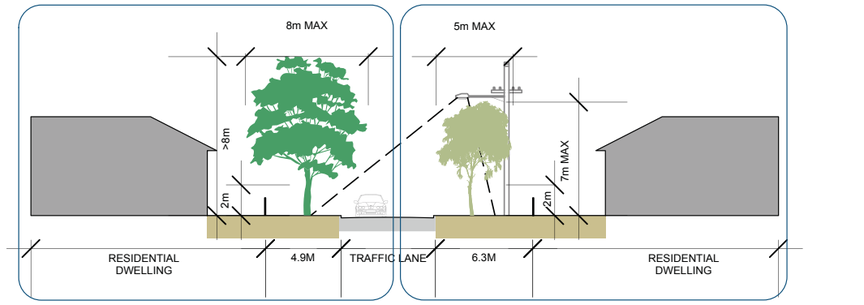
- The wide verges are good opportunities for medium sized trees
- Trees need to have good amenity value such as the quality of shade
- These trees also need to be tolerant of all three environmental zones with very different growing conditions

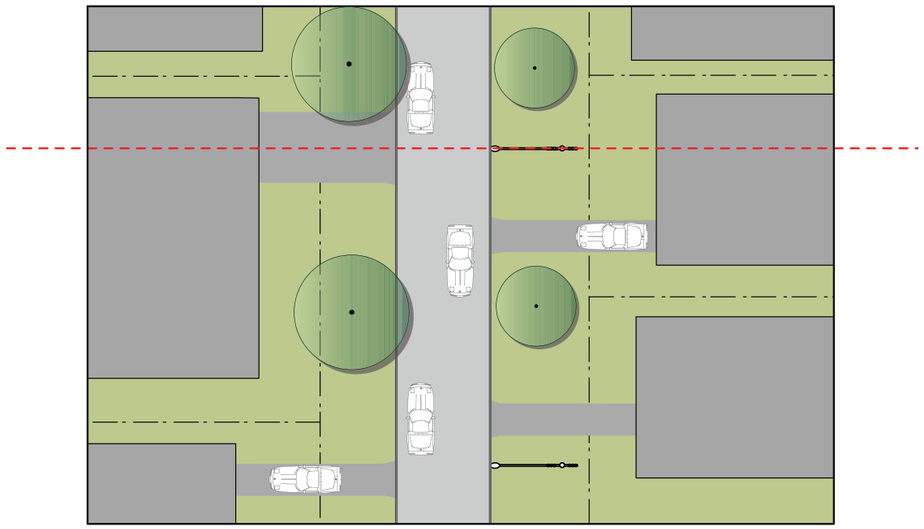
Potential Tree Selection (no powerlines)

ZONE 1 EXPOSED COASTAL	*ZONE 2 SHELTERED SLOPES*	*ZONE 3 FLOODPLAIN*
Alectryon coriaceus	*Alectryon coriaceus*	*Alectryon coriaceus*
Banksia integrifolia subsp. integrifolia	*Angophora hispida (Syn. A. cordifolia)*	*Alloxylon flammeum*
Banksia serrata	*Banksia integrifolia subsp. integrifolia*	*Backhousia citriodora*
Cupaniopsis anachardioides	*Banksia serrata*	*Bauhinia purpurea var alba*
Metrosideros excelsa	*Cupaniopsis anachardioides*	*Bauhinia variegata*
	Elaeocarpus reticulatus	*Brachychiton x roseus*
	Glochidion ferdinandi	*Cupaniopsis anachardioides*
	Melaleuca styphelioides	*Elaeocarpus reticulatus*
	Metrosideros excelsa	*Glochidion ferdinandi*
	Polyscias elegans	*Hymenosporum flavum*
	Syzygium australe	*Lagerstroemia indica x L. fauriei cultivars*
	Syzygium jambos	*Melaleuca decora*
	Syzygium oleosum	*Melaleuca styphelioides*
	Syzygium leuhmannii	*Metrosideros excelsa*
	Tristaniopsis laurina	*Melia azedarach*
		Polyscias elegans
		Syzygium australe
		Syzygium jambos
		Syzygium oleosum
		Syzygium leuhmannii
		Tibouchina macrantha
		Tristaniopsis laurina

The trees that can be used across all three environmental zones include:
Alectryon coriaceus
Cupaniopsis anachardioides
Metrosideros excelsa

Note:
While *Cupaniopsis anacardioides* is a very useful street tree, there is the danger of overusing it to the point of running a risk of vulnerability to pests and diseases across the urban forest and not taking opportunities for increasing diversity and interest in the landscape or taking opportunities for larger amenable trees where space permits.





MINOR STREET (RESIDENTIAL) (E.G CHURCH STREET YAMBA AND MELALEUCA DRIVE , WEST YAMBA)

Tree Street Selection Criteria Filters

Road Verge Side (no powerlines)

Verge width greater than 3.6 metres and less than 5m
Minor street residential
Narrow verge width requiring tree height > 5 metres and up to 10 metres in height
Tree canopy < 8 metres to prevent overshadowing of the private properties
No powerlines on one side only
Shade rating greater than three out of five
Suitable for the floodplain

Objectives:

- The wide verges are good opportunities for medium sized trees not under powerlines and small trees with
- Trees need to have good amenity value such as the quality of shade
- These trees also need to be tolerant of the varied environmental conditions across all three zones

Road Verge Side (no powerlines)

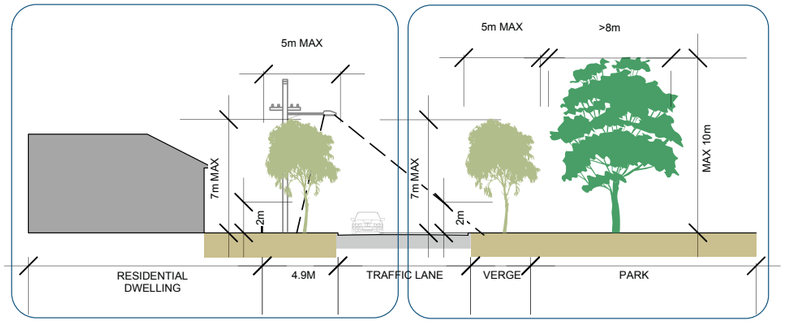
ZONE 1 EXPOSED COASTAL	*ZONE 2 SHELTERED SLOPE*	*ZONE 3 FLOOD PLAIN*
Alectryon coriaceus	*Alectryon coriaceus*	*Alloxylon flammeum*
Banksia integrifolia subsp. integrifolia	*Angophora hispida (Syn. A. cordifolia)*	*Backhousia citriodora*
Banksia serrata	*Banksia integrifolia subsp. integrifolia*	*Bauhinia purpurea var alba*
Metrosideros excelsa	*Banksia serrata*	*Bauhinia variegata*
Pandanus pedunculatus	*Elaeocarpus reticulatus*	*Elaeocarpus reticulatus*
	Glochidion ferdinandi	*Glochidion ferdinandi*
	Metrosideros excelsa	*Hymenosporum flavum*
	Polyscias elegans	*Lagerstroemia indica x L. fauriei cultivars*
	Syzygium australe	*Melaleuca decora*
	Syzygium jambos	*Metrosideros excelsa*
	Syzygium oleosum	*Polyscias elegans*
	Syzygium leuhmannii	*Syzygium australe*
		Syzygium jambos
		Syzygium oleosum
		Syzygium leuhmannii
		Tibouchina macrantha

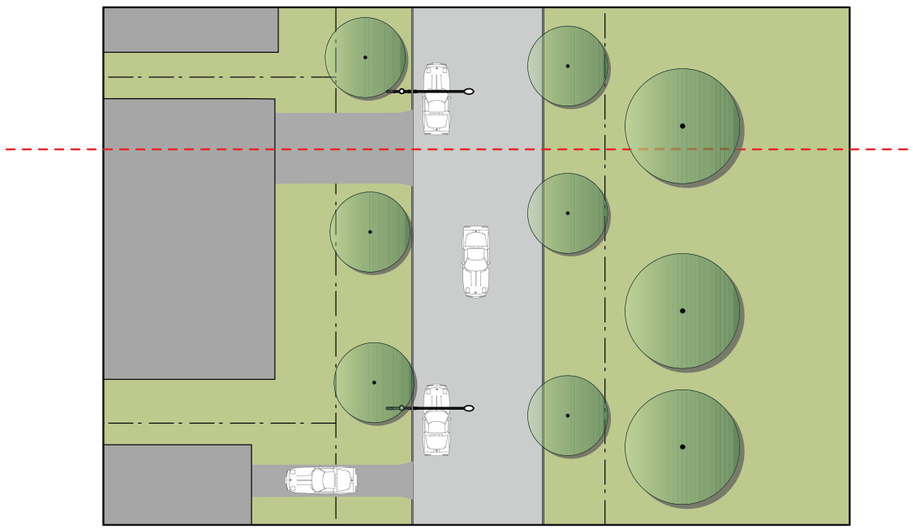
Road Verge Side (with powerlines)

Verge width greater than 3.6 metres and less than 5m
Minor street residential
Narrow verge width requiring tree height > 5 metres and up to 8 metres in height
Tree canopy < 8 metres to prevent overshadowing of the private properties
Shade rating greater than three out of five
Suitable for the floodplain

ZONE 1 EXPOSED COASTAL	*ZONE 2 SHELTERED SLOPE*	*ZONE 3 FLOOD PLAIN*
Banksia serrata	*Angophora hispida (Syn. A. cordifolia)*	*Bauhinia purpurea var alba*
Metrosideros excelsa	*Banksia serrata*	*Bauhinia variegata*
Pandanus pedunculatus	*Elaeocarpus reticulatus*	*Elaeocarpus reticulatus*
	Glochidion ferdinandi	*Glochidion ferdinandi*
		Lagerstroemia indica x L. fauriei cultivars
		Tibouchina macrantha

The positive impacts that the right species of mature trees have on a streetscape can be demonstrated in this photo study.





PARK EDGE FLOOPLAIN (RESIDENTIAL) (E.G STOREY AND LIONS PARK YAMBA AND HAKEA AND WATTLE PARK WEST YAMBA)

Tree Street Selection Criteria Filters

Road Verge Side (no powerlines)

Verge width greater than 3.6 metres
Minor street residential
Parkland interface requiring tree height > 15 metres and height unlimited
Tree canopy > than 10 metres
No powerlines on or one side only that can be avoided
Shade rating greater than three out of five
Suitable for the floodplain

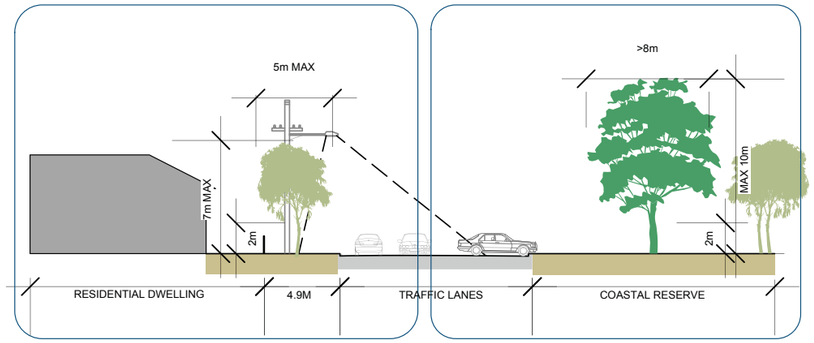
Objectives:

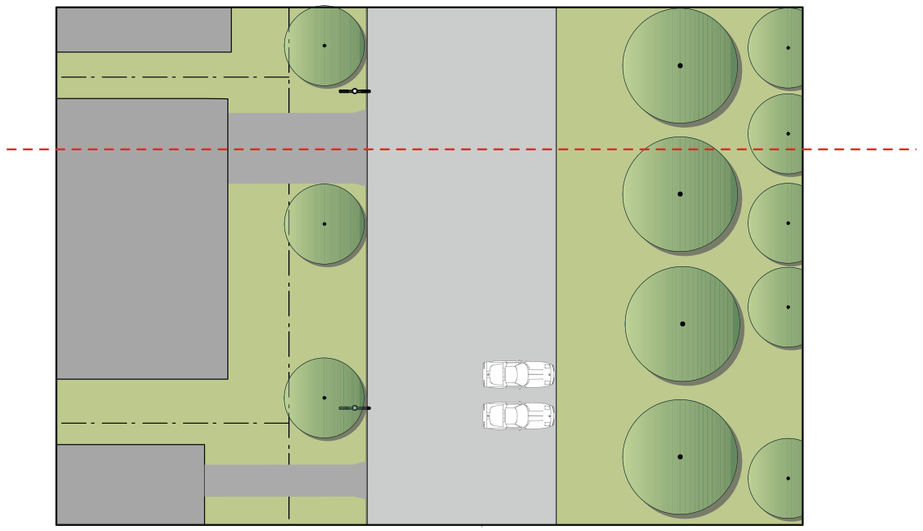
- Generous sized canopy trees need to have good amenity value such as the quality of shade
- To strengthen the urban forest within the centre of Yamba where the opportunity exists
- Expand upon the diversity of large trees to compliment the *Aracauria* forest
- Potential for use the *Araucarias* of Yamba into the West Yamba, but with 'non coastal' *Aracauriaceae* trees such as *Araucaria cunninghammi*)
- Create a strong planted edge and character to Yamba's non coastal open space, recreation ovals and reserves

Potential Tree Selection (no powerlines)

ZONE 3 FLOODPLAIN

Afrocarpus falcatus
Alphitonia excelsa
Araucaria cunninghamii
Brachychiton discolor
Casuarina cunninghamiana
Corymbia gummiferum
Elaeocarpus grandis
Elaeocarpus kirtonii
Eucalyptus robusta
Ficus obliqua
Ficus rubiginosa
Flindersia australis
Flindersia schottiana
Flindersia xanthoxylum
Syncarpia glommulifera
Toona ciliata
Waterhousea floribunda





PARK EDGE EXPOSED COASTAL (RESIDENTIAL) (E.G DOLPHIN BEACH)

Tree Street Selection Criteria Filters

Road Verge Side (no powerlines)
Verge width greater than 3.6 metres
Minor street residential
Parkland interface requiring tree height >8 metres and height unlimited
Tree canopy > than 6 metres
No powerlines on or one side only. that can be avoided
Shade rating greater than three out of five
Suitable for the exposed coastal zone

Objectives:

- Generous sized canopy trees need to have good amenity value such as the quality of shade.
- To strengthen the urban forest within the centre of Yamba where the opportunity exists
- Expand upon the diversity of large trees to compliment the *Aracauria* forest
- To be strategically planted to allow key views from reserve activity nodes such as lookouts, playgrounds and shelters
- To create windows by planting adjacent to property boundaries rather than directly in front of properties
- Create a strong planted edge and character to Yamba's coastal open space
- To maintain the *Araucaria* forest.
- Take to opportunity to plant within the car parking lanes

Potential Tree Selection (no powerlines)

ZONE 1 EXPOSED COASTAL

Alectryon coriaceus
Araucaria collumnaris
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Cupaniopsis anachardioides
Ficus rubiginosa (not frontline)
Metrosideros excelsa

Chapter 6

Technical and Tree Installation

6.1 POSITIONING OF STREET TREES WITHIN THE VERGE

Street trees share the road reservation with numerous competing demands for both above and below ground space. In order to minimise the potential conflicts between trees, built infrastructure, pedestrian and vehicular traffic and sightlines, reasonable clearances between trees and other elements must be observed. The minimum recommended clearances are set out in the following table:

Element	Clearance
Street intersection	
Telegraph pole	
Street light	
Bus stop	No tree planting along length of bus stop
Traffic lights	
Major directional signs	
Stormwater inlet pit	
Footpath	
Driveway crossover	

The distance that the tree should be placed relative to the kerb line may vary due to the existing constraints within the street. The Roads and Traffic Authority provides the following guidelines for placement based on the design speed of the roadway for a relatively flat verge:-

Design Speed (85th percentile) [km/h]	Clear Zone metres from the edge of the travel lane
60 or less	3
80	5
100	9
110	11

Note that the distance may vary if the verge is sloping. The RTA's Road Design Guide should be consulted to determine the appropriate distances for sloping verges. Safe sight distances are also recommended by the RTA between objects (including trees) and intersections to enable a driver to observe, react and stop a vehicle. These are specified in the RTA's Road Design Guide.

6.2 PLANT STOCK QUALITY

The quality of plant stock grown by commercial nurseries is variable in terms of product quality. Given the substantial investments in planning, site preparation, plant stock establishment maintenance and maintenance over the life of the tree, the quality of the plant stock is extremely important. Defects or severe deformation in the root system as a result of poor growing practices can lead to poor establishment and even whole tree failure many years after planting. Branching defects or improper pruning or support with the nursery can also lead to stem and branch failure after planting, and stock that is not well balanced will take longer to establish using artificial mechanisms for support. It is, therefore essential to purchase quality stock that conforms to rigorous criteria to minimise these risks and ensure rapid establishment, even if there is a price premium to do so.

NATSPEC has produced a guideline for assessing tree quality to be used when purchasing plant stock. All plant stock to be purchased for street planting should comply with this guideline and pre-inspection and non-destructive testing used to verify compliance. A standard checklist has been developed, to be used in conjunction with the guideline to assess the quality of plant stock. This should be undertaken at the nursery prior to purchase and prior to delivery to the site.

6.3 TREE PLANTING TECHNOLOGIES

Tree planting technologies are not considered as criteria for the tree strategy selection matrix. Due to limitations with expenditure and retrofitting of existing tree pits, tree planting technologies are not relied upon as a determinant of street tree performance. All of these technologies will only improve how well a tree grows on site. However, new street tree planting should incorporate tree planting technology to future proof trees and reduce the amount of maintenance and resources required for young tree establishment and development.

OBJECTIVES	TECHNOLOGIES
Increase usable soil root volumes to maximise tree growth	Street kerb extensions and blisters. Use of structural soil tree pits
Increase opportunities for gaseous exchange of water and oxygen to maximise tree growth	Use of porous or permeable pavements over structural soil
Reduce conflicts between tree growth and provide free pedestrian access	Use of porous or permeable pavements over structural soil
Enable opportunities for passive irrigation in the street from stormwater drainage	Use of tree pit kerb inlets

6.4 IN-SITU SITE SOILS

The properties of soil media, (its structure, texture, water holding capacity, drainage characteristics and so on) directly influence the establishment and growth of trees. The physical attributes of the soil (particularly oxygenation and water holding capacity) affect root growth and establishment and the chemical attributes affect the availability of nutrients for plant growth and development. It is essential that new trees establish as short a time frame as possible to reduce losses and reduce costs associated with on-going maintenance.

Chapter 6 TECHNICAL AND TREE INSTALLATION

Typically, urban soils have been highly modified in comparison to the original soil profile. They may be compacted, disturbed, inverted through excavations and filling, and low in organic matter and general nutrition. As such, planting sites generally require some form of soil amendment and improvement to ensure the successful establishment of new trees. Testing of the physical and chemical attributes of the soil can aid in determining the most appropriate treatment and amendment of the soil to ensure successful establishment of new plant stock. When undertaking new street plantings, full chemical and physical soil tests should be undertaken by a National Association of Testing Authorities (NATA) laboratory, together with recommendations for soil amelioration and fertilising to improve the soil to an acceptable level for the growth of the tree species proposed.

Where it is deemed appropriate to use some imported soil media to improve in-situ soils, such materials should comply with the requirements set out in AS 4419-2003 (Soils for Landscaping and Garden Use).

6.5 CONSTRUCTED SOIL PROFILES

In some situations it may be desirable to ‘manufacture’ appropriate soil materials for street tree planting, particularly in civic precincts with significant areas of pavement. Structural soils are load bearing growing media, specially developed for use in tree pits under pavements. They provide acceptable physical and chemical attributes for root growth and development whilst providing structural support to overlying pavements. Structural soils are typically manufactured using a blend of aggregate (gap-graded), a filler material which may include a variety of materials. Some of these are commercially available from soil suppliers (such as Benedict Sand and Gravel). The aggregate provides the structural support for the pavement, whilst the filler provides a media for nutrition and moisture from plant roots.

Porous pavements and structural soil

The traditional use of sealed pavements ensures that pavement bases remain free of water and to maintain their load bearing integrity. Of course this results in little opportunity for gaseous exchange for tree roots. The soils are compacted to exclude voids, resulting in no oxygen and little to no water percolation. This exclusion of the two elements vital for tree roots and plant growth results in poor tree growth. There are examples within Grafton where pavements have been taken to the base of the trees, that originally would have had grassed verges.

These trees are stunted, have poor growth, are vulnerable to drought, can be weakened and hazardous, require ongoing maintenance input and ultimately do not achieve the objectives or aspirations for which it was planted. While safe and usable pavements are essential for a street function, the important role that trees have in social well being and sustainability are of greater importance. There are systems that can allow both objectives to be realised.

The use of structural soil beneath porous pavements is a well established practice. In streetscapes where the benefit of trees is acknowledged, but where accessibility for vehicles and pedestrians is mandatory, load bearing soils are beneficial. Load bearing or structural soils are engineered, gap graded soils comprised of compacted basalt and soil fillers that still maintain soil voids for tree gaseous exchange. There are also a number of proprietary plastic pavement support systems, where voids between the pavement bearing pedestals have uncompacted soil for use by tree roots. The structural soils are cheaper than the ‘pedestals’ or cells, but are inefficient as 80% of the soil space is impenetrable basalt gravel. The pedestals have the pavement bearing capacity with 90% usable void space. They are however, more expensive installed per metre square.

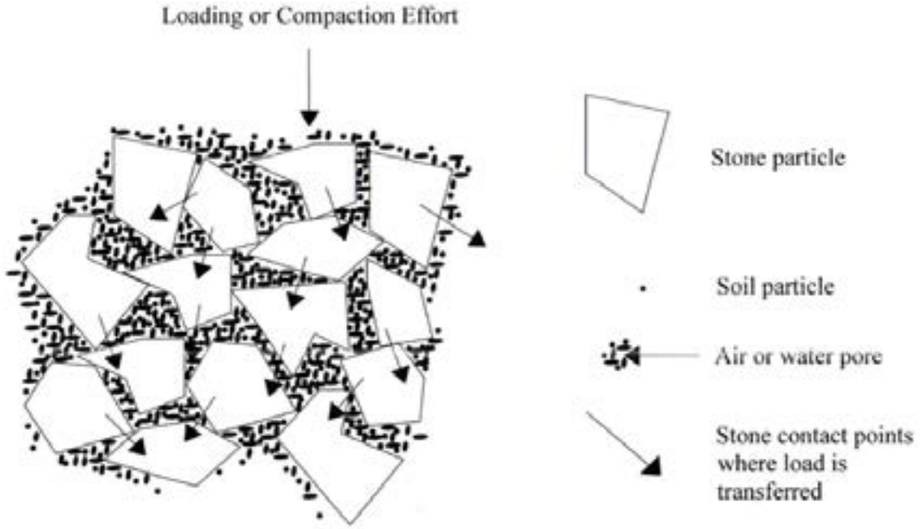
Both systems require permeable or porous pavements. Permeable pavements are non porous with notched cast into the edges to enable air and water to pass easily at the joints. Porous pavements are just that, they are gap graded concrete that allows water and air to pass directly through the pavement matrix. The joints are also wide and filled with fine basalt gravel. There are other pavement materials commonly used overseas that some councils in Australia are starting to trial. These include gap graded porous concrete, asphalt and for smaller areas resin bonded gravels such as 'Terrabond'.

6.6 DETERMINING ADEQUATE SOIL VOLUMES

Trees require adequate above and below ground space for proper growth and development. Typically, the below ground parts of a tree (its root system) are not well understood, primarily because it is hidden from view. The root system of a typical mature tree may reach at least to the canopy drip-line (the extent of its foliage and branches) and often two to three times the radius of the crown. In most soils the roots are relatively close to the surface, with the greater majority of roots found in the top metre of the soil surface. Root growth is most limited by available oxygen in the soil. Root growth is essential for the extraction of nutrients and moisture from the soil and also for support and anchorage of the tree. Roots are opportunistic and will growth wherever favourable soil conditions exist.

Permeable paving at Macquarie University installed retrospectively to alleviate compaction problems around the courtyards iconic Lemon Scented Gum 'forest'.

Porous gap graded concrete unit pavers flanking flush tree pits in a 'hit and miss' carpark. Sydney Water Depot Potts Hill, ASPECT Studios.



In order to survive and grow to maturity, trees need an adequate volume of soil to support the root system. In a street situation, there is much competition for below ground space for building and pavement foundations, drainage systems and underground services. These often form barriers to root growth. After oxygen, soil moisture levels are the most limiting factor for root growth. A tree needs a sufficient volume of soil to draw upon moisture to perform normal growth functions in between periods of natural rainfall. Insufficient soil moisture causes stress, and severe moisture stress leads to decline and eventual death. The water demands of plants can be supplemented by irrigation, but ideally the tree needs a sufficient volume to sustain its growth without the need for supplementary watering.

Naturally, the right selection of tree species that is most appropriate to the prevailing site conditions reduces the potential for moisture stress. However, the ultimate size of the tree for the planting situation must also be considered. Narrow verge areas will have limited available soil volume and therefore the ultimate size of the tree selected will be proportionate to the verge (or median) width. Large trees placed in narrow medians and verges markedly increases the risk of infrastructure damage and reduces the long term success of the planting.

In highly paved environments, such as civic plazas and streetscapes, adequate soil volumes need to be provided based on the type of soil media to be used, the ultimate size of the tree and whether or not supplementary watering can be provided using irrigation or Water Sustainable Urban Design (WSUD). There are numerous methods for calculating adequate soil volumes, most based on general 'rules of thumb'. More scientific methodologies consider the moisture demands of the tree based on its 'crop factor' (evapotranspiration demand), overall size (usually its 'crown projection' (the area of the crown projected to the ground plane) and the climate of the area (evaporation compared with rainfall).

Assuming that no supplementary watering is undertaken during the period of greatest moisture demand (months in which the deficit between evaporation and precipitation is maximum), the following soil volumes are recommended for this climatic zone by Lindsey and Bassuk (1991):

TREE SIZE	FORTNIGHTLY IRRIGATION	MONTHLY IRRIGATION	NO IRRIGATION
Large trees (16 metres in diameter at maturity)	101 m^3	203 m^3	591 m^3
Medium trees (8 metre canopy diameter at maturity)	25 m^3	51 m^3	149 m^3
Small trees (4 metre canopy diameter at maturity)	6 m^3	13 m^3	37 m^3

6.7 USE OF FERTILISERS AND SOIL AMELIORANTS

Fertilisers and soil ameliorants should only be applied where the results of soil physical and chemical tests indicate that it is necessary. Applying fertilisers indiscriminately can lead to toxic levels of minerals in the soil and decrease the availability of essential nutrients to the plant for normal growth and development. In severe cases, this can lead to the demise of a tree, particularly species that may be sensitive to some elements (such as the sensitivity to Phosphorus of Proteaceae tree species).

6.8 DRAINAGE

In heavy soils (clays or clay loams) drainage may need to be installed to ensure that the root system does not become waterlogged. Few trees can sustain growth on permanently waterlogged soils. Waterlogging of the soil profile can lead to the exclusion of oxygen leading to anaerobic soil conditions, which in turn lead to toxins in the soil which kill roots. Exclusion of oxygen also results in root decline and death.

Following excavation of the planting hole and prior to installation of the plant stock, simple percolation tests should be undertaken to ensure that the drainage of the planting pit will be adequate. These involve filling the planting pit with water and measuring and timing the drop in water level. Where the water level in the pit drops less than 50mm in a one hour period, consideration should be given to installing artificial drainage. This can be as simple as slightly grading the base of the planting pit to a low point, then excavating a trench to a low lying area away from the pit and installing an agricultural drain (flexible slotted pipe) and backfilling with coarse aggregate. Where this is not feasible, auger holes can be excavated at a low point in the base of the pit to accelerate drainage. These can be filled with sand or fine gravel.

6.9 EXCAVATION OF THE PLANTING PIT

The planting pit should be excavated as deep as the plant container and the base of the pit scarified prior to installing the plant stock. Excessive cultivation of the base of the pit can lead to excessive settlement as the soil beneath the root ball compresses. The hole should be excavated at least twice to three times wider than the plant container and the site soil amended as specified in the soil analysis prior to backfilling. Under no circumstances should the root ball be backfilled with highly organic soil mixes. When placed at depth, these can become anaerobic resulting in root death. Where additions of organic matter are specified, these should be incorporated into the top 100mm of soil only.

During excavation of the planting pit, the top 300mm of the soil profile should be separated from the lower horizons and then placed back at the same level when backfilling to avoid inverting or excessively mixing the soil horizons. Soil in the upper horizons typically has coarser texture and greater organic component than lower in the profile, and inverting the profile can lead to poor growing conditions.

6.10 PLANTING

Prior to installing the tree in the planting pit, the root ball should be thoroughly saturated and allowed to drain until moderately moist. If too wet the root ball will be heavy and fragile, risking excessive soil loss and root damage, too dry and it will be difficult to wet in the planting hole. As soil media used in potting dries out, it often becomes hydrophobic (water repellent) and is difficult to wet. Once in the ground and covered, regular watering will reduce this until such time as new root growth develops into the surrounding soil.

Trees should be completely removed from their containers and carefully placed into the planting hole. It is essential that the whole of the container is removed before installation or after installation. Under no circumstances should the base of polyethylene bags (sometimes uses as plant containers) be left beneath the root ball. This is poor practice and may lead to root circling and constriction, leading to poor establishment or failure of the tree in time.

For larger plant stock it may be necessary to lower the rootball into the planting hole using a small crane or Hiab Crane using slings. These should be placed evenly around the root ball, not around the trunk. Slippage and rubbing of the slings placed around the trunk can lead to severe damage of the vascular tissue around the trunk, leading to ring-barking of the tree. Larger stock may need to be oriented to north as it was growing in the nursery to reduce the risk of sunscald on the trunk and lower branches. The root ball should be placed with minimal disturbance to reduce soil loss and the tree placed with the main stem oriented as vertical as possible. The top of the root ball should finish flush with the surrounding ground level prior to backfilling with the amended site soil. No backfill should be placed over the rootball or in direct contact with the stem.

Following placement of the rootball, the amended site soil should be backfilled carefully around the root ball and lightly consolidated, taking care to place lower soil horizons in the same order as they were before extraction. Manufactured soil profiles may have formulated A and B soil horizon and these should be placed as specified. On dry or sloping sides, a shallow depression or ‘dish’ created around the planting pit can aid in containing water around the rootball until it soaks in, reducing run-off and water wastage.

6.11 MULCHES

Mulches are highly beneficial for new plantings to retain moisture and reduce evaporation from the soil surface. They also aid in reducing erosion of disturbed soil and moderate surface temperature, aiding in rapid root generation and establishment. Mulch used around new plantings should not exceed 50mm in depth. Greater depths can actually have a negative impact on root growth and development. Excessive amounts of mulch create a thatching effect which actually reduces moisture penetration to the root zone. Where possible, partly decomposed (composted) organic materials should be used initially. These break down relatively quickly, but will improve soil quality. Mulches used for this purpose should be supplied in accordance with AS 4454-2003 (Compost Soil Conditioners and Mulches). The mulch must be free of weed propagules and disease pathogens. Mulch rings should be replenished and enlarged in diameter as required at least until establishment.

6.12 ARTIFICIAL SUPPORT

Generally speaking, artificial support (installation of stakes and ties to support the stem during establishment) should not be required if the plant stock is supplied in accordance with NATSPEC guidelines with appropriate tree balance (ratio between tree height, stem calliper, root ball diameter and container volume). However, stakes placed outside the root ball may be useful in providing protection from damage during establishment and should be considered depending on the level use of the area and the potential for damage.

6.13 ESTABLISHMENT MAINTENANCE

To ensure the best possible outcome and ensure proper establishment, new trees should have high level maintenance for the first two growing seasons following planting.

6.14 WATERING

Newly planted trees should be deep watered at the time of planting and subsequently watered at least once a week in spring, summer and autumn or every month if planted in winter. Water saving gel or crystals, or Terracottem may be used to increase the water holding capacity of the soil. As weather conditions and rainfall can vary significantly, regular monitoring of soil moisture levels by an experienced arborist or horticulturist should be undertaken to ensure optimum soil moisture levels. During the first year of establishment, the soil around the tree should be maintained in a moist, but not wet condition and trees should be regularly monitored for signs of moisture stress. Typically, this includes drooping or wilting foliage or even partial defoliation and dieback (death of foliage and branchlets). The use of mulches will minimise watering frequency.

6.15 MONITORING AND INSPECTION

Trees should be inspected regularly, at minimum twice during growing seasons (spring, summer and autumn months) and once during the winter months. The trees should be inspected for any sign of pest or disease infestation, irregular growth patterns, soil moisture levels, signs of moisture stress, mulch levels and adjustment of stakes and ties and corrective action taken where required. All inspections should be undertaken by a qualified arborist or horticulturist.

Chapter 6 TECHNICAL AND TREE INSTALLATION

6.16 REPLENISHING MULCH

Organic mulch materials, such as woodchip and leaf mulch eventually decompose. Maintaining an adequate layer of mulch will promote faster plant establishment, minimise moisture stress and reduce weed competition, which in turn reduces watering and weed control frequency and therefore reduces maintenance costs. Organic mulches should be maintained at a minimum thickness of 50mm and maximum of thickness 75mm. Too much mulch can be damaging to the tree by forming a thatch layer which resists moisture penetration. For young trees, the mulch layer should be maintained to the full extent of the planting pit, or a minimum of 0.5 metres radius from the plant stem. Organic mulches should not be placed in direct contact with the plant stem. As mulches begin to thin-out, they should be topped-up to ensure an even 50-75mm thickness.

6.17 FERTILISING

Trees should be fertilised once a year in early spring with a balanced slow release fertiliser. A balanced fertiliser contains all the essential macro-nutrients (Nitrogen, Potassium and Phosphorus) for plant growth. It should be noted that some native species are sensitive to high levels of phosphorus. Special formulations containing low phosphorus levels are also available. Slow-release fertilisers use special technology to release nutrients to the plant over a prolonged period of time (usually two to four months). This minimises application frequency and avoids foliar burn that can occur if high doses of mineral salts are released to the soil within a short time frame.

6.18 WEED CONTROL

The maintenance of mulch cover will reduce weed competition. However, weed control may be required periodically around the base of the tree to minimise competition. Most herbaceous weeds and grasses can be controlled using non-selective herbicides containing the active constituent Glyphosate, sprayed directly onto the weeds. As this herbicide is non-selective, great care needs to be taken to avoid spray drift onto the foliage of young trees. Spray hoods placed over the spray wand can reduce drift, but treatment should be avoided in windy conditions and should not be undertaken when rainfall is forecast within the ensuing 24 hours. Care should be taken to use the minimum recommended rates, as excessive rates of application can percolate into the soil or mulch where there can be a high occupancy of fine roots. The herbicide can then be taken up by the tree resulting in plant death. Care should also be taken with the use of selective herbicides used to control broadleaved weeds and bindii in turf areas surrounding trees, particularly those with the active constituent Dicamba. Some of these herbicides are very toxic to trees and repeated applications can result in tree decline and death.

6.19 PEST AND DISEASE CONTROL

Pests and diseases can rapidly cause the decline and death of new trees if not kept in check. Most pest infestations on young trees are relatively minor and can be controlled by hand removal of insects, or small applications of pyrethrin or white oil. Pyrethrin is a natural (plant based) insecticide which works on contact with the insect. Some insects that produce protective coverings, such as scale or lerps, may require systemic pesticide applications, normally applied by foliar spray. Minor insect infestations rarely cause significant damage and can be largely ignored.

Grass cutting around trees

A significant amount of damage occurs to young trees as a result of mowing and lawn edging activities. Use of line trimmers (Whipper-Snippers) and mowing equipment around the stem of new trees can result in severe damage and even ring-barking of the stem, which may lead to the death of the tree. Stakes can be used to reasonable effect to protect trees within grassed areas and regular weed control avoids the need for close mowing and edge trimming around the plant stem.

6.20 STAKES AND TIES

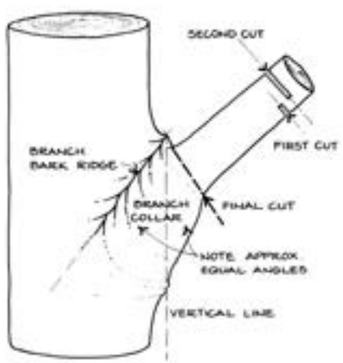
Stakes and ties should be checked at each inspection and adjusted or replaced as necessary. Stakes and ties can cause injury to the plant where they are in direct contact with the plant stem or branches. Ties (where used) must be loose enough to permit movement of the plant stem (which promotes natural strengthening and increase in stem calliper) whilst providing sufficient support for the tree. Plants which are grown in accordance with the NATSPEC Specification should not require artificial support. Stakes may be necessary as a temporary measure to provide protection from accidental damage and damage from mowing equipment.

6.21 FORMATIVE PRUNING

Formative pruning is the selective pruning of branches 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.

Early intervention has many advantages over late or no intervention, as follows:

- By identifying a removing growth defects early, the tree has a greater opportunity to develop a sound branching structure
- Wounds created during formative pruning are much smaller and therefore less susceptible to disease or fungal infection, and heal faster than larger wounds
- By removing defects early, potential failure points are also mitigated
- Failure points often create large wounds, which take a long time to heal and may damage the trees normal defence mechanisms, leading to disease
- Removing potential failure points also reduces the incidence of failures and therefore improves the safety of the environment surrounding the tree and reduces exposure to risk and liability
- If potential defects are left unchecked, the affected portion of the tree may become hazardous. The removal of large portions of a tree is generally undesirable as it can severely disfigure a tree



Formative pruning is a long term investment. Initial costs associated with formative pruning will be offset against potentially greater future costs associated with removing larger portions or entire trees that become dangerous due to defects.

Australian Standard No 4373-2007 “Pruning of Amenity Trees” contains reference to proper arboricultural techniques and can be used to specify formative pruning works. The NSW WorkCover Authority has also produced a Code of Practice for the Amenity Tree Industry (1998) which can be specified to ensure works are carried out to acceptable safety standards in accordance with current best practice.

Proper pruning practice involves the careful removal or shortening of branches where required without causing damage to the tree or increasing the risk of disease or pest infestation. Proper pruning requires a good knowledge of tree anatomy and should only be carried out by a skilled arborist with a minimum qualification of Australian Qualification Framework (AQF) Level 3 in Arboriculture and five years industry experience.

All trees have natural defences to resist disease infection and reduce the spread of decay. Where branches are improperly pruned without due regard to these mechanisms, the resultant wounds can exacerbate the risk of disease and lead to longer term problems or defects. It is therefore critical that the removal of branches is undertaken in accordance with proper arboricultural practice.

‘Natural Target Pruning’ is 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 (refer to Figure 1). Such a cut will not leave a stub or cause damage to the remaining trunk or branch, leading to better wound closure and healing. This alignment approximates the ‘natural’ alignment that the tree forms when shedding the branch, enhancing the tree’s natural defence mechanisms against decay causing fungi and insect infestation. The ‘targets’ are the two points that are aimed at to execute a proper pruning cut.

FIGURE 1 – Correct method for pruning a branch

When a branch is removed, unless it is very small (i.e. less than 50mm in diameter), it should be pruned by firstly undercutting the branch about 300mm from the branch crotch, then making a second incision from above. This two-step process (double-cut method) avoids the bark tearing as the branch falls and injures the branch collar or trunk. The final cut is made just outside the branch collar, without leaving a stub (refer to Figure 1). The Branch Bark Ridge should not be damaged in this process.

When a branch has been pruned properly, a complete ring of new tissue or “wound-wood” will encircle the cut and eventually close the wound in successive seasons. The smaller the cut, the faster the wound will heal. Pruning cuts should be made with clean, sharp pruning saws in preference to anvil pruners or similar implements which can crush and bruise live tissue near the branch collar.

6.22 CROWN-LIFTING

Removing the lower branches of trees (also known as “crown-lifting”) is often required to provide adequate clearance for pedestrians. Care should be taken to ensure that no more than one third (proportionate to the overall height) of the branches are removed at any one time. This may require small amounts of pruning to be undertaken progressively as the tree grows and matures. Pruning of lower branches should be undertaken in accordance with Natural Target Pruning Techniques (refer Figure 1).

Chapter 7

Definitions

Aerial Bundle Conductor (ABC)
A type of overhead low voltage electrical cable. Insulated cables are wrapped around a steel cable strubetween overhead poles. This minimises 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.

Canopy
The crown of a tree, comprising all of the foliage and branches.

Canopy drip-line
The extent of the canopy projected to the ground plane.

Complying Development
Development that meets set standards as specified by the local authority.

Construction Certificate
Certifies that relevant matters specified in the Environmental Planning and Assessment Regulation 2000 have been satisfied. This is required before any building work is carried out.

Consulting Arborist
A suitably experienced person with a minimum qualification of Australian Qualification Framework (AQF) Level 5 in Arboriculture.

Deciduous
A plant that sheds all of its leaves at one time during the year.

Decline
The progressive degeneration of the health of a tree.

Development Application
A request for permission to carry-out proposed development.

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.

Exotic (species)
An introduced species, not native to the Australian Continent.

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 LEP.

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.

Locally-indigenous (species)
A species native to the local area.

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.

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.

Chapter 7 DEFINITIONS

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 (SULE) weighed up against its significance in the landscape (sum of its amenity, ecological and heritage value).

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').

Safe Useful Life Expectancy (SULE)
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.

Significant Tree
A ‘Significant Tree’ is any ‘tree’ that is either, listed as a Heritage Item, located within a property that is listed as a Heritage Item or listed on Council’s Significant Tree Register or located within a Heritage Conservation Area.

Significant Tree Register
A listing of trees deemed to be Significant in accordance with Council's assessment criteria, usually based on guidelines prepared by the Heritage Council in accordance with the Burra Charter.

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.

Trade Arborist
A suitably experienced person with a minimum qualification of Australian Qualification Framework (AQF) Level 3 in Arboriculture.

Tree
A perennial plant having a single stem or relatively few woody stems, including palm trees and tree ferns, whether exotic (introduced), native or locally-indigenous species.

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.

Work
Any physical activity.

Chapter 8

Appendix

8.1 MASTER TREE MATRIX SCHEDULE

YAMBA STREET TREE AUDIT SCHEDULE