NORTH SYDNEY COUNCIL

North Sydney Urban Forest Strategy

January 2019

NORTH SYDNEY URBAN FOREST STRATEGY

FOREWORD

It is with great commitment that I present Council's second edition of the Urban Forest Strategy.

North Sydney Council has long recognised the importance of urban forests to the health and wellbeing of urban communities and was a strong advocate for the development of the Local Government Association of NSW's Urban Forest Policy 2003. This Urban Forest Strategy is the culmination of many years of research and mapping of the North Sydney Urban Forest; it provides an in-depth look at how our 'green infrastructure' is performing now and considers how we can maximise its performance into the future.

Urban greenspace is more than just the pretty bits and pieces that fill the spaces between buildings and roads; it is an integral component of a healthy urban environment providing immense services and benefits to the community. Without this urban greenery our city would be much hotter, our energy consumption much higher, our stormwater levels much greater, and our lives much more stressed as we would have no natural areas in which to recreate, no bird or animal life to admire and a whole lot less oxygen to breathe!

Valuing and managing our green infrastructure as an asset, in the same way we value our grey infrastructure (roads, buildings etc.), is a logical step now that we have the science to back up what we have always known: trees and vegetation are critical to a healthy environment. The latest international computer software has been used to calculate the asset value and dollar value of benefits provided by North Sydney's urban forest, and when you see that our street trees alone have a replacement value of $546 million and a net annual return in benefits of $3.73 million per annum you begin to understand how important this asset is.

This Urban Forest Strategy is a 'big picture' document: It sits above and guides the development and implementation of other plans and strategies relevant to urban green-space management. It reflects the goals and objectives of the North Sydney Community Strategic Plan 2013-2023 and the North Sydney Delivery Program and will provide an important measure of our environmental performance. I urge all to read and embrace the philosophies advocated in this Strategy.

Jilly Gibson
Mayor

EXECUTIVE SUMMARY

North Sydney Council is committed to maintaining a healthy and sustainable environment and has long recognised the importance of trees and vegetation in the urban setting. In response to the adoption of an Urban Forest Policy by the Local Government Association of NSW, North Sydney Council developed and implemented the first Urban Forest Strategy in 2011.

Urban forest can be defined as the totality of trees and shrubs on all public and private land in and around urban areas and is measured as a canopy cover percentage of the total area. Urban Forest is internationally recognised as a primary component of the urban ecosystem and an essential part of a "liveable" and economically sound community.

The arboriculture and environmental management industries have developed tools to measure and quantify the environmental and social benefits provided by the urban forest. We can now prove the value and importance of 'green' infrastructure and justify the cost of maintaining this important asset. This strategy will ensure industry best practice and cost effective resource allocation to maximize community benefits.

Internationally accepted urban forest modelling software (iTree) was used to calculate the asset value and ecosystem services (benefits value) provided by the North Sydney street tree population. Street tree audit data from 2014 showed a total of 17,214 street trees with the following values:

- Structural (replacement) value of $546 million (an average of $31,000/street tree)
- Value of carbon currently stored in street trees $1.75 million
- Annual net benefits of $3.73 million (pollution removal, avoided stormwater runoff, carbon sequestration & energy/carbon emission savings)

Streets make up only 16% of the North Sydney LGA so the overall value and benefits of our whole Urban Forest, which incorporates trees on parklands, private property, non Council managed public land and over 5ha of Bushland, could be up to six times these figures. These figures highlight the importance of a strong strategic approach to the management and perpetuation of the North Sydney urban forest.

Development of the first Urban Forest Strategy 2011 involved the following steps:

1. Assess our existing Urban Forest to define the asset
2. Measure existing performance - Calculate the economic value of the existing Urban Forest as an asset and as a provider of ecosystem services
3. Determine appropriate canopy cover goals for North Sydney and set targets and priorities
4. Develop a strategy to achieve our canopy cover goals and targets
5. Set in place appropriate measures to monitor and assess our performance

Based on land use within the North Sydney local government area and the international recommended target cover for CBD zones, Urban zones and Residential zones, the overall canopy cover target for North Sydney is 34.4%.

This second edition of the Urban Forest Strategy provided the opportunity for comprehensive assessment of performance. Canopy measurement in North Sydney commenced in 1997 with overall cover at just 19% across the Local Government Area (LGA). This steadily increased to 24% in 2004 and 33.9% in 2008, nearly meeting Council's target. The 2014 canopy assessment showed a slight decline to 30.7% which initially was thought could be attributed to more accurate data collection methods, but unfortunately the 2017 canopy assessment revealed an overall canopy cover of only 28.2% confirming canopy cover is declining across North Sydney LGA, as it is in many urban LGA's. This is a decline of over 5.5% from the 2008 peak, with losses across all land use zones and all land tenure zones, but greatest losses over private, suburban land.

This 2018 Urban Forest Strategy therefore revisits our strategic actions and priorities to identify what was working in the period from 1997-2008 and what changes may have taken place after that time. It identifies constraints and threats and suggests new actions that may overcome these.

Urban canopy increase requires a combination of tree protection, tree maintenance, and tree planting to be fully realized and efficiently implemented. As trees and tree crowns take time to grow, it may require 20 to 30 years to achieve a significant increase in canopy cover hence the importance of developing a comprehensive long-term strategy that engages all stakeholders, has clearly defined steps, and has easily measureable performance criteria.

A key outcome of this 2018 Urban Forest Strategy review is a comprehensive 'Methodology for Assessment of Tree Canopy and Tree Statistics'. The methodology formalises what Council has been doing since 1997 into a clear and consistent process. It details all of the statistical data that should be measured and monitored to assess performance and to guide the development of appropriate actions to achieve our Urban Forest goals.

Another major outcome of this 2018 review is a new matrix of actions. In this edition, our objectives have been streamlined to follow the themes of:

Value, Protect, Maintain, Plant and Monitor.

Prioritised actions have been listed to address the emerging issues, ranging from implementing education programs to increase community appreciation of urban forest values, through to broad-scale review of legislative controls to protect vegetation such as the NSC DCP2013. Some of these actions have already commenced while others may take some years to complete and implement. The important thing is that North Sydney Council has recognised the extreme value and importance of Urban Forest and set in place a course of action to achieve goals.

The whole community must value the urban forest and work together if we are to reverse the current decline and achieve the goal of reaching our target canopy cover.

1 INTRODUCTION

1.1 WHAT IS URBAN FOREST

The urban forest is recognised as a primary component of the urban ecosystem. It is one component of a complex built environment that includes roads, car parks, footpaths, underground and overhead services, buildings and other structures.

The planned, systematic, and integrated management of urban trees is referred to as Urban Forestry. Like its commercial counterpart, the urban forest is a net producer of products. The commercial forest produces timber and woodchip on a rotational basis and in return receives inputs from strategic planning, management and routine maintenance to ensure a sustainable supply of those products.

By comparison an urban forest produces numerous, but less tangible, benefits. These benefits, whilst poorly defined and less tangible than products like timber and woodchip, are arguably of greater value in assisting sustainable urban living in the twenty-first century.

Urban forest can be defined as the totality of trees and shrubs on all public and private land in and around urban areas and is measured as a canopy cover percentage of the total area. The canopy cover may vary in density depending on the vegetation type (e.g. almost solid cover under rainforest vegetation to more open cover under woodland or eucalypt forests) however the canopy cover percentage for Urban Forest measurement purely measures the percentage of land that has tree or shrub vegetation (over 3m tall) above it, regardless of density.

1.2 HISTORY OF URBAN FOREST MANAGEMENT

Recognition of the value of modern urban forest started in 1978 in the United States, with the drafting by Congress of the Cooperative Forestry Assistance Act. The 1978 Act officially recognized that urban and community forests “improve the quality of life for residents; enhance the economic value of residential and commercial property; improve air quality; reduce the build-up of carbon dioxide; mitigate the heat island effect in urban areas; and contribute to the social well-being and sense of community.” The Act specifically provided funds to promote the maintenance, expansion, and preservation of urban tree cover and to encourage research and the development of technical skills at local levels.

In Australia, in 2003 the NSW Local Government Association Conference endorsed an Urban Forest policy. The LGA Urban Forest Policy aims to improve urban forest planning, management and practices throughout NSW Local Government areas so that communities receive maximum benefit from their urban forest on all land, for an acceptable cost and in a manner based on the principles of Ecologically Sustainable Development (ESD).

The goal of the model urban forest is to enlarge and improve the urban tree canopy to obtain the maximum economic, ecological, and social benefits of trees. The table below describes traditional (and in many cases the current) management approach to trees in the left column and details the preferred Urban Forest management approach in the right column.

TRADITIONAL TREE MANAGEMENT	URBAN FOREST MODEL
Trees as ornament	Trees as infrastructure
Trees as Individuals	Forest (or overall canopy cover)
Trees have low priority	Trees have equal priority to other urban infrastructure such as roads and services
Trees have no monetary value	Urban Forest is seen as a valuable asset
Small and ornamental trees	Large Canopy Trees
Tree maintenance	Forest management
Aesthetics-based design	Ecological-based design
Legal boundaries determine management	Urban Forest as a continuous resource regardless of ownership boundaries

1.3 WHY IS URBAN FOREST IMPORTANT?

Urban forests are internationally recognised as significant community assets worthy of retention, protection and expansion. Urban forest is an essential part of a "liveable" and economically sound community. Urban forests are now often referred to as "green infrastructure". Green infrastructure provides important ecological and social functions that translate into direct cost savings to local government and indirect stimulation of the local economy.

Unlike traditional 'grey' infrastructure such as transportation and water systems, which begin to depreciate as soon as they are installed, green infrastructure, accrues value and provides greater services as time passes: the vegetation resource of a sustainable urban forest can provide a continuous high level of net benefits for many decades. Scientifically proven and quantified benefits include energy conservation, reduction of atmospheric contaminants, enhanced property values, reduction in storm water run-off, and increases in social well-being. (LGSA NSW Urban Forest Policy 2003)

Biodiversity

Biological diversity, or biodiversity, is the variety of all species on earth. It encapsulates the different plants, animals and micro-organisms, their genes, and the terrestrial, marine and freshwater ecosystems of which they are a part.

The North Sydney urban forest is critical to biodiversity values and provides crucial links between fragmented pockets of remnant urban bushland. The population and diversity of urban wildlife can be used as a clear measure of the health of the natural environment and significantly contributes to the quality of life of our residents.

Less than 5% of the original (pre European settlement) bushland vegetation remains in North Sydney and primarily occurs in narrow, fragmented reserves that are vulnerable to urban pressures. A healthy, connected urban forest is critical to the ongoing rehabilitation of our urban bushland as it facilitates the movement of wildlife, seeds, pollens and other ecosystem services in an otherwise disjointed natural landscape.

In 2010, Council engaged ecologists to undertake a comprehensive assessment of all North Sydney's remnant bushland. Several threatened plant and animal species, and three endangered ecological communities were identified. This survey provided a benchmark of North Sydney's natural assets and established a quantifiable measure of their intrinsic natural values.

The 2010 Natural Area Survey (NAS) found that North Sydney's bushland reserves support 12 distinct native vegetation communities, three of which (Coastal Saltmarsh, Swamp Oak Forest on Coastal Floodplains, and the Sydney Turpentine-Ironbark Forest) are listed as endangered ecological communities in NSW.

Understanding the critical importance of green linkages between remnant bushland the NAS also identified strategic corridors that would aid in these linkages with further planting. This Urban Forest Strategy recognises the importance of these green corridor zones and seeks to enhance their development in coordination with other mutually beneficial objectives.

Trees can significantly reduce the Urban Heat Island Effect

The Urban Heat Island Effect is localised warming due to the increase in the large amounts of paved and dark coloured surfaces like roads, roofs, large buildings and car parks. The sun's heat is absorbed not reflected and causes the surface and ambient temperatures to rise. Human heat production, such as the heat produced through car engines and air conditioners also contribute to the Urban Heat Island Effect. On hot summer days, cities can be several degrees hotter than their rural surrounds.

The Urban Heat Island Effect has the potential to adversely impact public health, air quality and energy use in a number of ways.

- **Poor Air Quality**: Hotter air increases both the frequency and intensity of ground-level ozone (the main ingredient in smog). Smog is formed when air pollutants such as nitrogen oxides (NOx) and Volatile Organic Compounds (VOCs) are mixed with sunlight and heat. The rate of this chemical reaction increases with higher temperatures.

- **Risks to Public Health**: The Urban Heat Island effect intensifies heat waves in cities, making residents and workers uncomfortable and putting them at increased risk for heat exhaustion and heat stroke. In addition, high concentrations of ground level ozone aggravate respiratory problems such as asthma, putting children and the elderly at particular risk.

- **High Energy Use**: Hotter temperatures increase demand for air conditioning, increasing energy use when demand is already high. This in turn contributes to power shortages and increasing carbon dioxide emissions.

- **Other documented impacts** as a result of the Urban Heat Island Effect include impacts to biodiversity, increased water demand, decreased productivity and even increased rates in domestic violence.

A heatwave in Melbourne in late January 2009 exemplifies such conditions. On 27 January the maximum temperature rose to 36.4°C from a high of 25.5°C the previous day. The maximum temperatures during the next three days were 43.4°C, 44.3°C and 45.1°C, before dropping to 30.5°C on 31 January. Night-time minimum temperatures were also very much above average. There were 374 excess deaths recorded during this period. The death rate peaked on 30 and 31 January, towards the end of the heatwave, lagging behind the extreme temperatures by a few days (DHS 2009; Figure 10).

Trees can reduce temperatures by up to 5 degrees Celsius. Temperatures are cooler around trees and vegetation because of the effects of evaporation and shading. Shade from trees prevents the ground from heating up and water that is naturally transpired from the leaves of plants humidifies the air: when this water (humidity) evaporates it cools the air.

Trees Store and Sequester Carbon

Carbon dioxide (CO2) is a natural greenhouse gas in the atmosphere and is in part responsible for the earth's relatively stable climate. It is a 'greenhouse' gas because it traps heat near the earth's surface, contributing to observed and predicted global warming. Human activities, especially the burning of fossil fuels such as coal and oil and destruction of natural forests, are greatly increasing the level of CO2 in the atmosphere.

Trees remove carbon dioxide from the atmosphere through the natural process of photosynthesis and store the carbon (C) in their leaves, branches, stems, bark and roots. Approximately 45% of the dry weight of a tree's biomass is carbon. One tonne of C = 3.67 tonnes of 'carbon dioxide equivalent' (CO2-e).

A healthy urban forest can store thousands of tonnes of Carbon. Additionally, as the trees grow, they sequester more carbon every year. Although urban trees require carbon inputs for their production, establishment and maintenance, and they have a finite lifespan in the urban setting, over their lifespan there is a positive carbon outcome, particularly if at the end of their safe useful life tree products are salvaged e.g. logs harvested or timber milled and foliage mulched and reused in the landscape.

Trees Play a Major Role in Stormwater Management

Studies have found that a typical medium-sized tree can intercept as much as 9000 litres of rainfall per year. When stormwater hits impervious surfaces in urban areas, the heat from those surfaces increases the water temperature. The stormwater also picks up various pollutants: everything from excess lawn fertilizers to oils on roadways. This translates into water-quality problems when large volumes of heated stormwater flow into receiving waters, posing a threat to temperature-sensitive species as well as providing conditions for algal blooms and nutrient imbalances.

A healthy urban forest can reduce the amount of runoff and pollutant loading in receiving waters in four primary ways:

1. Through evapotranspiration, trees draw moisture from the soil ground surface, thereby increasing soil water storage potential.

2. Leaves, branch surfaces and trunk bark intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.

3. Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.

4. Tree canopies reduce soil erosion by diminishing the impact of raindrops on barren surfaces.

Trees contribute to the local economy:

- Residential property values are enhanced by up to 20% by the presence of trees
    - In an analysis of 2,608 real-estate transactions over 10 months, researchers found that homes with "street trees," those planted between the sidewalk and street, sold for $7,130 more, on average than homes without street trees. (Wall Street Journal, October 10, 2013)

- Rental rates are up to 7% higher for commercial office properties having a quality landscape versus comparable properties lacking that value. (The Influence of Trees and Landscaping on Rents at Office Buildings. K. Laverne and Winson-Geiederman, 2003. Journal of Arboriculture 29, 5, 281-290)

- Consumers report being willing to spend up to 12% more in central business districts having large trees (Trees Mean Business: City Trees and the Retail Streetscape by Kathleen L. Wolf, Ph.D., 2009 University of Washington http://www.naturewithin.info/citybiz/mainstreetnews_aug09_trees.pdf)

- Desk workers with a view of nature report less illness and greater job satisfaction.

Trees provide human services and health benefits:

- Experiences of nearby nature reduce stress response, including driving and commuting (Beyond Blue to Green – The Benefits of contact with nature for mental health and wellbeing Deakin University Australia www.beyondblue.org.au)

- Urban neighbourhoods having large trees and quality landscapes experience lower crime rates (Green Streets Not Mean Streets, 2001 Frances Kuo, University of Illinois Landscape and Human Health, Laboratory http://lhhl.illinois.edu/crime.htm)

- Patients in hospitals who have views of nature from their beds recover faster. www.naturewithin.info

- Children diagnosed with ADD show reduced symptoms after spending time in outdoor green spaces (Faber-Taylor 2001, Kuo and Faber-Taylor 2004, Faber-Taylor and Kuo 2009 http://lhhl.illinois.edu/adhd.htm)

1.4 HOW THIS STRATEGY WAS DEVELOPED

Urban Forest agencies around the world recommend that every community wanting to develop an effective Urban Forest Policy should do the following:

1. assess their tree cover,
2. calculate its economic value as an ecosystem service

3. set tree canopy goals
4. implement steps to achieve goals
5. monitor and assess performance

The North Sydney Urban Forest Strategy has followed the above procedure.

1.5 HOW THIS STRATEGY RELATES TO OTHER DOCUMENTS

1.5.1 NORTH SYDNEY COMMUNITY STRATEGIC PLAN

The North Sydney Community Strategic Plan 2018-2028 is Council's most important strategic document and sets the direction for where the community of North Sydney wants to be in the year 2028. The Plan is founded on the guiding principles of sustainability and a quadruple bottom line (QBL) approach. The Community Strategic Plan addresses environmental, social, economic and civic leadership considerations through five key directions:

1 – Our Living Environment
2 – Our Built Infrastructure
3 – Our Future Planning
4 – Our Social Vitality
5 – Our Civic Leadership

To put the Community Strategic Plan into practice, Council has developed a number of sub-plans including: A Long Term Resourcing Strategy, a 2-year Delivery Program and annual Operational Plans

1.5.2 NORTH SYDNEY DELIVERY PROGRAM

North Sydney Council 4 year fixed term Delivery Program describes the actions required to achieve the objectives outlined in the Community Strategic Plan. The directions and goals within the Delivery Program that relate to this Urban Forest Strategy are listed below

Direction 1 – Our Living Environment

Goals

1.1 Protected and enhanced natural environment and biodiversity
1.2 North Sydney is sustainable and resilient
1.3 Quality urban green spaces
1.4 Open space & recreation facilities meet community needs

Direction 2 – Our Built Infrastructure

Goals

2.1 Infrastructure and Assets meet community needs
2.3 Vibrant centres, public domain, villages and streetscapes
2.4 Sustainable transport is encouraged
2.5 Improved parking and traffic management

Direction 3 – Our Future Planning

Goals

3.1 Prosperous and vibrant economy
3.2 North Sydney CBD is one of Australia's pre-eminent commercial centres
3.3 North Sydney is smart and innovative
3.4 North Sydney is distinctive with a sense of place and quality design
3.5 North Sydney is regulatory compliant

Direction 4 – Our Social Vitality

Goals

4.1 Connected, inclusive, healthy and safe community
4.2 North Sydney is creative and eventful
4.3 North Sydney is a place of lifelong learning
4.4 North Sydney's history is preserved and recognised

Direction 5 – Our Civic Leadership

Goals

5.1 Council leads the strategic direction of North Sydney
5.2 Council is well-governed and customer focussed
5.3 Community is informed and consulted
5.4 Council's service delivery is well supported
5.5 Council is an employer of choice

1.5.3 NORTH SYDNEY LOCAL ENVIRONMENTAL PLAN (NSLEP 2013)

NSLEP is the principal document through which Council administers and controls development within the North Sydney Local Government Area. The NSLEP provides development controls for new buildings and other developments. The controls cover building height, floor space ratios, environmental protection measures, tree protection measures, landscaping requirements, overshadowing, and heritage and conservation protection requirements.

1.5.4 NORTH SYDNEY DEVELOPMENT CONTROL PLAN (DCP 2013)

The DCP contains Council's detailed provisions on all aspects of development.

DCP Section 1 – Residential Development

The general objectives of this Section of the DCP are to ensure that residential development reinforces the aims and targets of Council's Residential Development Strategy. The general objectives are to ensure that residential development:

- provides a range of living opportunities that attract and cater for a diverse population;

- does not have adverse impacts on residential amenity or environmental quality;
- is in context with surrounding development;
- contributes to the garden setting and lower scale character of North Sydney's residential neighbourhoods;

DCP Section 2 – Commercial Development

The general objectives of this Section of the DCP, as they relate to the Urban Forest, are:

- To ensure that buildings are designed to contribute positively to its surroundings at street level and particularly to diversity, vitality, social engagement and 'a sense of place'.
- Provide an acceptable level of amenity for residents within centres and adjoining centres.
- To create safe and high quality urban environments through careful design of buildings and use of materials, and a well-designed and maintained public domain.
- To soften the highly urbanised landscape by introducing water and greenery.
- Minimise stormwater runoff, maintain and improve stormwater quality and encourage recycling where possible.
- Contribute to attractive and well-designed public open spaces to service increased population of the area.

DCP Section 15 – Bushland

The controls in this section apply to land zoned E2-Environmental Conservation and seek to complement the management of bushland areas by Council and the community. The controls are compatible with the long term conservation and management of remnant bushland in accordance with Council's Bushland Plan of Management (under the Local Government Act 1993) and the reserve-specific Bushland Rehabilitation Plans. The controls in this section of the DCP establish a "Bushland Buffer Zone" within 300m of land zoned E2 to assist in the appropriate design and management of private land adjoining bushland as well as contribute to the development of strategic green corridor linkages between North Sydney's otherwise fragmented bushland reserves.

This Section of the DCP is consistent with the State Government's Connected Corridors for Biodiversity Project as it identifies strategic linkages and prioritises their enhancement through appropriate planting on private land.

DCP Section 16 – Tree and Vegetation Management

This section sets out Council's specific goals with regard to management of urban trees and vegetation within the Council area, in particular detailing the requirements for tree protection and tree planting in relation to land development. This section also contains Councils 'Tree Management Order' controls.

The objectives of this Section of the DCP are to:

1. Maintain the visual, social and environmental amenity of the area through the preservation of trees and other vegetation.
2. Maintain and increase the totality of trees and vegetation across the North Sydney area by embracing the principles of Urban Forest Management, green (habitat) corridors and Continuous Cover Arboriculture.
3. Ensure the planting of adequate numbers of appropriate trees in association with new development in the North Sydney area.
4. Promote the value of and the need for the protection of trees and vegetation to the community, developers and Council staff and encourage the reporting of tree vandalism.
5. Protect existing trees and vegetation during construction of development.
6. Minimise the risk of injury to people or damage to property from trees and vegetation.
7. To recognise the financial value of trees and vegetation.
8. Ensure that vegetation does not result in the unreasonable reduction in amenity of adjoining properties in terms of access to sunlight and views.

1.5.5 NORTH SYDNEY STREET TREE STRATEGY 2016

This document provides the framework and guidelines to ensure that all existing street trees are managed in accordance with industry best practice, to maximise their benefits to the North Sydney Community.

1.5.6 NORTH SYDNEY COUNCIL TREE VANDALISM POLICY

This policy details how to investigate and assess incidents of malicious damage to trees. It also details the procedures to be followed once the level of significance of the incident has been assessed.

1.5.7 NORTH SYDNEY OPEN SPACE PLANS OF MANAGEMENT

North Sydney Council's set of 12 Plans of Management provide clear guidelines for the effective short and long-term management of all parks and reserves owned by Council or under Council's control. They provide a framework within which managers can develop a balanced response to current opportunities and address future pressures. The Plans also ensure that the unique qualities of North Sydney's parks and reserves are conserved, and that future development is appropriate. Plans of Management may deal with one particular park or reserve (Significant area Plans of Management), they may cover a number of similar use areas such as sportsgrounds or bushland (Generic Plans of Management) or they may cover a number of areas united by a common geographical feature, such as the harbour foreshore (Geographical Plans of Management).

1.6 LAND TO WHICH THIS STRATEGY APPLIES

This strategy applies to all land within the North Sydney local government area, regardless of ownership.

2 GOALS AND OBJECTIVES

A sustainable urban forest is one in which all sectors of the community share a vision for their forest and act to realise that vision through specific goals and objectives. It includes neighbourhoods, public spaces and private land. At one level an attainable vision requires that a community agree on the benefits of trees and act to maximize those benefits. On another level, this cooperation requires that private land owners acknowledge the key role of their trees to community health.

2.1 GOALS

North Sydney Council will achieve and maintain a level of urban forest canopy cover that meets internationally accepted targets (see section 3.2 of this document). This urban forest will consist of a diverse species range that reflects both the local indigenous landscape and our cultural heritage of exotic plantings, so that the existing character of North Sydney is maintained in perpetuity. The canopy will be carefully managed using industry best practice and the principles of Ecologically Sustainable Development to ensure maximum environmental and social benefits and cost effective use of resources.

2.2 OBJECTIVES

Our objectives are:

General

- To ensure no net loss of canopy and to ensure canopy cover meets identified targets.
- To value and manage the urban forest as an integral and essential component of urban infrastructure.
- To strategically plan and work across administrative boundaries and disciplines to effectively manage the urban forest within the North Sydney local government area.

Community Engagement

- To maximize community awareness, understanding and appreciation of the value and benefits of the urban forest.
- To maximize community awareness, understanding and appreciation of the life cycle of trees in the urban setting and the principles of urban forest management.
- To engage the community as active partners in the management and perpetuation of the Urban Forest in North Sydney.
- To recognise and applaud private land owners who contribute to the urban forest.
- To provide incentives for private land owners to contribute to the urban forest.

    - The ‘community’ includes residents, property owners, schools/colleges, State Government Authorities (e.g. Rail Corp, Roads and Maritime Services), businesses and service providers (e.g. Ausgrid, Telstra, Optus).

Canopy Cover

- To determine appropriate target canopy cover for North Sydney to provide maximum benefits to the community (This action was completed in the first edition of the North Sydney Urban Forest Policy 2011 and revised in this edition).
- To develop and implement strategies that will meet identified targets for canopy cover over North Sydney.
- To plant a diverse range of both native and non-invasive exotic species to maintain the existing character of North Sydney.
- To plant the largest growing and longest lived species of tree possible for the given growing conditions and site constraints taking into consideration such issues as soils, climate, physical access, existing vegetation, heritage, character/aesthetics, scenic views and solar access.
- To ensure continuous cover by providing a range of age classes within the urban forest tree population.
- To prioritise the enhancement of strategic canopy linkages between areas of remnant bushland.

Management

- To maximise the health and longevity of all canopy trees through management practices that meet industry best practice standards.
- To consider wildlife habitat, corridors and bushland linkages when managing the urban forest.
- To consider supplementing fauna habitat where opportunities exist (i.e. retaining hollows and standing dead trees; installing nest-boxes and carving hollows).
- To manage urban forest in a manner that maintains tree risk at an acceptable level.
- To ensure that all trees that have to be removed are replaced wherever feasible.
- To regularly audit and measure the urban forest to monitor the effectiveness of this Urban Forest Strategy.

3 NORTH SYDNEY'S URBAN FOREST

The North Sydney Local Government Area is located on the northern side of Sydney Harbour and covers approximately 10 square kilometres. The estimated residential population is 73,077 (ABS 2017). It is both urban and green in character, comprising two major Central Business Districts (North Sydney and St Leonards), several smaller urban centres, residential areas, parks and open spaces. Approximately 5% of the land area is bushland (58.7ha is zoned E2 Environmental Conservation, with 49ha classified remnant bushland in the NAS) and 10% is zoned public open space or public recreation. Approximately 20% of the land area is taken up with 'Special Uses' such as roads, railways etc. and more than 54% of the land area is covered by hard surfaces (roads, buildings and footpaths).

3.1 VALUE AND BENEFITS OF NORTH SYDNEY'S URBAN FOREST

North Sydney Council has conducted a number of comprehensive street tree audits (1997, 2001, 2008, 2014). Although North Sydney's 17,200 street trees only make up a small percentage of the total urban forest, the street tree audit information provides a useful sample of the overall canopy, and allows realistic calculations to be made regarding urban forest benefits.

The North Sydney street tree data has been analysed twice (2009 & 2016) using 'iTree': a state-of-the-art, peer-reviewed, software suite from the USDA Forestry Service. This modelling program is currently being used by over 5200 organisations in the United States and Canada, over 350 in Europe and a further 400+ around the rest of the world (including135 in Australia and New Zealand). The program was used to calculate the economic benefits of the street tree population in North Sydney, confirming the value of our green infrastructure and justifying the cost of maintaining this vital asset.

The North Sydney Street Tree Population consists of approximately 17,214 individual trees with a replacement value of $546 million. The gross dollar value of benefits provided by these trees per annum is $5.18m and after Council's maintenance costs of $1.45m the net annual return in benefits is $3.73 million per annum.

It is important to acknowledge that street trees are only a small proportion of the overall urban forest (roads make up 16% of the North Sydney land area): The North Sydney urban forest (public and private land combined) could have a value of up to six times the above figures – a staggering $22 million in net benefits per annum.

3.2 CANOPY COVER TARGETS

International agencies promote the range of 25% to 40% as the ideal overall canopy cover to maximise benefits to the community (depending on climate and land use patterns).

The internationally recommended canopy cover target for our climatic zone in North Sydney is approximately 40%. This recommended percentage is further broken down by specific land-use targets as follows:

- Recommended - 15% canopy cover in Central Business Districts
- Recommended - 25% canopy cover in Urban zones (medium and high density residential areas)
- Recommended - 50% canopy cover in Suburban residential zones (low density residential areas)

(Source: http://www.americanforests.org/resources/urbanforests/treedeficit.php)

A precise overall target canopy cover for North Sydney was calculated based on proportions of CBD, Urban, and Suburban land use in the North Sydney Council local government area and the recommended canopy cover targets in each of these zones. The results are shown in the table below

Land use	Recommended % Canopy Cover over this land-use	Proportion of NS land area covered by this land-use %	Contribution to target % Cover for North Sydney
CBD	15	10	1.5
Urban	25	48.3	12.1
Suburban	50	41.7	20.8
Overall Target % Cover for North Sydney			**34.4**

3.3 EXISTING CANOPY COVER IN NORTH SYDNEY

North Sydney Council has conducted five canopy cover assessments over the past 21 years. The North Sydney figures were obtained based on measuring the percentage of land covered by vegetation over 3m in height with the following results:

- In 1997 total average canopy coverage was 19%.
- In 2001 total average canopy coverage had increased to 24%.
- In 2008 total average canopy cover had further increased to 33.9%.
- In 2014 total average canopy cover had decreased to 30.7%.
- In 2017 total average canopy cover had further decreased to 28.2%

During the 2008, 2014 and 2017 assessments, more detailed canopy cover measurements were recorded with canopy cover performance broken down by both land use and land ownership (tenure) and the results are shown in the table below.

3.3.1 Canopy cover summary and changes over time

Description	% of LGA	Target Canopy Cover	1997 %	2001 %	2008 %	2014 %	2017 %	Total Decline Since 2008
Overall Canopy Cover	100	**34.4%**	**19**	**24**	**33.9**	**30.7**	**28.2**	**5.7**
CBD	10	**15%**			16.5	13.5	14.2	2.3
Urban	48.3	**25%**			32.4	28.8	26.9	5.6
Suburban	41.7	**50%**			39.8	37	33	**6.8**
Public Land	25.7				50.5	52.8	50	0.5
Private Land	58				31.6	26.4	24	**7.5**
Roads	16.3	**30%**			28.1	26.1	23.4	4.7

In an effort to correlate these figures as effectively as possible, Council engaged specialists to compare the most recent 2017 data capture with the historic data from 2014 and 2008.

The consultants noted that the technology available to monitor canopy cover has advanced significantly since 2008, with corresponding improvements in the accuracy and quality of the data. As a result, it is not clear to what extent these changes represent actual changes in canopy cover, and what changes reflect differences in canopy classification methodology and method of data analysis, however there are distinct change trends that are consistent enough and large enough to warrant serious attention.

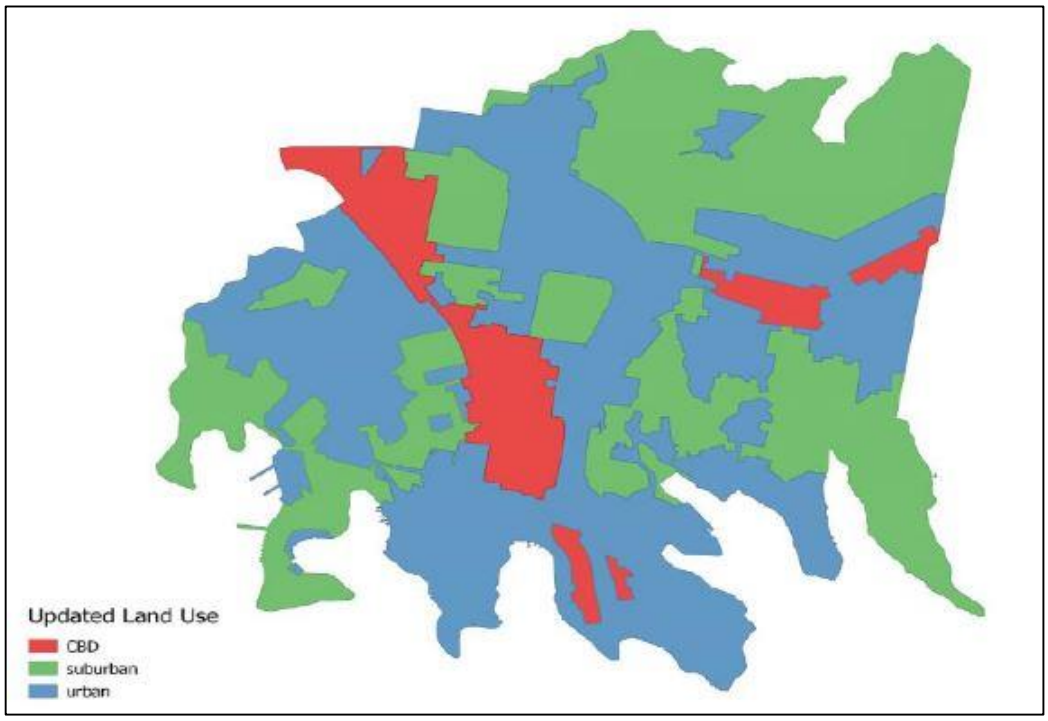
The consultants cross-checked the land use and land tenure boundaries and recalculated the percentages to ensure consistency. The above table can now be used to make broad conclusions as follows:

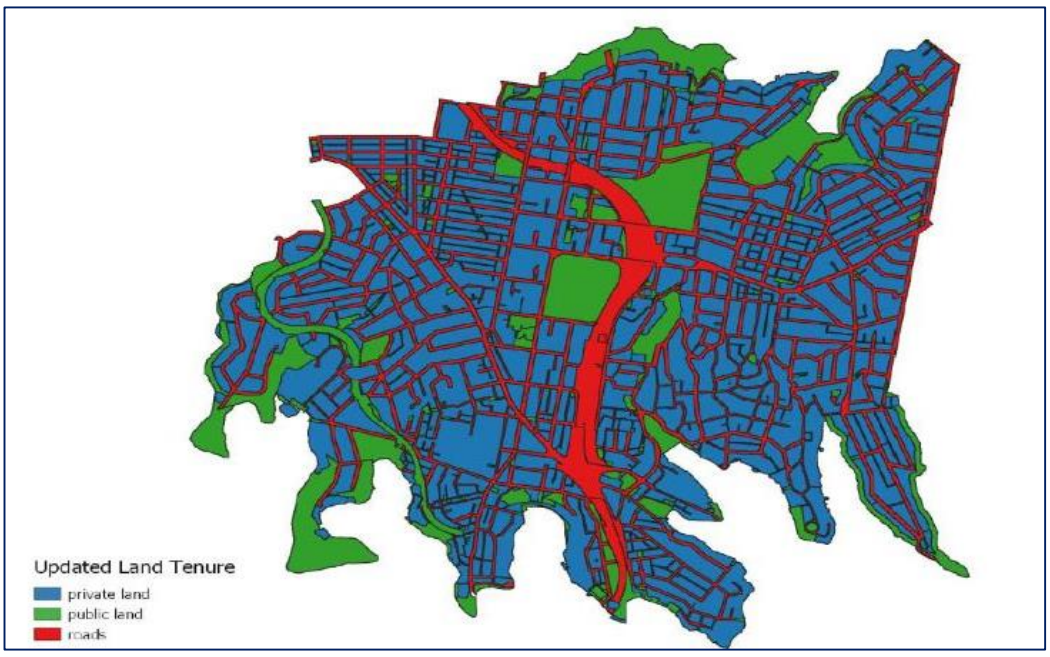
- The greatest decline in canopy cover has happened on private land and in suburban areas.

- Private land losses have had a dramatic impact on overall canopy cover due to the fact that private land makes up 58% of the LGA.

- Decreases in canopy cover on public land and roads have less impact on overall canopy cover for the LGA as these make up a smaller percentage of the total land area.

- Even with recent decline, canopy cover in Urban areas and CBD's is still close to international industry targets.





4 MANAGING NORTH SYDNEY'S URBAN FOREST

4.1 CONSTRAINTS AND THREATS

The canopy assessment results demonstrate that Council's policies and procedures were effective in increasing percentage canopy cover across the Council area up until about 2008, however since then, canopy growth appears to have plateaued and the Urban Forest has come under intense pressure resulting in the more recent decline.

Canopy has remained relatively stable in the heavily built up CBD zone however there has been a loss of canopy over roads. This particular loss is of extreme concern as although they only make up 16% of land area, roads are major contributors to urban heat and roads are major contributors to pollution.

Recent threats to canopy cover over roads include:

- The new B-Line bus route, new double decker buses and construction of new Metro stations at North Sydney and Crows Nest. Roads and Maritime Services and Transport for NSW have both been heavily pruning and removing roadside vegetation for these services.

- Powerline clearance. Ausgrid contractors have been heavily pruning roadside vegetation for line clearance.

The greatest area of canopy loss since 2008 has been over private, suburban land, declining 6.8 - 7.5%. In suburban areas canopy cover is at risk due to the pressure for urban consolidation. Australians are building larger and larger houses and there is a strong trend toward outdoor living spaces that are also hard surfaced and walled. These trends combined with the increase in dual or multiple occupancy and reduction in block sizes, contribute to urban heat islands and reduce the traditionally available backyard space for canopy trees.

Locations that traditionally accommodated large trees such as school grounds, are also under immense pressure, with more and more classrooms and buildings needed to house growing student populations.

Bushland constitutes less than 5% of North Sydney's land area however most bushland has 100% canopy cover, making protection of these areas crucial. The hilly landform of North Sydney and the fact that the bulk of our bushland is very fragmented and located along drainage lines and around the lower elevation and foreshore areas means that the bushland is extremely vulnerable to the impacts of urban development including nutrient loadings, pollution, erosion and invasion of weeds. Our bushland is also susceptible to illegal clearing, vandalism, private encroachment and dumping of rubbish.

Any decline in the health of the bushland canopy would have a significant impact on overall urban forest in North Sydney. Furthermore, crucial to the long-term sustainability of Councils bushland reserves is the ability for genetically diverse propagules (pollens, seeds etc.) to move between remnant areas. The urban forest provides the pathways for this transfer of genetic material, reinforcing the need to protect what remains and enhance for the future.

Other potential threats to canopy cover include:

- Introduction of the 10/50 Vegetation Clearing Scheme by NSW Rural Fire service in 2013 impacted on canopy cover in the NSC LGA. Note: due to recently adopted (2017) changes to Council's bushfire prone land map, the 10/50 vegetation clearance entitlement scheme is now virtually inapplicable in North Sydney. Only Berry Is & Balls Head are not listed as category 1 bushfire prone land and so only houses within 100m of these reserves can use the scheme. Due to the peninsula nature of their landscapes, only a handful of adjoining properties fall within the 100m entitlement zone.

- State Environmental Planning Policy SEPP (Infrastructure) 2007. Allows infrastructure construction, maintenance and expansion with minimal input from Council or the community in relation to tree protection

- The State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP).

As these policies come under the jurisdiction of other government bodies, Council must continue to liaise with those authorities and lobby for tree and canopy protection.

4.2 SPECIES DIVERSITY

North Sydney currently has a wide diversity of species and a good balance between native and exotic species. This diversity and balance reflects both the local indigenous landscape and the cultural landscape that has evolved since European habitation. North Sydney Council recognises that all trees regardless of their place of origin, contribute to the environment: This is verified by tree benefit modelling programs which base calculations on leaf area and stem volume, and do not differentiate based on 'place of origin'.

The current North Sydney street tree population consists of approximately 54% native species and 46% exotic species, and approximately 30% of the population is deciduous. While many argue that deciduous trees have no leaf area during winter, there are other important benefits derived during this period (i.e. additional sunlight to adjacent buildings reduces energy consumption for heating and lighting, whilst the branch structure still functions to buffer wind and therefore reduce the wind-chill factor).

Deciduous trees are also better able to cope in more polluted roadside growing environments: where an evergreen tree would have vigour reduced by a build-up of pollution on foliage, deciduous trees shed dirty, clogged leaves every autumn and grow a healthy, vigorous, new canopy every spring.

Whilst indigenous species may be well suited to the 'natural' local environmental conditions, the growing conditions in an urban setting, particularly a street situation, are very different from natural conditions (e.g. soil compaction, higher nutrient levels, altered drainage patterns, etc.) and often indigenous species cannot cope with these restrictions. Where remnant indigenous species are surviving and performing well, every effort should be made to protect and perpetuate these specimens for their important genetic values.

Many exotic species have been in cultivation for hundreds of years and over that time they have been carefully bred for superior performance. They have been hybridised and selected for their vigour in difficult urban growing conditions and many of them are propagated from cutting or grafting, ensuring uniformity of size, shape and growth habit.

Currently North Sydney has a fairly balanced mix of natives and exotics and proposes to continue planting in this ratio. In accordance with industry best practice, and to ensure that an outbreak of pests or disease does not dramatically impact the urban forest, North Sydney Council will strive to ensure that no one Genus exceeds 10% of the population, except for strategic bushland linkage corridors, where planting of endemic long-lived canopy species will be prioritised (as appropriate).

4.3 UNDESIRABLE SPECIES

Council accepts that every living tree, regardless of species or provenance, is providing environmental benefits, however it is also recognised that some species are less desirable than others. In an urban setting, bushland is a fragile and finite resource that must be preserved and protected. Any species that is known to invade bushland must be carefully managed and/or phased out and replaced with a more appropriate species.

There may also be species that, although not on the Noxious Weeds list, are of particular hazard, nuisance or weed potential in the North Sydney setting, or they are just extremely commonplace and of low amenity value. Examples include particular tree species with known brittle wood and a propensity for branch failure, certain palm trees that drop large quantities of fruits posing trip hazards or health issues, trees that are known to harbour fruit fly etc.

The primary resource for identifying problem species in North Sydney is the Greater Sydney Regional Strategic Weed Management Plan and in particular the Sydney-North regional strategic weed management plan.

https://www.northsydney.nsw.gov.au/waste_environment/bushland_wildlife/biosecurity_weeds

Exempt species may be listed as exempt species in the DCP 2013 (section 16 – Tree and Vegetation Management). Whilst a species might be exempt from protection controls, that does not mean that a particular specimen is not providing environmental and aesthetic benefits and careful consideration should always be undertaken before any tree removal.

The Noxious Weeds and Exempt Species lists are dynamic documents that change over time in relation to factors such as research findings and climate change impacts. Furthermore, some popular species of native plant that have been mass planted in parks, gardens and streetscapes, cause an imbalance in native fauna populations, which in-turn has implications for urban ecosystems in general. Consideration for phasing out and replacement planting of these species with appropriate local native alternatives is important in reinstating a semblance of balance in our urban fauna mix.

Management of undesirable species will be carried out in accordance with industry best practice and the principles of urban forest: this could mean that where an undesirable species is providing habitat/canopy/amenity it may need to be retained and managed for a number of years until alternate habitat/canopy/amenity is established. Where exempt or undesirable species are in a heritage conservation area and contributing to heritage character, other practices may need to be implemented, in accordance with any relevant legislation, to retain the tree(s) till the end of their natural life such as carefully timed pruning to prevent seed set.

4.4 DISTRIBUTION OF AGE CLASSES – CONTINUOUS COVER

Continuous Cover Arboriculture is a forest management phrase that embodies the principle of growing trees of all ages in the same area for the multiple benefits that this approach delivers. One of those benefits is that the amenity of forests managed in this way does not fluctuate wildly as older trees have to be removed.

A common feature of urban tree planting is large tracts of trees of a similar size or age. The implications of this are that many trees will reach maturity and need removing at about the same time, resulting in rapid changes to the local landscape. Sustained amenity is achieved by establishing a range of age classes within a local population; from new planting right through to mature trees. (www.barrelltreecare.co.uk)

Active tree planting programs must be carried out continuously to ensure that there is always a range of age classes across the urban forest population.

4.5 MANAGEMENT PRACTICES

North Sydney Council will strive to ensure that the urban forest is managed holistically and in accordance with industry best practice regardless of ownership boundaries. To achieve this goal Council will embrace and promote all relevant industry guidelines including:

- Australian Standard 4373-2007 Pruning of Amenity Trees
- Australian Standard 4970-2009 Protection of Trees on Development Sites
- Australian Standard 2303-2015 Tree Stock for Landscape Use
- Workplace Codes of Conduct for Amenity Tree Workers

The objectives of these industry guidelines have been incorporated into Councils functions and services through such means as:

- Council's Infrastructure Specifications
- Council's policy documents including DCP 16 – Tree and Vegetation Management
- Council's contract documents
- Council's development processes
- Council's community consultation processes

Adhering to industry best practice will maximise the health and longevity of individual trees within the urban forest and will minimise Council's and the community's exposure to risk.

4.6 IMPLEMENTATION PRIORITIES

Urban canopy increase requires a combination of tree protection, tree maintenance, and tree planting to be fully realized and efficiently implemented. As trees and tree crowns take time to grow, it may require 20 to 30 years to achieve a significant increase in canopy cover hence the importance of developing a comprehensive long-term strategy that engages all stakeholders, has clearly defined steps, and has easily measureable performance criteria. Luley and Bond (2002) offer the following conceptual analysis for increasing Urban Tree Cover:

CT = CB+ CN+ CG - CM

Where:

CT = Total Urban Tree Cover in the modelling domain over time (realization of Urban Tree Cover goal);
CB = the existing Urban Tree Cover;
CN = Urban Tree Cover increase from new trees (planting);
CG = the growth of existing Urban Tree Cover (protection and maintenance); and,
CM = Urban Tree Cover mortality or loss due to natural and man-induced causes.

Urban Tree Cover or canopy cover enhancement can be most efficiently realized by maximizing protection and maintenance in combination with new plantings.

To effectively achieve our 34.4% Urban forest canopy goal, the North Sydney Urban Forest Strategy must include all land within the Council area (both private and public land).

- On public land under the care and control of Council there are already mechanisms in place to protect, maintain and plant trees.

- On land under the control of other public authorities (e.g. State Transit, Roads and Traffic Authority, Dept. of Education) careful collaboration will be required to develop strategies that meet the identified needs of all stakeholders.

- On private land, a combination of education and outreach, landowner incentives, and refocusing of regulatory mechanisms to specifically achieve canopy target objectives, will be required.

To ensure effective implementation of this strategy, and efficient use of resources, the following key priorities have been developed;

Value, Protect, Maintain, Plant, Monitor

A comprehensive implementation strategy is contained in Part 6.0 – Implementation Strategy (Matrix). This matrix sets out the objectives and actions to be taken in response to each of the priorities.

5 PERFORMANCE MONITORING

To accurately determine whether targets are being achieved it is important to have measurable performance criteria. The following will be carried out on a regular basis:

- Canopy assessments will be carried out every two years using aerial photography and mapping.
    - Detailed performance assessments will be undertaken after each new aerial photography capture, using the Methodology for Assessment of Canopy Cover and Tree Statistics
    - The results will be analysed and compared to previous years to determine if canopy cover is increasing, static or decreasing in the various zones
- Audits of sample tree populations - street trees will be audited and statistics maintained in a database in accordance with the Street Tree Strategy (currently every five years). The results of the audits will also be analysed and recorded in accordance with the Methodology for Assessment of Canopy Cover and Tree Statistics.
- Condition reports on bushland areas will be carried out annually in accordance with the North Sydney Bushland Plan of Management.
- Monitoring of budget and resource usage will be carried out annually
- Community satisfaction surveys will be carried out in accordance with Council's Community Strategic Plan 2018-2028 (currently undertaken every two years).

As budgets and technology become available more high-tech assessments such as thermal imaging may be considered as a method of identifying priority planting areas and as a subsequent performance measure.

6 IMPLEMENTATION STRATEGY - ACTIONS

6.1 VALUE, PROTECT, MAINTAIN, PLANT, MONITOR THE EXISTING URBAN FOREST

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
Value	To value and manage the urban forest as an integral and essential component of urban Infrastructure	Regularly assess the North Sydney Urban Forest and use modelling software to calculate benefits provided and convey these results to all stakeholders	Using internationally accepted software to calculate scientifically proven environmental benefits and dollar savings will help all stakeholders to value trees and agree on a shared vision	Street Tree audit conducted every 5 years and data processed using iTree software.	Ongoing	OSE	Street Tree Strategy 2016
	To maximize community awareness, understanding and appreciation of the value and benefits of the urban forest	Develop and implement an Urban Forest Education program to convey to all stakeholders the value and importance of urban forest.	This program will maximize community awareness, understanding and appreciation of the life cycle of trees in the urban setting and the principles of urban forest management It will also engage the community as active partners in the management and perpetuation of the Urban Forest in North Sydney This program may contain a number of sub-programs targeting different stakeholders eg: - School children - Residents - Other government authorities - Councillors and other divisions of Council A sustainable urban forest is one in which all sectors of the community agree on the benefits of trees and share a vision for their forest.	Urban Forest Education program(s) developed and implemented	ST	OSE	

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
		Develop and implement an Urban Forest Incentives program to encourage and reward community members that contribute to the urban forest vision.	This program will recognise and applaud private land owners who contribute to the urban forest and provide incentives for private land owners to contribute to the urban forest. This program may include such things as: - Rewards for those already supporting canopy cover on their land - Free trees and advice for those wanting to plant more canopy trees on their land An incentives program demonstrates that Council genuinely values the contributions made by the community. Utilise existing community engagement programs (such as Native Havens) to promote the expansion of urban canopy on private land and provide incentives to landholders who participate in these programs.	Urban Forest Incentives program developed and implemented. Number of residents engaged in the Urban Forest Incentives Program.	ST	OSE	
	To ensure adequate funding is available to achieve the objectives of this Urban Forest Strategy	Allocate an appropriate annual budget to cover the key actions detailed in this Urban Forest Strategy.	Once all stakeholders understand the value of the urban forest and have a shared vision, allocation of funding can be justified and supported. Using modelling software to detail the value of the urban forest and the annual benefits it provides validates funding for maintenance and expansion.	Adequate funding is available. Actions detailed in this strategy are completed.	Ongoing	OSE	Delivery Program

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
		Seek external funding where ever opportunities arise.	NSW Govt has allocated large sums of grant funding for Urban Forest under the 5 Million Trees program. Other sources of funding such as Commonwealth grants or sponsorship should also be investigated.	Amount of external funding obtained.	ongoing	OSE	
Protect	To ensure no net loss of canopy & to ensure canopy cover meets identified targets for the defined land use and land tenure zones.	Regularly assess the North Sydney Urban Forest canopy cover using aerial imagery.	Council aims to assess canopy cover using latest available technology (aerial photography and LIDAR) to assess performance against targets for the various land tenure and land use zones. A methodology has been developed that details all of the datasets that should be analysed and assessed.	Canopy cover assessed every two years	Ongoing	OSE	Urban Forest Strategy 2018
		Conduct a review of Council's Tree and Vegetation Management policies to ensure that they are effective in protecting urban forest on private land.	This should include a review of the DCP including Tree Management Permit definitions and procedures. It may also include benchmarking against other LGA's. NSC's current tree protection height is from 10m for most species. Many other Councils protect from 3m or 5m.	Review of DCP2013 is undertaken.	ST	CIS OSE	NSC DCP 2013
		Ensure that all stakeholders are aware of Council's tree protection and management policies for both public and private trees through regular publicity and promotion.	Developers, Private Certifiers, Arborists/Landscapers and the general community all need to be kept aware of Council's Tree protection and management policies. This could be done through flyers, social media, Council website etc.	Publicity and promotion of Council's policies carried out annually. A dedicated page is kept current on Council's website	Ongoing	OSE	

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
		Enforce tree protection policies.	This includes the DCP and may include both protection of existing trees, enforcing compulsory planting of new trees and punitive measures in the case of breaches of policy.	All Council policies are enforced. Number of breaches per annum.	Ongoing	OSE CIS	NSC DCP2013 NSC Tree Vandalism Policy
		Conduct a review of in-house procedures relating to Council projects that may impact on Public urban forest	Good communication between departments within Council is imperative to achieving the shared vision for Urban Forest. Evaluation of existing trees should be conducted by Council arborists in the first instance, before design work commences.	No net loss of canopy on Council run projects. Council arborists consulted on all Council projects.	Ongoing	OSE CIS EPS	
Maintain	To maximise the growth, longevity and safety of the existing urban forest.	Manage all trees on public land in accordance with Council's Open Space Plans of Management or other Strategic Plans.	Plans of Management have been developed for all public land and may be either site specific, generic or geographical; Tree Management Strategic documents include: Street Tree Strategy & Urban Forest Strategy.	All trees managed in accordance with relevant plans of management or strategies. No net loss of canopy on public land.	Ongoing	OSE	
		Ensure that industry best practice is followed when assessing risk in relation to canopy trees.	Council promotes proactive (rather than reactive) management of the urban forest to minimise risk. This applies to both Council-owned trees and private trees.	Number of foreseeable tree failure incidents per annum. Less than 5% of street trees have SULE ratings of less than 5 years.	Ongoing		QTRA

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
		Ensure that all other agencies working on public trees within NSC LGA are aware of industry best practice and Council's Policies and Strategies	Other agencies that carry out work on public trees include: - Ausgrid (electricity) - Sydney Water - RMS and TforNSW (roads and other transport corridors) Industry best practice is detailed in Australian Standards and Codes of Practice eg - AS4373 Pruning of Amenity Trees - AS4970 Protection of Trees on Development Sites	A dedicated page is kept current on Council's website with Policies and Strategies available to download. Publicity and promotion of Council's policies carried out annually.	Ongoing	OSE CIS COS	
		Provide professional arboricultural advice to the North Sydney Community to assist them to maintain trees on private land.	Consultations with a Council arborist are available through the Tree Management Permit system or through the Tree Management Supervisor. It is important that arborists are quickly and easily accessible to ensure appropriate and timely decisions are made regarding valuable canopy trees.	No net loss of canopy across the LGA. Number of assessments or consultations provided by council arborists.	Ongoing	OSE	
		Maintain a range of age classes within the urban forest across all land use and land tenure zones by planting adequate numbers of new trees each year.	This applies to both Public and Private land. An Urban Forest Incentives program with free trees will help to achieve this action on private land. The Street Tree Strategy details how many new trees should be planted per annum to achieve this on public land.	Number of trees planted across the LGA per annum.	Ongoing	OSE	Street Tree Strategy 2016

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
Plant	To ensure no net loss of canopy & to ensure canopy cover meets identified targets in the defined land use and land tenure zones	Regularly assess the North Sydney Urban Forest canopy cover using aerial imagery.	Council aims to assess canopy cover using latest available technology (aerial photography and LIDAR) to assess performance against targets for the various land tenure and land use zones.	Canopy cover data obtained every two years	Ongoing	OSE	Urban Forest Strategy 2018
		Use data from aerial canopy assessments and street tree audits to identify potential planting locations across the LGA on both public and private land.	Street tree audits conducted every 5 years specifically highlight any potential street tree planting sites. These sites are planted in accordance with the Street Tree Strategy. Analysis of Aerial photography will allow Council to identify potential planting sites on private land which could be planted in accordance with the Urban Forest Incentives program.	Number of new tree planting locations identified.	Ongoing	OSE	Street Tree Strategy 2016
		Assess and prioritise any new planting sites identified and commence planting in accordance with policies, strategies or programs.	Highest priority areas will be those where: - Targets are not being met - Canopy decline is greatest - The Urban Heat Island Effect is greatest, - The new trees will offer greatest benefits. Consider Council's identified strategic bushland linkage zones and incorporate street trees, other public land trees and private trees to improve canopy connectivity and habitat.	Number of new trees planted. Canopy cover increasing.	ST Ongoing	OSE	Natural Areas Study (NAS)

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
			The greatest levels of canopy loss are occurring on private suburban land. The Urban Forest Incentives Program should therefore include a process for providing free trees and free advice for planting on private property.				
		Ensure that all trees that have to be removed are replaced wherever feasible.	A healthy Urban Forest has a range of age classes and inevitably mature trees will reach the end of their safe useful life and will need to be replaced. Some trees will also be removed for approved developments. It is critical that canopy trees that are removed, are replaced with an equal area of canopy cover. It is not appropriate to remove large trees and replace with small trees or shrubs.	No net loss of canopy.	Ongoing	OSE CIS	
		Where tree planting is a condition of development consent, ensure planting of appropriate species and appropriate maintenance and protection is undertaken for the tree(s) to survive to maturity.	Tree planting is often a condition of development consent. Council policy needs to be robust enough to ensure the survival of such trees to maturity. Systems need to be in place to ensure appropriate species are recommended (i.e. a recommended species list for the NSC LGA). A follow up inspection procedure also needs to be in place.	Recommended species list developed for NSC. Inspection or checking system developed to enforce planting conditions.	ST Ongoing	OSE CIS	

Key Priority	Objective	Actions	Comments	Performance Indicator	Priority	resp. dept	References
Monitor	To ensure no net loss of canopy & to ensure canopy cover meets identified targets in the defined land use and land tenure zones	Regularly assess the North Sydney Urban Forest canopy cover using aerial imagery.	Council aims to assess canopy cover using latest available technology (aerial photography and LIDAR) to assess performance against targets for the various land tenure and land use zones. A methodology has been developed that details all of the datasets that should be assessed.	Canopy cover data obtained every two years.	Ongoing	OSE	Urban Forest Strategy 2018
		Conduct comparative analysis of aerial assessments to identify areas where canopy cover is changing over time	It is important that systematic and detailed analysis is conducted in accordance with the methodology to identify areas where targets are being met and those areas where decline is occurring. Knowing which areas are successful and which are not, will allow specific actions to be developed for each.	Detailed analysis conducted every 2 years after canopy cover is recorded.	Ongoing	OSE	

7 APPENDICES

7.1 METHODOLOGY FOR ASSESSING TREE COVER AND TREE STATISTICS

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Introduction

This document has been produced in an effort to provide a methodology that can be easily replicated to regularly and accurately measure Council's performance with regard to documented Urban Forest goals. The key performance criteria have been collated from Council's core strategic tree management documents: The Urban Forest Strategy 2011 and the Street Tree Strategy 2016.

In order to implement this methodology two key actions must be undertaken as follows:

- Aerial imagery and canopy data capture and assessment across the Local Government area
    - This is a Key action to be undertaken every two years. Detailed in the Urban Forest Strategy 2011.
- Comprehensive audit of all street trees growing within the Local Government area
    - This is a Key action to be undertaken every five years. Detailed in the Street Tree Strategy 2016.

The latest aerial photography capture was completed in December 2017 and the next comprehensive street tree audit is due in 2018.

Street Trees as a Snapshot of Urban Forest in North Sydney

Benefits provided by Street Trees

The values and benefits listed in the table below have been derived using an internationally accepted computer modelling software package known as iTree. This state-of-the-art, peer-reviewed, software suite from the USDA Forestry Service is currently being used by over 5200 organisations in the United States and Canada, over 350 in Europe and a further 400+ around the rest of the world (including135 in Australia and New Zealand).

The program was used to calculate the economic benefits of the street tree population in North Sydney using data collected during the comprehensive street tree audits. In 2008 the software included formulas and costings for the United States but more recently a specific Australian version has been produced hence the variation in values. It is anticipated that there will be more similarity in values between the 2013 and upcoming 2018 audits.

Table of benefits over time

Description	**2008 ITree STREETS**	**2013 ITree ECO**
Total street tree population	16,500	17,200
Replacement value	$22 million	$546 million
Carbon Storage	$431,000	$1.75 million
Annual Pollution benefits	$548,000	$3.14 million

Total annual carbon sequestration (tonnes)	$54,000	$7,200
Stormwater benefits $	$57,000	$250,000
Energy savings	$345,000	$34,000
Aesthetics and other benefits	$3.4 million	Not a report output
Total annual benefits $	$4.4 million	$5.18 million
Annual maintenance costs $	$1.3 million	$1.45 million
Net return benefits per annum $	**$3.1 million**	**$3.73 million**

Species (Genus) Diversity of Street Trees

Table of Changes Over Time

	Common Name	Botanic Name	1999Approx % of total street trees	2008Approx % of total street trees	2013Approx % of total street trees
1	Bottlebrush	Callistemon species	14.5%	15	16%
2	Plane Tree	Platanus species	11.5%	11	10.8%
3	Gum Tree	Eucalyptus, Corymbia, Angophora	5.5%	7.1	8.6%
4	Brushbox	Lophostemon confertus	8%	8	8%
5	Jacaranda	Jacaranda mimosifolia	5%	5.6	5.8%
6	Chinese Tallowwood	Sapium sebiferum	5.5%	5.4	5.1%
7	Paperbark	Melaleuca quinquenervia	3.5%	4.2	4%
8	Photinia	Photinia species	2.5%	2.7	2.9%
9	Watergum	Tristaniopsis laurina	2.5%	2.7	2.8%
10	Fig	Ficus species		2.2	2.2%
11	Crepe Myrtle	Lagerstroemia			2.1%
12	Casurarina	Allocasuarina & Casuarina			2%
13	Camellia	Camellia species	1.5%	2	1.9%
14	Flowering Plum	Prunus cerasifera nigra		1.7	1.6%
15	Banksia	Banksia			1.4%
16	Qld Firewheel	Stenocarpus sinuatus		0.7	1%
17	Lillipilly	Syzigium			1%
18	Oleander	Nerium oleander	1%	0.9	0.9%
19	Hibiscus	Hibiscus species	1.5%	0.7	0.7%
20	Wild Olive	Olea africana	1%	0.8	0.7%

21	Peppercorn	Schinus areira		0.8	0.7%
22	Tea Tree	Leptospermum petersonii		0.7	0.7%
23	Camphorlaurel	Cinnamomum Camphora		0.8	0.6%
24	Ash	Fraxinus species		0.7	0.5%
	Vacant		2%	6%	8%

Using the above table and the North Sydney Street Tree Database, some broad summaries can be made of the North Sydney Tree population as follows:

- Approximately 80% of the North Sydney tree population is made up of the first 20 genus listed in the above table.

- In 1999 Approximately 50% of the tree population was made up of native species. In 2013 the native % has increased slightly to 54%

- Approximately 30% of the tree population is made up of deciduous trees and this has remained steady since 1999

    - Approx 5.8% of the street tree population has a life expectancy of less than 5 years. This is a decrease from 9% in 1999 but a slight increase from 3% in 2008.

    - In 1999 Vacant Tree sites made up approximately 2% of total tree planting sites. This percentage increased to 6% in 2008 and 8% in 2013 however the increase can be attributed to actively seeking out potential new tree sites during the more recent audits. Preliminary investigation of some of the vacant sites also revealed the following:

        - Sites that are overshadowed by canopy trees on private property and therefore not conducive to planting at this point in time

        - Sites where it is desirable to maintain scenic views

Pie Chart of Current Species Composition

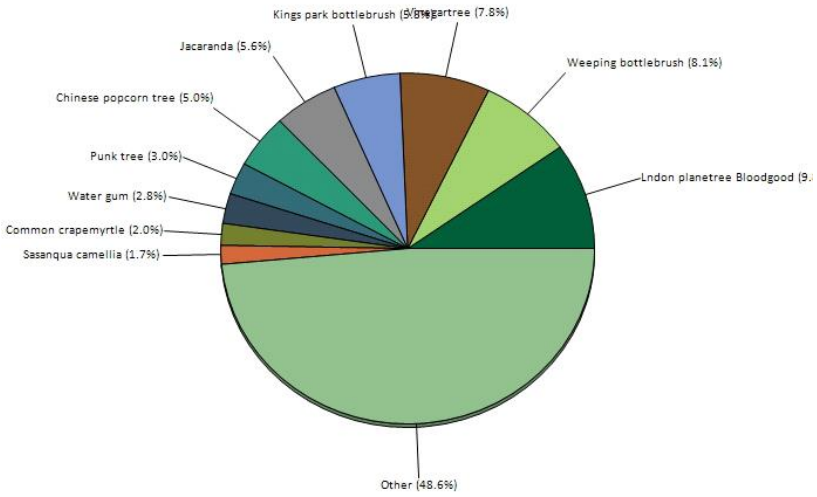
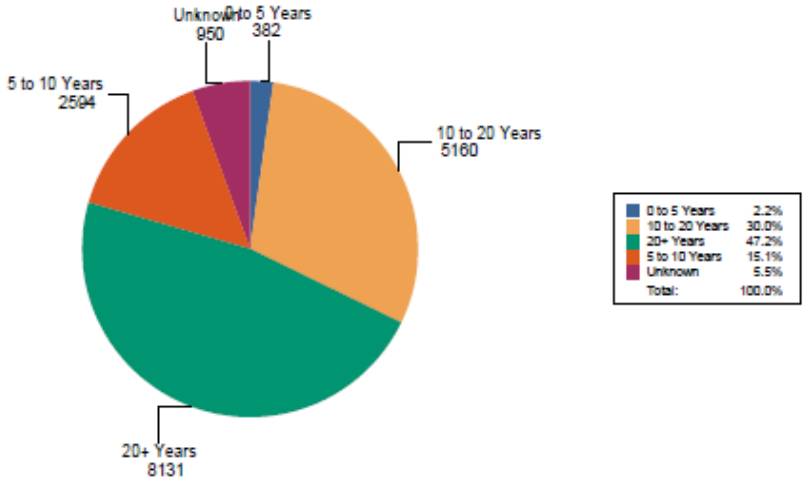


Figure 1. Tree species composition in North Sydney Council

Age Class / SULE of North Sydney Street Trees

AM Tree Life Expectancy Report

Age	Count	Percentage
0 to 5 Years	382	2.22%
10 to 20 Years	5,160	29.97%
20+ Years	8,131	47.23%
5 to 10 Years	2,594	15.07%
Unknown	950	5.52%
Total	**17,217**	



Tree Planting Statistics

Description	2012	2013	2014	2015	2016	2017
Total Number of Trees Planted by Tree team	315	462	387	420	412	410
• Number of trees planted in Streets		298	296	360	358	343
• Number of trees planted in Ovals & Reserves		164	91	60	54	67
• Total number of 'NEW' trees planted			101	120	115	144
• Number of 'NEW' trees in Streets			46	88	74	103
• Number of 'NEW' trees in Ovals & Reserves			55	32	41	36
• Approx number of replacement trees that are due to vandalism or new tree failure 10-15%			36	38	37	18
Total number of Trees planted on public land by Bushcare;					233	423
Number of new trees planted by other departments – eg Mainstreet & Development					41	8 4
TOTAL NUMBER OF TREES PLANTED BY NSC					**686**	**845**

Development Application Statistics

	2012 to 2016 inclusive	Average number per annum	Comments
Development Applications			
Total number of development sites in North Sydney LGA	**4960**	**1012**	DA's + Complying development
Number of Complying Developments	1751	350	These are notified to Council but not assessed by Council. Range from minor works to full dwellings.
Number of development applications	3209	642	It is unknown how many of these allowed tree removal
Number of DA's referred to tree officer	510	102	NB – only 10% of developments involve the tree officer
Number of tree bonds held	181	36	
Tree Management Applications - Private Properties (no DA)			
Number of Tree Management Permit inspections		1040	Often multiple trees on site
Number of removal permits issued		620	80% have Replacement conditions
Number of pruning permits issued		1800	

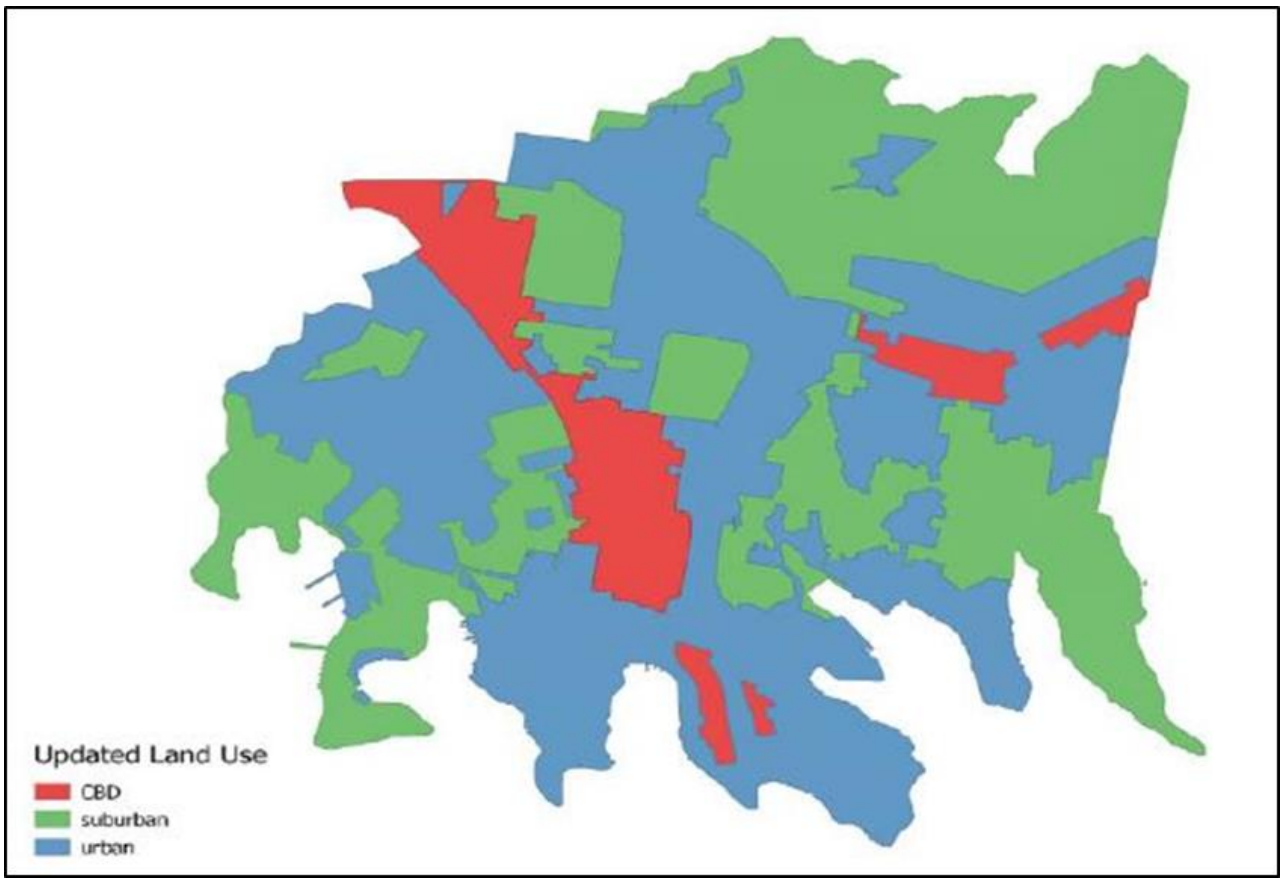
Tree Removal Statistics 2017

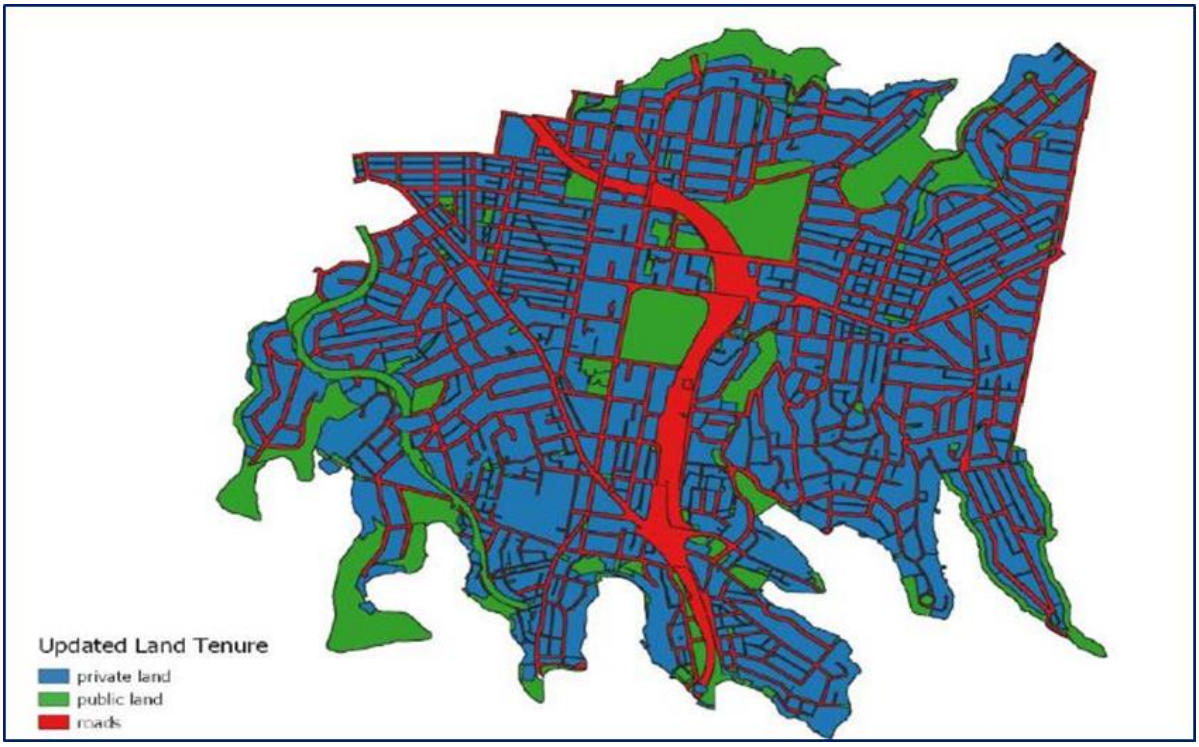
Private Property		
Tree Management removal Permits issued	620	These are on private property & have been inspected by Council arborist and deemed poor condition or low amenity value. 80% have Replacement conditions
Council Projects		
Number of public trees removed	20	Mainstreet programs and other Public works – e.g. Crows Nest Woolies, Mount st Plaza, Blue Street Upgrade
Vandalism		
Number of street trees vandalised	37	Approx. 12.5% of cbd trees planted
Number of other tree vandalism incidents	3	As recorded via the Tree Vandalism Policy
Other Authorities		
RMS for B-Line buses	50	
TforNSW for Metro	30	
Ausgrid for powerlines, Sydney Water etc.	2	
Total number of trees removed	**762**	

Canopy cover summary and changes over time

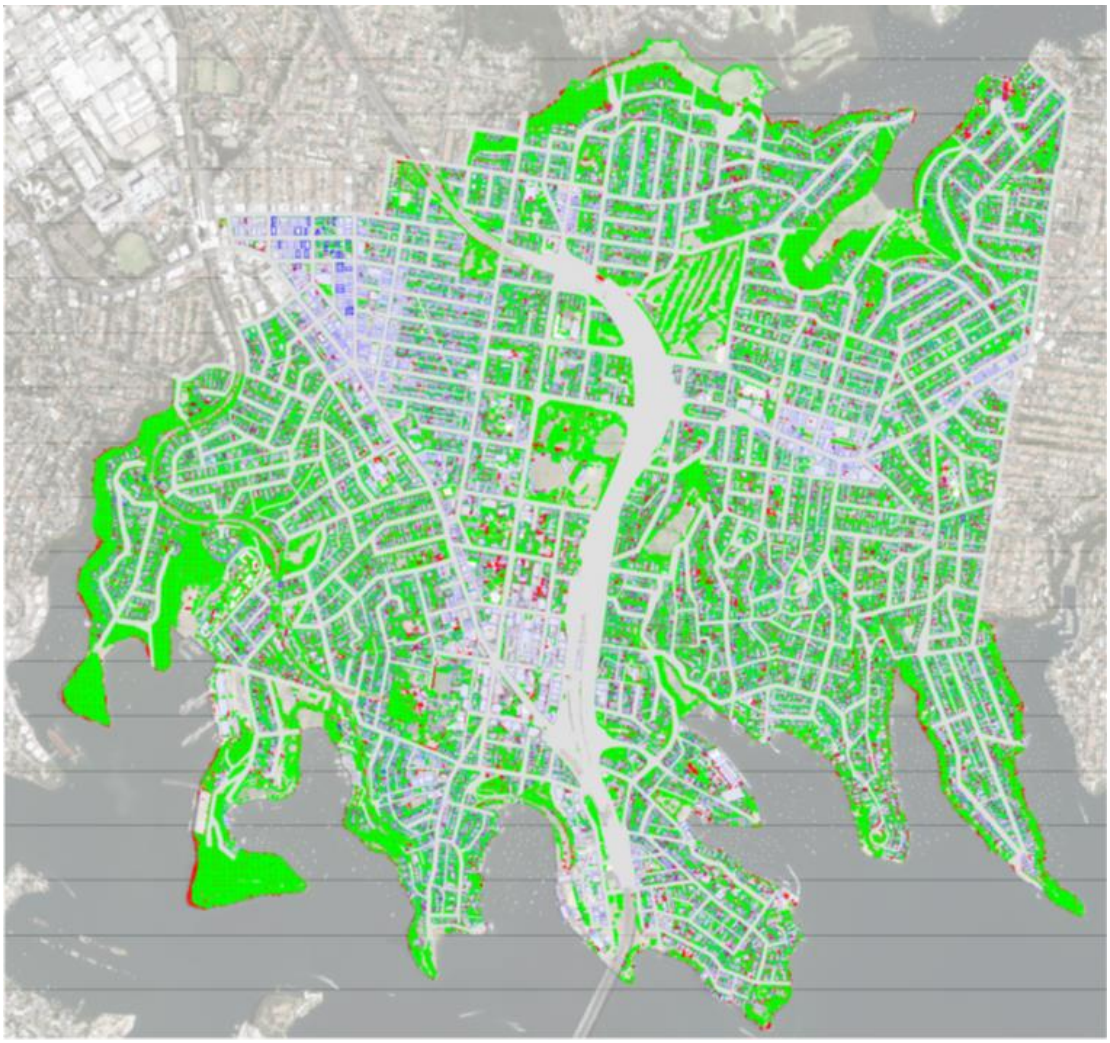
NB – figures in green are increases, figures in red are decreases.

Description	% of LGA	TARGET	1997 %	2001 %	2008 %	2014 %	2017 %	Total Decline Since 2008
Overall Canopy Cover	100	**34.4%**	19	**24**	**33.9**	**30.7**	**28.2**	**5.7**
CBD	10	**15%**			16.5	13.5	14.2	2.3
Urban	48.3	**25%**			32.4	28.8	26.9	5.6
Suburban	41.7	**50%**			39.8	37	33	**6.8**
Public Land	25.7				50.5	52.8	50	0.5
Private Land	58				31.6	26.4	24	**7.5**
Roads	16.3	**30%**			28.1	26.1	23.4	4.7





Map of Canopy Cover – Red 2009 & Green 2014



7.2 CLIMATE COMPARISON BETWEEN SYDNEY AND AMERICAN CITIES

American Forests recommend different canopy cover targets depending on general climatic conditions.

In the United States they have identified two distinct climatic zones with the target canopy cover in the eastern and higher rainfall coastal zones being 40%, while for the drier south & western zones they have recommended 25% as the target canopy cover.

Within each of these zones, the targets for canopy cover based on land-use also vary.

For metropolitan areas east of the Mississippi and in the Pacific Northwest:

Target Overall Average Canopy Cover of 40% consisting of:

Central business districts 15% cover

Urban residential zones 25% cover

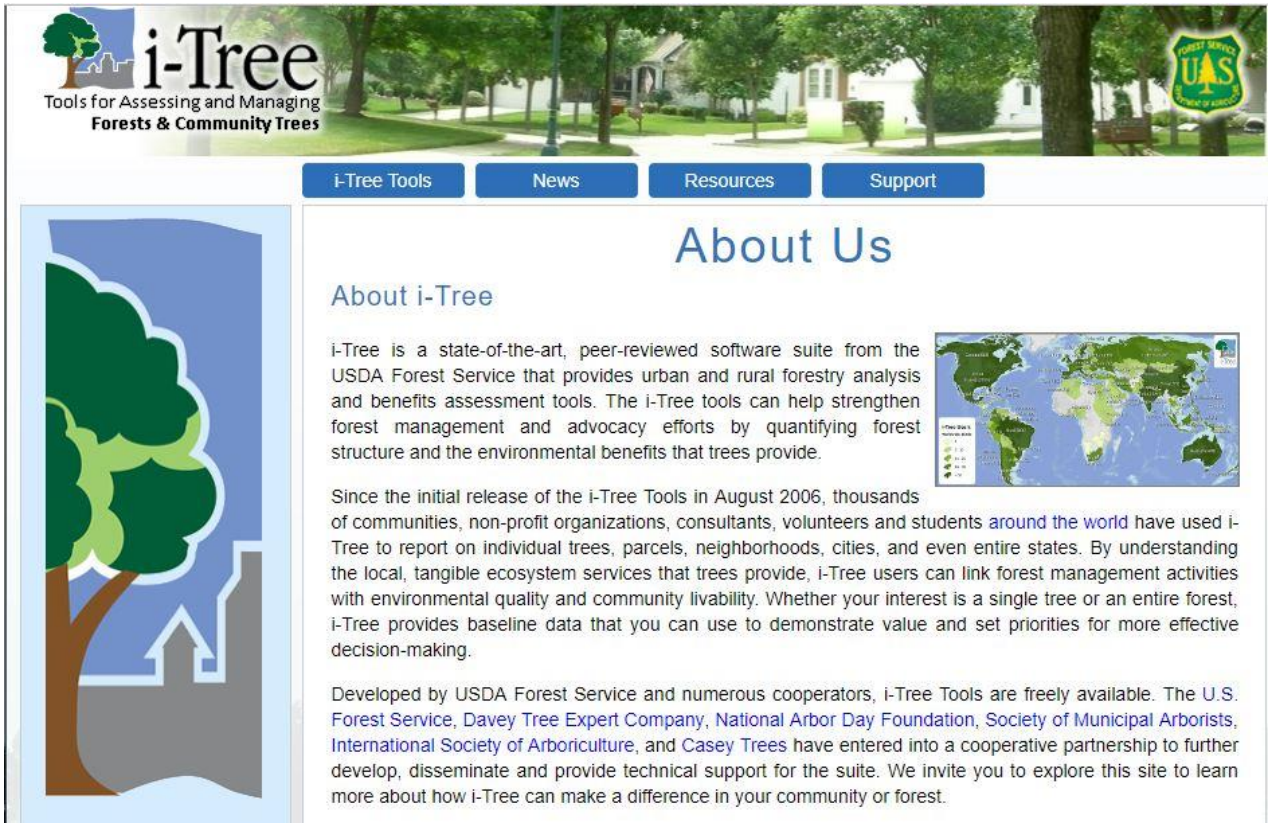
Suburban residential zones 50% cover

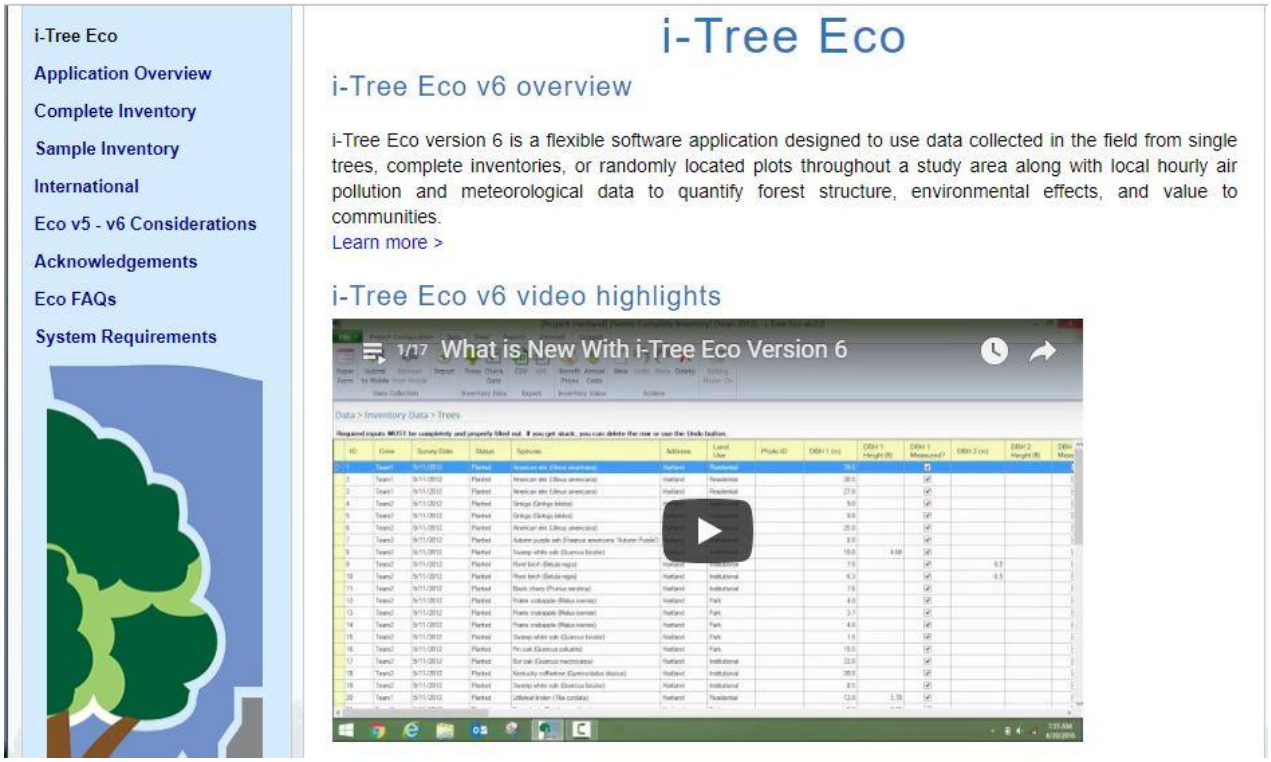
To determine which targets were the most appropriate to use for North Sydney, Council contacted the Australian Bureau of Meteorology (BOM) to find out which American city has a climate the closest to that of Sydney. The BOM advised that Charleston on the east coast of the United States had the closest climatic conditions to those of Sydney.

The table below demonstrates the similarities between the climates in Charleston and Sydney

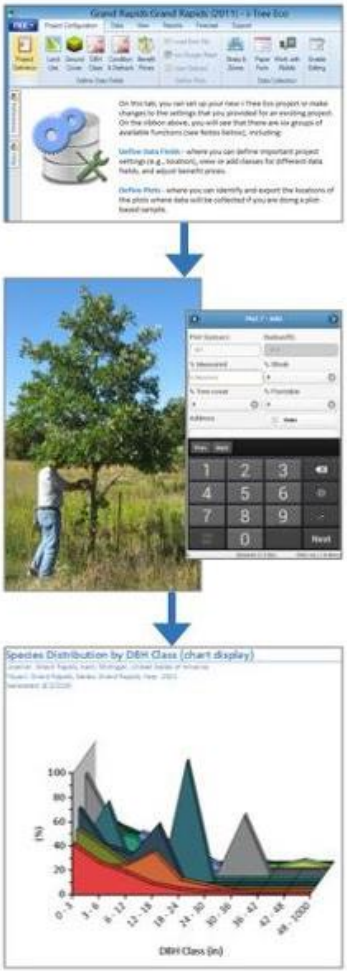
	Month	Average High Temp Degrees Celsius		Average Low Temp Degrees Celsius		Average rainfall Inches	
		Charleston	Sydney	Charleston	Sydney	Charleston	Sydney
Winter	December & June	16.66	17.77	5	10.55	3.1	2.15
	January & July	14.44	16.66	3.33	9.44	3.5	4.48
	February & August	16.11	18.33	4.44	109	3.3	4.55
Spring	March & September	20.56	20.55	8.3	12.22	4.3	3.87
	April & October	24.2	22.22	12.2	14.44	2.7	3.94
	May & November	29.4	23.33	17.22	16.11	4.0	5.36
Summer	June & December	31.1	25	20.55	18.33	6.4	3.3
	July & January	32.22	25.55	22.77	19.4	6.8	2.71
	August & February	31.66	26.11	22.22	20.55	7.2	3.83
Autumn	September & March	29.4	24.2	20.55	18.33	4.7	2.44
	October & April	24.2	22.77	13.33	15.55	2.9	3.07
	November & May	20.56	19.44	8.3	12.77	2.5	3.45
						51.4	43.15

7.3 ITREE DETAILS





What does Eco provide?



i-Tree Eco provides extensive forest and individual tree analyses including the following:

Functional Analyses:

- Pollution removal and human health impacts
- Carbon sequestration and storage
- Avoided runoff
- Building energy effects
- Tree bioemissions

Structural and compositional analyses:

- Species condition and distribution
- Leaf area and biomass
- Species importance values
- Diversity indices and relative performance

Forecasting modeling options including:

- Tree planting inputs
- Extreme event impacts for weather and pests
- Annual mortality adjustments

Management information including:

- Pest risk analysis
- User defined optional fields
- Cost benefit analysis

Who is using Eco?

Thousands of people in the United States and internationally have used Eco for projects ranging from small tree inventories to regional scale assessments. Eco users include government agencies, consultants, nonprofits, universities, researchers, volunteers, educators, advocates and more.

Choose your project type

Complete Inventory - Typically used for smaller public areas or private properties such as corporate campuses, parks, apartment complexes, individual homes or cemeteries.
Learn more >

Sample Inventory - Used when the study area is too large to cost-effectively inventory the entire tree population. Project estimates and benefits are based on sampling of random plots.
Learn more >

Learning resources

Manuals and Guides - Provide step-by-step instructions for all project phases. New guides offer detailed information on specific topics.
Learn more >

Video Learning - New instructional videos are being developed to show you how to use the Eco v6 application.
Learn more >

Model Methods, Technical Papers and Journal Articles - Explain the background model science, processes and limitations. See the Archives Eco v6 sections.
Learn more >

International Eco users

Adapted for Canada, Australia, the United Kingdom, and Mexico - Eco v6 has been adapted for use throughout Canada, Australia, the United Kingdom, and Mexico with pollution and weather data preprocessed and available in the application.

Processing for other international Eco users - International projects completed in countries other than Canada, Australia, the U.K., and Mexico will require using the new i-Tree Database currently in development. In an effort to accommodate growing international interest, we are transitioning to this new system that will help automate processing and allow users to have their new international locations incorporated into a future version of Eco.

- i-Tree Database - Online system to add data for new, previously unsupported project areas outside the United States, Canada, Australia, the United Kingdom, and Mexico.
- Eco Guide to International Projects - Former guide for international projects outside the U.S, AU, CAN and the UK. This guide can be used for reference while it is being updated for the new i-Tree Database system.