Newcastle Urban Forest

Background Paper

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The City of Newcastle

Contact Details:

Newcastle City Council
282 King Street
NEWCASTLE NSW 2300

PO Box 489
NEWCASTLE NSW 2300

Telephone: 4974 2000
Fascimile: 4974 2222
Email: mail@ncc.nsw.gov.au

Website: www.newcastle.nsw.gov.au

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1 INTRODUCTION

1.1 BACKGROUND

The local government charter under the *Local Government Act 1993* requires all Councils to have regard to the principles of ecologically sustainable development in carrying out their responsibilities, including the management of resources that impact on the environment. The urban forest is one such resource.

Urban forest is the totality of woody vegetation occurring across the urban landscape. The concepts of urban forests and urban forestry are relatively new and subjects of ongoing debate but there is international agreement that the focus is primarily on trees in close proximity to where urban people live and work. A lack of information about urban forest and the dispersed nature of the resource in public and private land hinders the development of an integrated approach to its management.

Urban Forest includes bushland, parks, gardens and streets

Australia is increasingly recognising urban forest as a resource within the urban fabric, and the need for a more unified approach to its management - not only for public lands such as bushland reserves, city parks, reserves and streets, but also for the extensive areas of privately owned green spaces in and near urban areas. North American and European urban forest research and programs were initiated and continue to be funded at national and state government levels, whereas in NSW Councils are developing plans to ensure their urban forest remains an integral part in the continuing development of their cities and suburbs.

Urban forest – the forest at people's doorstep

Urban forest has been acknowledged at the State level by the NSW Local Government Association which adopted an Urban Forest Policy in November 2003 (see Appendix 7.1). The policy defines urban forest as *"the totality of trees and shrubs on all public and private land in and around urban areas (including bushland, parkland, gardens and street trees) and is measured as a canopy cover percentage of the total area, and is recognised as a primary component of the urban ecosystem*".

The Policy recommends an integrated inter-governmental approach facilitating a planned, systematic and integrated framework to manage trees within an urban forest structure. (see Appendix 7.2). The Policy raised considerable interest amongst Councillors, Council officers and the community, prompting Newcastle City Council to convene a workshop on 28 September 2004. The workshop reached a broad consensus on the role and importance of urban forest and associated green space.

Urban Forest - the forest at people's doorstep

In particular, it was agreed that urban forest:

- encompasses both public and private land
- refers to the totality of vegetation within urban areas, not just trees
- should be seen as a major infrastructure asset in its own right
- provides a wide range of benefits to city-dwellers.

1.2 WHAT IS URBAN FOREST?

The urban forest is a public infrastructure system - it is one component of the complex built environment that includes roads, car parks, and footpaths, above and below ground utilities, buildings and other structures.

Urban forest incorporates the totality of vegetation that:

- occurs within or near an urban area
- functions as a key element of urban ecosystems
- provides the urban community with multiple economic, environmental and social benefits.

Although the tree in all its forms is the primary focus of urban forestry, the concept emphasises the collective contribution made by urban vegetation irrespective of its origin, ecosystem type, growth form, location or ownership (see Table 1). It highlights the need for a unified management approach to all vegetation within and near urban areas.

Table 1: Scope of urban forest

Origin:	Ecosystem type:	Growth form:	Location:	Ownership:
• native	• bushland	• trees	• inner city	• public parks
• planted	• wetlands	• shrubs	• suburban	• public streets
• naturalised	• gardens	• groundcover	• urban fringe	• private land
	• avenues	• aquatic	• near-urban	• institutional land

Urban forestry is an interdisciplinary, community-based, multi-objective approach to managing urban green spaces that has been successfully implemented, particularly in Europe and North America and is developing in a number of Asian countries.

Key strengths of the urban forestry approach:

Newcastle's Urban Forest – The totality of trees and shrubs across the entire LGA

- It is **integrative**, incorporating different elements of urban green structures into a whole (the 'urban forest').
- It is **strategic**, aimed at developing longer-term policies and plans for urban tree resources, connecting to different sectors, agendas and programs.
- It is aimed at **delivering multiple benefits**, stressing the economic, environmental and social-cultural goods and services urban forests can provide.
- It is **multidisciplinary** and aiming to become interdisciplinary, involving experts from natural as well as social sciences.
- It is **participatory**, targeted at developing partnerships between all stakeholders.

1.3 WHY DO WE NEED URBAN FOREST?

Research into the contributions of urban forest reveals significant social, spiritual and psychological benefits for individuals and for communities. These benefits or 'human services' provide an important and compelling reason to cultivate and sustain trees in urban areas.

> ***The greater the quantity and quality of urban forest, the greater the value of the benefits provided.***

Urban forest also provides 'ecosystem services', for example by reducing the urban heat island effect, capturing airborne particle pollution and intercepting storm water – services that would otherwise require greater capital expenditure than the cost of maintaining tree canopy cover. North American benefit-cost analyses show total benefits outweigh total costs by a ratio of 1.85. Urban forest is a key element in the functioning of urban ecosystems, that is, the dynamic complex of interactions that occur between humans, other living organisms, natural processes and the built environment. Through these interactions, urban forest contributes to a variety of cleansing, recycling and renewal processes referred to as 'ecosystem services' (see Table 2). Ecosystem services are essential for sustaining human life, and provide many intangible aesthetic and cultural benefits.

Table 2: Systems and benefits of urban forest

Ecosystem services	Urban forest benefits to community
atmospheric (microclimate) regulation	microclimate regulation
air and water purification	air quality control
stormwater management & flood control	soil & water management
waste detoxification and decomposition	carbon storage
soil protection, formation and renewal	biodiversity conservation
carbon absorption	recreational, cultural & aesthetic values
maintenance of biodiversity	economic development
pollination and seed dispersal	economic products

The greater the quantity and quality of urban forest, the greater the value of the ecosystem services or other benefits provided (see Part 2). These are 'free' services, yet are worth many tens or hundreds of millions of dollars. If these services are diminished by the loss or deterioration of urban forest, we pay a price for this in a range of economic, social and environmental impacts. For these reasons, managing urban forest has an important role in achieving a healthy, liveable and sustainable city.

The capacity of urban forest to provide environmental social and economic benefits has been extensively studied overseas, but this data can only be applied indicatively to Australian conditions. As noted by the NSW Local Government Association's *Urban Forest Policy* (see Appendix 7.1), there is little data specific to Australian cities, highlighting the need to support local research.

School trees contribute to the urban forest

Similarly, much of the research into measuring and valuing urban forest has been undertaken in North America and Europe. Some of the variables used to measure urban forest can be then utilised to set measurable outcomes (targets) to define 'indicators' for evaluating urban forest

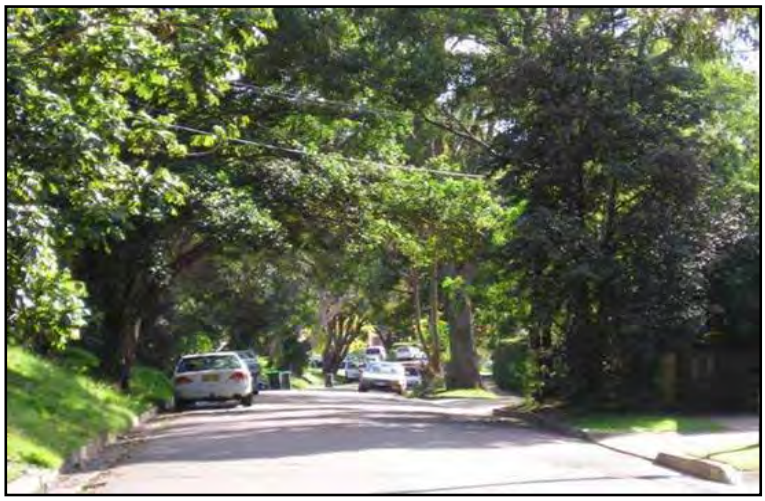
improvement over time (see Appendix 7.4). At present, no work has been undertaken to quantify the extent of the urban forest (through canopy cover) within the Newcastle area.

1.4 WHERE IS THE 'URBAN FOREST'

Cities comprise heavily built-up areas in which buildings and impervious pavement take up a significant percentage of their total area. Nevertheless, there are always many spaces and niches containing trees or vegetation even in the most densely built-up parts of cities. These spaces can be termed *green space*.

Green space specifically refers to space that is capable of sustaining trees, vegetation, or a tree canopy and includes:

- open spaces that are not built over by buildings or pavement
- paved spaces over which a tree canopy can be established
- roof spaces that can support roof gardens
- wall spaces that can support vines, espaliers or other vegetation.



Roadside and garden trees contribute to the urban forest

Green space represents the space within which urban forest currently exists, or could potentially be established in the future. The total area of green space thus provides a measure of the maximum potential to establish, maintain or expand urban forest and conversely, a reduction in green space reflects a loss of such potential.

2 URBAN FOREST BENEFITS

2.1 THE BENEFITS OF URBAN FOREST

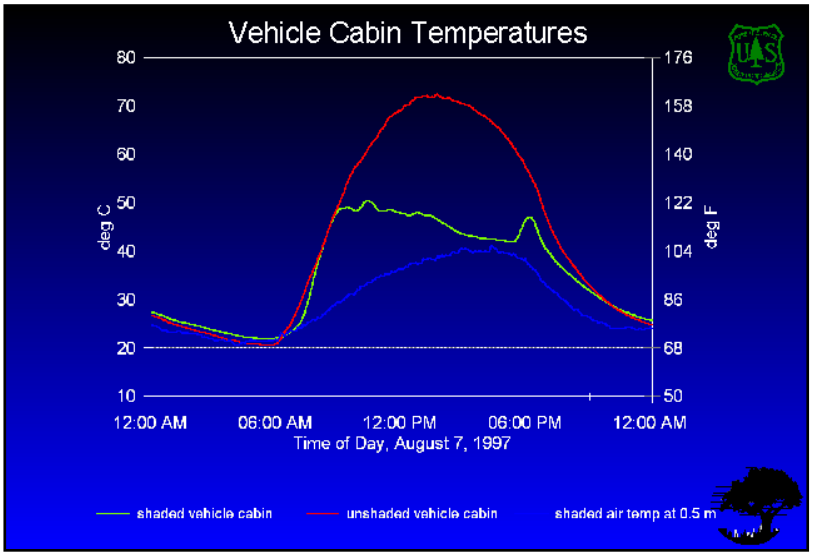
Urban forest provides a wide and important range of benefits, some of which are relatively intangible, difficult to quantify or express in monetary terms, but nonetheless make a real and profound contribution to the quality of the urban environment. The following is a summary of the most important benefits of urban forest. Some examples of quantified benefits and values of urban forest can be found at Appendix 8.3.

2.1.1 Microclimatic regulation

Cities are associated with a 'heat island effect', caused the greater capacity of non-vegetated surfaces such as roofs, walls, roads and paving to absorb solar energy as compared to vegetated surfaces. This absorbed energy is re-radiated to the atmosphere at night, thereby increasing the ambient temperature of the whole urban area relative to surrounding areas. Higher urban temperatures can have a surprisingly wide range of detrimental effects, including reduced human comfort (leading to increased energy and water use), atmospheric impacts (higher ozone levels, increased greenhouse gas emissions) and a number of public health issues (such as higher levels of heat stress).

Vegetation and trees in particular, moderate the urban climate

Vegetation and trees in particular moderate the urban microclimate by shading buildings and paved surfaces. Shading of windows, west-facing walls, air conditioning units, footpaths and public outdoor spaces can provide the greatest benefits. However, careful placement and species selection is required to avoid loss of warmth and sunlight during winter. Transpiration via leaf surfaces also provides cooling. It has been calculated that a 5% increase in canopy cover can reduce summer air temperatures by 1-2^0 C.



In summer, the temperature inside an unshaded parked vehicle can reach 70 °C

Shade trees reducing the 'heat island effect' in a car park

Shade reduces exposure to ultraviolet (UV) radiation, which is an important public health issue due to the high incidence of skin cancers in Australia. In exposed locations such as beachside suburbs, well placed large trees reduce the discomfort and damaging effects of strong on-shore winds.

2.1.2 Soil and water management

Impervious surfaces such as roofs, roads and courtyards have major effects on urban hydrology. For example, the quantity of runoff is greatly increased, soil infiltration may be disrupted, peak runoff generally occurs during a much shorter period and runoff velocity is increased. Depending on local conditions, these changes may cause increased flooding, greater erosion potential, rising water tables and the flushing of pollutants from road surfaces into watercourses by runoff. Vegetation, and particularly trees because of their size can significantly moderate many of these impacts.. For example, much of the precipitation from small rain showers is intercepted by leaf surfaces and evaporates, thereby counteracting increased runoff from impervious surfaces. This significantly reduces the potential for pollutants that have accumulated on road surfaces to be washed into watercourses during frequent, smaller-scale rain showers. Vegetation and especially trees help to stabilise soil and therefore prevent erosion.

One large tree captures up to 10,000 litres of stormwater per year.

Through the process of evapotranspiration (ie the loss of water by evaporation from soil and transpiration from leaves), trees are capable of raising potentially large quantities of water from the subsoil each day, thereby acting as efficient solar pumps. This process regulates the level of the water table, which is particularly important in areas affected by slope instability, salinity, soil contamination and other groundwater-related risks.

Many tree species support important symbiotic relationships with soil bacteria and mycorrhizal fungi. Soil microbes play a direct role in filtering stormwater ('bioretention'), and can degrade a variety of pollutants into substances that are taken up by tree roots and either stored or metabolised within various parts of the tree. At present these processes are imperfectly understood, particularly in Australia which has a unique suite of symbionts that have evolved in tandem with Australian tree species and ecological conditions.

Illustration of the volume of stormwater captured by a single 50mm storm event in the City of Boulder USA

2.1.3 Air quality control

The leaves and trunks of trees provide an enormous surface area on which air pollutant absorption and deposition processes may operate. This surface area may be more than ten times that of a tree's canopy cover. Roots, trunks, stems, leaves and bark are known to function as a sink for a variety of pollutants, including dust, particulates, gases and heavy metals. Pollutants translocated to root areas can be broken down by soil microbes. Street trees have a particular role because of their proximity to the source of vehicle emissions.

Roots, trunks, stems, leaves and bark function as a sink for airborne pollutants.

A further contribution that urban trees make to air quality is through their amelioration of the urban heat island effect. The rate of formation of photochemical smog and its precursors is partly related to temperature. Consequently, temperature reductions induced by tree planting may help to reduce photochemical smog formation during critical summer periods.

Different species vary in their tolerance to air pollution and their effectiveness in removing pollutants. The overall contribution that trees can make to regulating air quality is probably relatively modest, and reliance on other mechanisms will need to continue to deal with high pollution levels.

2.1.4 Carbon storage

Through the process of photosynthesis trees remove carbon from the atmosphere and store it in their biomass. Whilst it might be thought that urban forest has potential as a mechanism to counter carbon emissions from fossil fuel combustion, it must be appreciated that carbon stored in tree biomass is subsequently returned to the atmosphere as carbon dioxide when a tree dies and decays. As most urban trees have a relatively short life span (due to pollution levels and wear and tear), the actual value of urban forest for long-term carbon storage is unlikely to be an important function. However, urban forest does contribute to reducing atmospheric CO_2 by reducing demand for air-conditioning, thereby reducing power plant emissions.

Trees remove carbon from the atmosphere and store it in their biomass

2.1.5 Biodiversity conservation

Urban forest supports a surprisingly high level of biodiversity which in some cases exceeds that of surrounding natural or rural areas. Interspersed buildings, trees and species-diverse gardens provide highly productive habitat to which many species have successfully adapted, including a growing number of native species. Species that can utilise aerial or arboreal habitats, such as birds, bats, arboreal mammals and many insects, have been the most successful in urban environments, reflecting the importance of tree canopies.

Mature trees containing hollows are essential habitat for many wildlife species

Remnant native bushland and wetlands which persist in a relatively natural state within urban areas provide important natural biodiversity values. For example, the Hunter Estuary Wetlands, Blackbutt Reserve and Jesmond Bush contain significant biodiversity in their own right, and are highly valued by the community. However, their long-term viability is threatened by a variety of factors, such as invasive species, changes in hydrological and fire regimes, and fragmentation by transport and utility infrastructure. Encouraging residents and other landholders to plant a range of appropriate trees, shrubs and understorey species in their gardens would be beneficial.

Urban forest supports a high level of biodiversity in some cases exceeding that of surrounding natural or rural areas.

Smaller areas of remnant bushland and other areas with significant canopy cover are also important for their value as habitat corridors. Such corridors can enable certain wildlife to move through an urban area, thereby enabling links with natural habitat outside of the city and reducing fragmentation of natural ecosystems. This is an important issue for maintaining diversity in urban reserves such as Blackbutt Reserve and Jesmond Bushland.

2.1.6 Recreational, cultural and aesthetic values

The recreational and aesthetic values that people derive from parks, gardens and other urban green spaces are well known, and are reflected both in the extent of visitation of public parks and reserves, and in the importance of gardening as an urban pastime. It is also reflected in a cultural preference for tree-lined streets. Trees and gardens help create a diverse and attractive urban environment that provides aesthetic satisfaction, civic pride and historical or cultural links, to name but a few. They are an important urban design tool that can contribute to qualities such as legibility, local identity and a sense of place-all of which contribute positively to building strong communities.

There is increasing evidence of the health benefits of urban vegetation

There is increasing evidence of the health benefits of urban greenery can have a positive impact on people's physical and mental health by providing settings for physical exercise, reducing ultraviolet radiation and air pollution, and reducing stress. Active community involvement in activities such as tree planting, weed control

and community gardens promotes the strengthening of local communities. The growth in the Landcare movement in urban areas in recent years is an example of this.

Urban forest keeps people in touch with nature and natural processes

Urban forest keeps people in touch with nature and natural processes. These 'nature experiences' provide a wide range of educational, recreational and inspirational values close to where people live. The retention of trees, birds and other natural elements satisfies a deep longing held by many people to be close to nature. The world's most liveable cities are characterised by the integration of urban greening with the city's built fabric.

Urban forest and quality urban green space are priceless assets that make communities liveable and contribute to improved public health

2.1.7 Traffic management

Trees play an important role in creating compatible street environments for both motor vehicles and pedestrians. Trees can be used to provide a visual cue to motorists to reduce speed in retail and residential streets, to separate pedestrians from vehicles and to separate different streams of vehicles. When planted in rows, the trunks and branches of street trees create a transparent edge that clearly defines the vehicle and pedestrian realms. The planting of street trees within kerbside lanes significantly increases the pedestrian realm, whilst still allowing that lane to be used for parking. Using street trees as a traffic management tool requires detailed attention to location, spacing and species selection, and consideration of a wide range of issues, including urban design objectives, heritage values, sight lines, safety issues, co-existence with utility services.

2.1.8 Economic benefits

Urban forest adds positively to the attractiveness of a city, its quality of life and perceptions of its image and status. Maintaining regional amenity, climate, water quality and biodiversity are increasingly important for maintaining economic competitiveness, particularly for attracting labour and investment to sectors such as tourism, corporate services, creative arts, and research and development.

Ecological accounting systems now exist to enable organisations to better account for their natural assets

Shade trees have a strong positive influence on property values

Numerous overseas studies show that effective streetscape aesthetics and shade trees have a strong positive influence on property values, public perceptions and consumer retail behaviour. A 1999 Canberra study identified that a single representative street tree in optimum condition has an internal rate of return of over 25%, and can produce almost $16,000 in cumulative benefits in its lifetime. The Canberra urban forest as a whole has the potential to produce an estimated $45 to $97 million worth of benefits annually. Trees are thus an important tool in urban rejuvenation.

2.1.9 Economic products

In many parts of the world, urban forest provides a wide range of products of direct economic value, such as fruit, nuts, honey, edible fungi, timber, fire wood, fodder and compost. This often reflects long traditions rooted in the need to survive times of war, siege or famine. Backyard fruit trees and vegetable gardens were widespread in Australia until as little as 25 years ago, but have now become relatively scarce. The permaculture movement advocates the continuing importance of food production and 'edible landscaping' within cities. There is a developing urban agriculture movement in many North American cities that aims to improve access to quality food in cities by creating local sources of fresh produce. Perhaps the most direct economic product from Newcastle's urban forest is mulch and compost, produced either domestically or from Council green waste collections, and much of which is returned to Newcastle's public greenspace to benefit the soil and the existing trees.

2.2 PLACING A VALUE ON URBAN FOREST

Urban trees, vegetation and other natural assets are of considerable worth. For example the ACT urban forest contributes $3.5 million in stormwater benefits; $3.9 million energy reduction benefits, and $7.9 million annual pollution reduction benefits. Nevertheless, such assets traditionally have been overlooked by conventional accounting systems because they do not have a direct economic value (unlike, for example, trees cultivated for commercial forestry). Being 'public goods', natural assets are not readily tradable, so it is difficult to arrive at market valuations for them in the same way as most other economic goods and services. There has been a world-wide tendency to assign little or no value to natural assets, resulting in distorted economic decisions that degrade the stock of natural capital. A key sustainability principle to improved valuation and pricing of assets seeks to address this issue.

Whilst urban forest may have little 'exchange value', it nevertheless has significant value when considered against a variety of other criteria, such as intrinsic value, aesthetic value or the provision of ecosystem services. Various indirect techniques can be used to place monetary amounts on these values. For example, aesthetic value is often reflected in property values. Several ecological accounting systems now exist to enable organisations to better account for their natural assets. This points to the need for urban forest to be recognised in balance sheets in much the same way as other major asset categories, such as buildings or utility infrastructure. It is possible to put a monetary value on Newcastle's urban forest, however, at the present time, there is no information available to make such a calculation.

3 NEWCASTLE'S URBAN FOREST

3.1 EXTENT OF THE RESOURCE

The extent of Newcastle's green spaces (how much we have) and their ownership and control (who looks after them) will have an important bearing on the kind of actions needed to maintain or expand urban forest. It will also determine the relative share between public, private and institutional spaces, each of which requires different management approaches.

Urban forest exists within public private and institutional land each requiring different management approaches

The extent of Newcastle's green space is shown in the table at Appendix 7.5. Whilst there is some uncertainty in the data, due largely to the lack of information regarding public streets and private gardens, the overall picture which emerges is the considerable extent of green space. At the very least, Newcastle's green space exceeds roughly 100 km^2 or 50% of the Newcastle local government area. This confirms the considerable potential to establish, maintain or expand Newcastle's urban forest.

Figure 1 shows the breakdown of ownership and control of green spaces, and that public green space and private green space are of roughly equal proportions.

Street and avenue plantings are an important component of public greenspace

Whilst the actual extent of space located within public streets is currently unknown, the number of street trees within those spaces has been recorded—more than 70,000! Public streets, private gardens and education lands, whilst not enumerated in Figure 1, nevertheless represent a very important green space resource. These spaces, whilst individually small, are collectively very extensive. They are also important because they represent the green spaces immediately adjacent to our homes, workplaces and schools.

3.2 MANAGING THE RESOURCE

The traditional concept of 'open space' focuses on what is known as public green space. Green space however, is a much broader concept as it includes private and institutional lands. This broader outlook is a necessary consequence of the 'urban forest' model, which requires a unified approach to all vegetation within or near urban areas.

Green space includes land used for a wide variety of purposes, and that has a variety of land tenures, consequently its management is the direct responsibility of many government agencies, individual land owners and private corporations.

Fletcher and Summerhill green space

Public green space is the direct responsibility of government agencies. In the Newcastle local government area, the most important agencies are the NSW Department of Environment and Conservation (National Parks and Wildlife Service) and Newcastle City Council, who are responsible for approximately 40% and 12% (respectively) of total public green space. In some cases, trustees have been appointed to manage Crown reserves dedicated for specific purposes. Examples include the International Sports Centre and Sandgate Cemetery. Public green space also includes public streets, which are largely managed by Newcastle City Council.

Private green space, such as private gardens and rural properties is the direct responsibility of private landholders. The Council has an indirect role in the management of private green space through its planning and development assessment functions under the *Newcastle Local Environmental Plan 2003*, including regulation of the removal and pruning of trees.

Institutional green space is the direct responsibility of various government agencies and private corporations. It includes council-owned land classified as 'operational land', such as the Summerhill Waste Management Centre.

Maintaining urban forest within institutional green space will generally be a subsidiary land management objective to the primary land use (for example, a mine, heavy industry, or transport terminal). Nevertheless, maintaining urban forest will often play an essential role in supporting the primary land use, such as by providing a visual barrier, reducing dust, remediating land contamination or absorbing carbon.

Table 3 summarises the three basic green space types, categorised by ownership, accessibility and land use characteristics.

Table 3: Green space types

Green space type	Ownership and management	Access	Land use	Examples
Public green space	Owned and managed by government agencies on behalf of the community	Public access freely available	Public recreation, nature conservation, public access	Parks, sports-grounds, cemeteries, bushland reserves, conservation reserves, public streets.
Private green space	Owned by private land holders; managed by individual owners or occupants	Usually accessible only to individual private owners or occupants	Residential, commercial, mixed use, agriculture	Private gardens, rural properties.
Institutional green space	Owned and managed by a variety of government agencies and private corporations	Public access usually not permitted, or subject to restrictions	Institutional, utility or operational purposes	Schools, tertiary education campuses, hospitals, mines, quarries, heavy industry, ports, airports, transport terminals, railways, freeways, utility establishments and easements, waste facilities, defence land, derelict and contaminated land.

3.2.1 Policy and Legislative Context

Apart from the NSW Local Government Association's Urban Forest Policy (2003) (see Appendix 7.1), there is no policy framework specifically relating to urban forest and how it should managed. However, there is a broad policy and legislative framework of indirect relevance relating to issues such as sustainability, biodiversity conservation, natural resource management and infrastructure provision. This framework exists at a variety of levels; international, national, state, regional, and local.

3.2.2 Measuring the Urban Forest

Many of the techniques used to describe and measure ecological processes operating in natural ecosystems can also be applied to urban ecosystems. There is increasing research interest in this field, as it provides a firm basis for placing quantitative or monetary values on the ecosystem services provided by urban forest. This would enable urban forest investment to be evaluated using conventional cost-benefit analysis or similar techniques.

To date, much of the research has been undertaken in North America and Europe, and can only be applied indicatively to Australian conditions due to major differences in climate, soils, soil microbes, tree species and urban form. Australian research relating to greenhouse gas sequestration is, however, likely to be relevant. There is a pressing need for basic research on the role that trees and other vegetation play in regulating urban microclimatic, atmospheric, water and soil processes under Australian conditions, as well as impacts on a variety of socio-economic characteristics. Further information is attached at Appendix 7.4.

American Forests CityGreen software calculates the ecological benefits of urban

3.2.3 Targets and Indicators

Targets are measurable outcomes that are to be achieved by a given date or other predefined circumstance. They enable the success or effectiveness of actions to be appraised.

It is currently not possible to set specific targets for the quantity or quality of urban forest that would have any basis or validity in Australia. This is due to the lack of relevant quantitative information. However, there is scope to define 'indicators' the measurement of which will highlight changes over time; either positive or negative.

Canopy cover and canopy cover index are of particular interest because of their use as broad indicators of the magnitude of urban forest and its potential to provide multiple benefits. This reflects the importance of tree canopies in providing surfaces for ecological interactions in the vertical space above man-made surfaces such as roads and paving. In addition, canopy cover tends to approximate the extent of subterranean root systems, which also provide significant sites for ecological interactions. At the present time, no work has been undertaken to quantify canopy cover within the Newcastle area.

Tree cover is directly related to environmental quality. Maintaining a robust enough tree cover to function as green infrastructure reduces the need and expense of building infrastructure to manage air and water resources. Computer software developed by the American Forests' organisation assists US cities calculate the environmental and economic values of the ecosystem services that trees provide. As a result cities are integrating "green" into their 'built' infrastructure

American Forest recommended canopy cover targets	
Average tree cover counting all zones	40%
Suburban residential zones	50%
Urban residential zones	25%
Central bus districts	15%

3.3 CHALLENGES FOR THE NEWCASTLE URBAN FOREST

3.3.1 Continuing Reduction of Green Space Area

Backyards and the trees, shrubs and gardens they contain are increasingly being replaced by residential floorspace and impervious pavement. Trends driving this include:

- replacement of old dwellings with new dwellings that have a larger 'footprint' than the original dwelling, often more than twice as large;
- increased preference for private yards to be paved with impervious surfaces;
- growth in the number of vehicles per dwelling, resulting in an increased allocation of private land and public footpaths to paved driveways; and
- infill or urban consolidation initiatives (urban housing projects and residential flat buildings).

Increased densities remove green space & trees, and increase impervious surfaces

The consolidation of established suburbs served by existing transport, utility and social infrastructure is generally recognised as a more sustainable development model than expanding the 'urban footprint' at the urban fringe. However, a consequence of consolidation is the loss of green space, and canopy trees in existing urban areas (principally private green space) as well as an increase in impervious surfaces and heat absorbing surfaces.

Wide driveways reduce public green space area and tree planting potential

As the urban population increases as a result of consolidation, the amount of private greenspace and tree canopy area contracts. This increases demand and therefore pressure on existing public green space. The renewal of Parks and their street linkages with, amongst other things new shade trees, is now increasingly important.

Increasing ground surface imperviousness is an important issue because it alters the hydrology regime to which the present tree population is adapted. This is likely to cause the decline and loss of stressed and marginally adapted trees imposing additional costs, and threatening the attractiveness and liveability of established areas.

Housing trends prevent future tree planting, increase imperviousness and heat

3.3.2 Decline in the Condition of Mature Public Trees

The condition of a substantial proportion of Newcastle's mature street and parkland trees is declining. Much of the tree stock planted 60 to 100 years ago is reaching the stage where natural attrition due to age, accelerated by stress from pollution, soil deterioration, water deficits, wrong pruning, and cramped growing conditions, will occur. Stress weakened trees are more vulnerable to drought, insects and disease, all of which worsen their condition or may even kill them outright.

Mature canopy in Cooks Hill

The decline of aged trees is inevitable and has to be carefully and strategically managed

Practically every New Zealand Christmas Bush *(Metrosideros spp)* that once graced Newcastle's coastal suburbs has died in the past 6 years as a result of a native boring insect. It is estimated that as many as 1000 trees have been killed. Many significant public tree plantings are over-mature and stressed. Most of the city's mature fig trees are approaching the end of their retainable life span and many have become so large that they are causing damage to surrounding buildings and infrastructure. To address these problems, resources are needed to establish a systematic tree maintenance and tree replacement program.

Distinctive character - Parkway Ave

The distinctive character of many of Newcastle's suburbs derives from historical avenue and parkland plantings with species such as Figs, Brushbox and Norfolk Island Pine. The loss of these prominent mature plantings would be unthinkable to many in the community as evidenced by widespread concern at the removal of a number of landmark street and park trees in recent years. More such cases will inevitably arise in the future highlighting the need to begin planning in anticipation.

3.3.3 Effects of Urban Consolidation

In most cases building and subdivision design has not adequately considered the needs of existing and future trees, the planting of which is often seen as a subsidiary matter to be resolved on completion of construction. As a consequence, provision is rarely made for retention of suitable trees or planting of new trees so that they that can co-exist with buildings, utility infrastructure and people without unnecessary conflicts. Similarly, opportunities to modify development design to accommodate appropriate existing trees are rarely taken up. A limited understanding of trees and the lack of suitably experienced arborists to advise early in the design process contributes to this situation.

There is a high rate of injury and removal of street trees during or immediately after construction works. The lack of physical protection of trees and deliberate removal to accommodate driveways contribute to this situation. Such conflicts can be reduced when consideration is given to street trees at the design and assessment stage of proposals. The trend in constructing wide driveway aprons across public footpaths permanently removes the space to plant street trees to compensate for the loss of green space due to infill development.

New villa development design cannot support new trees.

The design of new villas and town houses removes opportunity for establishing even a single medium sized shade tree per lot. For example, restrictions on building height require a larger footprint to achieve the same number of units and results in very small private green spaces that usually preclude tree planting As a result existing tree canopy is diminishing in proportion to the area of new villa and town house construction. Consequences of this include an increase in storm-water runoff and urban heat island effects, and changes in the appearance and character of suburbs. There is a need for innovative design solutions as well as the need to embark on an expanded program of street and other public green space planting to compensate.

3.3.4 Street Trees, Utilities and Infrastructure

There are continuing conflicts between street trees and overhead power lines, resulting from the need to maintain safe clearance around power lines, as well as the placement of powerlines over the spaces customarily used for street trees. Necessary for safety reasons, utility pruning programs are unsympathetic to trees, encouraging misshapen growth, increased susceptibility to disease and reduced aesthetic appearance. As a result, a tree's life expectancy can be significantly

Utili**ty solutions compromise tree health and amenity**

Mature Paperbark trees growing in the confined space of a narrow footpath

reduced, leading to pressure on Council to remove street trees and replace with shrubs. It is also an historical fact that early tree selection did not often consider the realities of urban infrastructure, and could not have anticipated the density and nature of today's infrastructure, or the impacts of today's OH&S legislation and risk management. Conflicts also occur with sewer mains and pipes, footpaths and underground cables. These conflicts often involve mature trees and ageing or obsolete infrastructure (e.g. cracked sewer pipes)

3.3.5 Trees and Use of Private Land

Sometimes there are conflicts between trees and the occupation of private lands that are unrelated to new development or management and maintenance regimes. These conflicts can vary from requests to remove an existing tree due to root problems, the perceived 'nuisance' of leaf litter (eg dropping into swimming pools) and shading, through to requests for pruning of overhanging limbs. In some instances, problems can arise between public trees (street trees, parklands and reserves) and adjoining private property. In other instances, the tree may be located on the owner's property. As with other situations of conflict, an appropriate assessment and maintenance mechanism is necessary to ensure that complaints and requests are appropriately managed.

Large forest Eucalypts quickly outgrow the available space when planted in narrow footpaths and streets

3.3.6 Public Safety and Legal Liability

Trees are increasingly vulnerable in the 'climate of litigation'. The potential for expensive civil claims for personal injury or property damage is creating strong pressures for the removal of public trees, even where they are not causing any specific damage. Trees in public streets, parkland and private property are all affected. Some of these risks are amplified by declining tree health. Risk management objectives often conflict with vegetation management objectives and there needs to be a coordinated approach that considers both.

Trees are increasingly vulnerable in the 'climate of litigation'

3.3.7 Species Selection

There have been major changes in species preferences over the last 150 years. Early street and parkland plantings showed a distinct bias for symmetrical trees (such as Norfolk Island Pines) and glossy-leaved native species from the coastal rainforests (such as Moreton Bay and Hills Figs). This preference was superseded by one for northern hemisphere species during much of the 20th century, to be replaced by a patriotic passion for 'natives' during the 1970s and 1980s. Derived principally from the fire-dependent sclerophyll forests of south-eastern Australia, many of the native species planted in the 1980s have proved highly problematic in many urban settings particularly species of Gum (*Eucalyptus and Corymbia)*, Paperbark,(*Melaleuca)* and She-oak (*Casuarina and Allocasuarina)* .

Research is needed especially on the selection and development of locally indigenous species

There has been little systematic selection and breeding of Australian tree species for urban use which is why the performance of native species is unpredictable and non-uniform. In contrast, many of the exotic species traditionally planted in Australia are the product of long and intensive selection and breeding programs that have produced urban tolerance and uniform performance. Recent trends include a return to exotics, as well as the use of locally indigenous species derived from locally-sourced seed stock. Informal trials using species from east coast dry rainforests also show promise for future urban uses.

Current tree selection is usually largely based on personal preference, and on very limited criteria such as native origins, fashion, flower colour or commercial availability. The result of this approach is an unconsciously-created urban plant community that is essentially experimental. It may take 20 years or more to fully appreciate the consequences, such as dominance by undesirable tree species, unacceptable risk levels, and even unintended changes to fauna composition. A major proportion of Council's street tree maintenance budget is spent on pruning or removing species planted less than 30 years ago.

Species selection needs to consciously create holistically-planned urban settings that satisfy a range of context-specific natural or cultural values. This entails identifying relevant ecological, environmental and urban design objectives for a given site or setting, and then selecting plant species that are consistent with those objectives.

A pre-requisite for this approach will be systematic and context-specific information on the suitability of different species and genetic types (including locally indigenous, native and exotic species) in a variety of urban settings.

However, there is currently limited reliable information relevant to Australian conditions that can be used to address this need. Specific Australian research is needed especially on the selection and development of locally indigenous species as a future horticultural resource. This would promote local character, meet ecological objectives and address practical issues such as risk and suitability in the urban environment.

3.3.8 Climate Change.

Climate change is increasingly recognised as a process that will reshape understanding of which plants grow best in a given place. Predictions of how climate will change are well documented but the potential impacts on the natural environment are not as well understood. (Finlay 2006)

Although the Kyoto Protocol does not apply to urban vegetation, it is expected to alter the political environment surrounding urban vegetation, such that the value of urban vegetation increases. It is possible that the post-Kyoto protocol will include urban vegetation. Either way, there will be an opportunity to increase the public awareness of trees in cities, an opportunity to have the real value of urban vegetation calculated and recognized., and the potential to significantly affect decision making processes. (Moore 2006)

Predicated increased storm intensity from climate change

Mature trees will have a significant place in urban landscapes of the future and they must be managed to ensure that they remain healthy and fulfil the full potential of their lifespans. Through recognizing tree structure, appropriate space needs to be provided for their canopies and root systems. This will reduce interference with root systems, in particular, leading to healthier, longer lived trees and lowered maintenance costs. In order to have trees reach maturity larger spaces to accommodate them need to be a part of sustainable urban design. (Moore 2006)

3.3.9 Management Considerations

Council's Asset Management functions

Management responsibility for trees and vegetation on Council land is divided among a variety of Service Units (see Table 5). Altogether, in 2006, there were 30 Service Elements (over 6 Groups and 16 Service Units) within the Council administration whose decisions or works directly influence urban forest to a greater or lesser extent.

Table 5: Division of responsibility: tree & vegetation assets	
Type of land	Responsible service unit
Community land; Crown or leasehold (parks, sports-grounds, bushland reserves)	Parks & Recreation Unit
Beaches	Facilities Management Unit
Public roads & other non-operational land	Asset Management Unit, City Works (Road Maintenance)
Operational land (eg Summerhill WMF, libraries, museum, community facilities)	Relevant asset operator

The current division of responsibility highlights the need to develop an organisation-wide framework for managing urban forest. For example, greening programs (tree planting, bush regeneration and environmental planting) are not integrated across the organisation. Within these programs, not all staff involved in species selection or stock acceptance are suitably qualified or aware of past experience with various species, or have risk management training suitable for the work.

This arrangement leads to conflicting activities and approaches; missed opportunities for cooperative works; misunderstanding of tree issues and impacts; confused roles and responsibilities; inappropriate species selection, and sometimes poor quality control. As a consequence the survival and establishment rate of new trees is relatively poor and the structure of trees that eventually establish is rarely satisfactory.

Landscape and road median maintenance practices such as tractor mowing, grass and weed control using line trimmers and herbicide applications and road and footway repairs need improvement to reduce tree injury.

Councils built assets in Nesca Park (above). Nesca Park trees (below) are not yet recorded as assets

There is a degree of public dissatisfaction with response times for work requested on street and parkland trees. This is a result of a large backlog of works, insufficient resources, the ageing of street and park trees, past selections, and sometimes unrealistic public expectations. Existing tree programs are focussed on risk management and resource considerations, and seek to deal with high-risk matters first – this means that resources are not being used for scheduled preventative maintenance, thereby furthering the need for future remedial works.

The Major Asset Preservation Program (MAPP) provides a comprehensive asset management framework for structures, facilities, roads and drainage systems. The program now includes 70,000+ public trees and 68Km of creeks. Once the entire natural assets of the city are contained within the program, information will be available to determine the overall quantity, state or condition of trees and vegetation. This information will be used to make decisions about the amount of resources required to maintain and sustain Newcastle's natural assets.

Existing programs are focussed on risk management

In general, investment and maintenance in the public tree resource has not kept pace with development pressures and the attrition of trees under urban conditions. Increased investment in urban forest programs needs to be supported by the adoption of accounting systems that include the value of urban trees, bushland and other natural assets. This would allow changes in the overall value of these assets, as well as returns on investment to be monitored.

Current management approaches to trees and vegetation are essentially reactive. Council has commenced a move to a strategic asset management approach to optimise potential environmental, economic and social benefits from urban forest. This involves a package of measures to:

- review resource levels earmarked for urban forest maintenance and development
- coordinate tree and vegetation planting and development programs
- strengthen the integration between teams whose work may affect the viability or safety of trees and vegetation, particularly in the maintenance area
- embed urban forest assets into Council's Major Asset Preservation Program to ensure its proactive long term management and viability.
- guide the development and establishment of streetscapes across the city

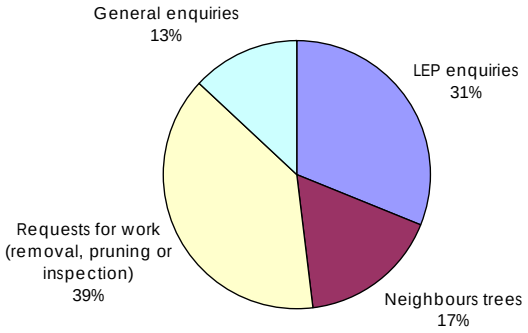
Service Delivery

A major function of the management of Council's trees deals with requests from the public. These requests are currently addressed within a risk management framework, and work is mainly re-active rather than pro-active. As such, work is driven by public requests.

The Urban Trees team receives a high volume of requests in the form of telephone calls, letters and emails regarding Council's public trees. The requests concern:

- Removal of public tree
- Pruning of public tree
- Inspection of public tree
- Planting/replanting following removal of public tree
- Information
- LEP application forms for removal/pruning of private trees
- Assistance regarding neighbours trees

Urban Trees telephone enquiries February 2006



Communication is also received for reporting alleged unauthorised actions, reporting damage to property for insurance claims, and expressing dissatisfaction with service/outcomes.

The Urban Trees team responds to public enquiries with an on-site inspection of the tree in question, using an objective risk assessment framework. This inspection by a qualified Arborist determines the work action required. 100% of requests receive this service within 14 days. Work is then issued according to the risk assessment priority given.

As an example in February 2006, the Urban Trees team reported receiving a total of 562 telephone enquiries. Approximately 61% of these calls were dealt with by phone. The calls that required further action were requests for service. Following is a graph which shows a breakdown of the types of requests received for February.

Council's Regulatory & approval functions

Responsibility for regulatory and approval functions relating to trees and vegetation is divided amongst three Service units (see Table 6).

Table 6: Division of responsibility: regulatory functions for trees & vegetation

Type of land	Responsible service unit
Private land Development approvals, including tree removals & pruning; enforcement	Development & Building Services Unit, Sustainable Planning and Development Urban Tree team assess CDC applications for trees
Community land Advice on tree removals and work in parks, sports-grounds, bushland reserves; enforcement	City Works (Urban Tree Team), City Services Infrastructure Development Unit (Landscape Architecture), City Services
Public roads Advice on tree removals and work in road reserves; enforcement	Infrastructure Development Unit (Landscape Architectural Services), City Services

The Development and Building Services Unit assesses and issues approvals for new development that may impact on both private and public trees, but it is not specifically resourced to deal with tree matters.

In the case of works within road reserves, Council has the dual role of commenting on proposals by public authorities, and authorising private works. Such works have the potential to impact on street and parkland trees, and possibly also privately-owned trees.

Most utilities operate under separate legislation requiring them only to 'consider' Council advice on protecting public assets

The Infrastructure Services team (City Services) assesses major and moderate sized works e.g. cross-city sewer, electricity and communications works and private works not related to development consent. This is undertaken in consultation with the City Arborist and/or the Urban Tree Team, and any tree management requirements are included in the Council's response to the proposal. In most instances the utility operates under separate legislation that only requires it to consider Council's advice on the protection of public assets. Council therefore has no means to enforce asset protection during utility works. In the case of works such as plumbers' road openings, applications are dealt with by phone, and for private driveway crossings approvals are generally dealt with by City Works where there may or may not be any vegetation assessment undertaken.

Utility works often damage public

In many cases, works by utilities, private contractors and residents are not reported to the Council unless removal of a street tree is required. This results in unrecorded injury to public trees and increases Council liability exposure because injured trees are more likely to fail than healthy trees.

Consideration needs to be given to consolidating and simplifying regulatory functions through a clearer allocation of responsibility. This would assist in the coordination of development approvals, separate regulatory functions from operational functions (such as tree removal), as well as enabling greater expertise to be applied in the consideration of proposals.

Trees (Disputes Between Neighbours) Act 2006

In 2006 the NSW government introduced the Trees (Dispute Between Neighbours) Act. The purposes of the Act are to enable the Court to make orders to remedy, restrain or prevent damage to property or to prevent injury to any person when a tree that is situated on adjoining land might cause that damage or injury. The Act also permits the Court to order compensation for or rectification of damage caused by a tree. Previously tree dispute matters where handled though mediation with the Community Justice Centre or Chamber Magistrates and finally the local court system. The Act authorises Council to enter the land to ascertain if the work has been carried out in accordance with the order, and to carry out the work if the owner has failed to do so in accordance with the order.

If Council acted on the authority to enter land to ascertain or carry out the work this would result in Council resources being redirected from scheduled work. Whilst it is not considered that the current legislation will create significant resource issues for Council, consideration will need to be given as to the circumstances that would lead to Council acting in accordance with the authority the Act provides.

The Act will be reviewed in 2008 and it is understood that consideration will be given as to whether Council trees should remain as exempt from the provisions of the legislation. The inclusion of Council trees in the legislation is likely to have resource implications for Council.

3.3.10 Other Major Landowners as Land Managers

The division of responsibility between various State government agencies (such as the NSW Dept of Education and Training and the NSW Dept of Housing) leads to situations where the responsibility for tree selection, planting, maintenance and removal programs falls to individual schools for assessment or to individual housing estate managers. The absence of an overall policy framework and limited knowledge of arboricultural issues results in fragmented decision-making, poor species selection and the loss of retainable trees through poor technical advice. Budget constraints often mean managers employ low skilled labour for maintenance projects that may compromise tree health and longevity.

3.3.11 Land Management

Salt Exposure in Coastal Suburbs

Dixon Park – highly exposed

Before European settlement, the coastal natural vegetation comprised low dense heathland with larger trees confined to sheltered gullies. That natural vegetation has now almost totally disappeared, except for a few isolated and extremely important remnants. Without the benefit of the original heathland Newcastle coastal areas are today extremely exposed to salt laden onshore winds. It is now impossible to establish locally indigenous trees without first establishing substantial shelter.

The inland penetration of salt over several kilometres significantly limits the potential to establish trees. In addition, trees planted in exposed locations become stunted and wind-pruned. Salt penetration also contributes to corrosion of buildings, household appliances and vehicles.

Today's intensive risk management focus precludes once popular coastal species, and borers now prevent New Zealand Christmas Bush from being planted. The only means of improving opportunities for

planting a more diverse range of indigenous trees in coastal areas is to establish hardy front line trees to act as salt-wind breaks. When established these trees will allow a much wider range of locally indigenous species to survive.

Fremantle WA wind and salt sheltered public greenspace

Bar Beach – a highly wind and salt exposed coastal greenspace

There are no front-line tree plantings in coastal greenspaces such as Dixon Park, Merewether and Bar Beach to ameliorate salt ingress or to reduce the discomfort of on-shore wind on the users of local greenspace. Coastal tree planting proposals may be unpopular if seen as a threat to currently unimpeded ocean views. However, the establishment of strategic plantings with species that have the natural ability to 'comb' salt from the wind needs to be closely investigated in consultation with the community. Once the important frontline trees are established, a very wide range of locally indigenous species can be grown and the amenity of coastal greenspace will be significantly improved.

Managing bushfire risk

Fire is an important ecological process in many bushland ecosystems. It also presents a significant risk to buildings, infrastructure and human life. Bushland in close proximity to built assets has to be managed so as to treat these risks in accordance with the *Rural Fires Act 1997* and Rural Fire Service guidelines (*Planning for Bushfire Protection*).

The provision of asset protection zones is an important risk management measure, but where these extend into bushland reserves, they may also cause significant ecological disturbance to bushland remnants, with implications for their long-term viability. This highlights the need for bush fire management practices to take into account likely impacts on biodiversity, and to incorporate ecologically appropriate approaches.

Revegetating cleared land

Almost half of Newcastle's green space occurs on large landholdings at the urban fringe. These areas are important because they provide the setting or context within which the City is nestled. In many cases these lands have been cleared for agricultural, mining or industrial activities that are no longer being pursued. Some sites are in a derelict or contaminated condition. Conservation, regeneration or re-establishment of native vegetation on such land needs to be actively considered for a variety of objectives, such as water management, regional image, habitat connectivity, arresting land degradation, carbon sequestration and contaminated land remediation.

Restoring natural watercourses and riparian habitats

Many of Newcastle's parklands are traversed by channelised watercourses constructed during the early 20th century. These channels were constructed to manage local flooding hazards, and have caused highly deleterious impacts on the ecological condition of aquatic and riparian environments. Other watercourses survive unchannelised, but have also been negatively affected by modification to suit urban development. There is increasing interest in the ecological restoration of these former natural watercourses and their associated riparian zones. Stream restoration will require long-term solutions that consider a wide range of issues such as flood hazards, geomorphology, ecological structure, recreation needs and human population dynamics.

Watercourse requiring rehabilitation

Scope exists to integrate stream restoration with programs for expanding urban forest within parklands, particularly as part of measures to establish and strengthen habitat corridor, and to increase aggregate canopy cover.

3.3.12 Nature conservation

Maintaining the viability of urban bushland & wetlands

Newcastle's green space contains important remnants of native vegetation. These include bushland reserves managed by the Council (415 ha) as well as conservation reserves managed by the National Parks and Wildlife Service (3,900 ha).

Major changes to fire, hydrological and nutrient regimes over the last two centuries, and the introduction of invasive species are degrading the health, condition and viability of these remnants. Fragmentation is a key process threatening their long-term survival due to:

- disturbance along perimeter margins from weeds, fire, and urban runoff;
- disturbance from unregulated use by off-road vehicles and horses using utility corridors traversing urban bushland;
- insufficient area to support many fauna species;
- restrictions on genetic transfer between isolated populations;
- constraints on the movement of nomadic or migratory species; and
- reduced potential for re-introduction of species following disease or other chance events.

The community increasingly values the retention of urban bushland because of its potential to provide recreational, aesthetic, educational, inspirational and other intangible opportunities close to where people live. Managing the long-term survival of these areas in the face continuing disturbance from a growing urban population represents a major challenge.

Emphasis will need to placed on improved management of bushland perimeters, and maintaining fire, hydrological, nutrient and other ecological regimes that more closely mimic natural conditions. Repairing past degradation is also important, particularly for the Hunter Estuary Wetlands which are recognised for their international significance as habitat for migratory birds. The long-term projects of the Hunter-Central Rivers Catchment Management Authority to restore natural salinity regimes in Hexham Swamp is one such case.

Maintaining habitat connectivity

Urban bushland remnants are highly fragmented, and reversing this fragmentation will generally not be possible. However, the effects of landscape fragmentation can be moderated by the provision of habitat corridors. Habitat corridors provide vegetation and habitat linkages that improve opportunities for genetic

transfer and support migratory movements, at least for some species. In 2006 Council Parks and Recreation section began work on the Green Corridors program linking Glenrock SRA and Blackbutt Reserve.

3.3.13 Community

Promoting the value of urban forest as an intergenerational resource that provides multiple benefits to the community

In some instances, trees are seen as being in conflict with development potential and commercial interests (for example, by constraining development of a site or by obscuring commercial signs). There is a need to distinguish between individual interests and broader ecological, social and economic benefits for the community. Promoting the benefits of the urban forest to the wider community will help gain understanding and support in the longer term. Recent US research demonstrates economic benefits where appropriate tree densities are achieved in commercial districts.

Improving city and regional image

Hunter St – a quality precinct

Because of its heritage of mining and industrial activities during the 19th and 20th centuries, Newcastle is typically perceived within Australia and overseas, as having an archetypical 'rust-belt' setting. Such negative image perceptions (whether or not accurate) are unhelpful for attracting labour and investment to a wide range of tertiary sector activities likely to be of importance to the City's economic prosperity during the 21st Century, such as tourism, corporate services, creative arts, research, etc.

Planting improves the amenity and therefore the popularity and viability of commercial precincts

Programs to improve the quality, management and presentation of Newcastle's urban forest have the potential to promote improved city and regional image, and thus should be closely interlinked with regional economic development programs.

An industrial city with a green image

Strengthening community-based management programs

Recent years have seen a phenomenal growth in direct community involvement in the care and maintenance of bushland reserves. Sponsored through the Landcare movement, activities such as tree planting, bush regeneration and weed control have become popular pastimes that not only provide positive environmental benefits, but also help strengthen local communities. Urban forest programs could benefit greatly by strengthening community-based management programs, such as by expanding their range to a wider range of public spaces such as public streets and parklands. Whilst this approach is not suitable in high risk situations, there are many types of work that the community can assist with. Local participation will generate support and understanding for future works.

Improving community information & advice

Whilst tree planting has long been a popular urban activity well supported in recent times for example by the Landcare movement, the practice of whole-of-life tree care or arboriculture as it is known has not been so widely appreciated or practiced. Arboriculture is one of the branches of horticulture within the plant sciences. Arboriculturists, also known as arborists, manage both single trees and trees in small groups. The primary role of the arborist is to develop management programs for trees. Arboricultural practice includes tree assessment, selection, pruning, soil management, disease and pest management, tree felling and tree planting. Arboriculture training is provided by the NSW TAFE Commission within the Australian Qualifications Framework (AQF). Courses range from AQF levels 1 and 2 for operatives and tree workers through to the AQF level 5 diploma course that develops skill for higher level consulting, municipal tree preservation administration and enforcement, and for managing large urban tree populations.

Despite advances in arboricultural training, the private tree services sector remains unregulated and poorly organised even though it involves a very high risk category work type. There are few experienced, skilled arboriculturists in the Hunter region to provide advice to residents, nurseries and developers. This is an emerging area of knowledge, however even in the green industries many have poor understanding of advances in the field and there are numerous unqualified practitioners offering advice. Consequently, incorrect, misleading and alarmist advice on trees is often being provided to applicants and residents resulting in poor quality development applications and illegal works being undertaken on trees.

Council needs to be pro-active in this regard by developing information and education programs and advocating for more qualified operators to enter the industry and to raise the awareness of developers, authorities and residents of the need to engage adequately qualified advisers.

Moreton Bay Figs - Newcastle's century old legacy

4.0 SUMMARY OF MANAGEMENT ISSUES AND CHALLENGES

Well managed natural systems and appropriately selected and maintained trees close to homes, schools and workplaces contribute to the local economy, community health and social well being. In addition the Newcastle urban forest provides services benefiting storm-water management, air pollution reduction, energy conservation and urban heat reduction.

The future of Newcastle's urban forest is influenced by a range of cultural, biological, planning and management issues and challenges.

Table 4 is a summary of the urban forest management issues.

Table 4: Key Urban Forest Management Issues
Public perceptions and the high volume of service requests for urban trees. Council receives on average 25 calls per day, 52% of calls concern public trees and 48% concern private tree regulations. Approximately 19% of requests do not lead to further work and 81% require some form of action. The high service request rate contributes to service backlogs which generates concern at perceived inaction.
Risk management is the primary determinant for Councils' tree works program resource allocation. The risk emphasis hinders the development and implementation of a proactive, scheduled maintenance approach.
The lack of a strategic approach to managing natural systems and public and private trees means a continuation of the current approach is likely to cost more in the future.
Complex tree regulatory provisions. The provisions need to be simplified to reduce their potential to act as a disincentive to the planting and care of trees on private land.
Urban design has not always accounted for the requirements of existing trees, and past tree selections have not always accounted for the nature of surrounding infrastructure. The management of existing trees and planning for future trees needs to be integrated with Councils planning and management systems
Total canopy cover is an effective way of measuring the ecosystem benefits of urban forest. The total canopy area in Newcastle is not known and there is currently no data specific to Australia so the canopy targets used in North America can only be used as a guide.

Table 5 is a summary of the challenges facing the urban forest.

Table 5: Key Challenges facing the Newcastle Urban Forest
The majority of the Newcastle urban forest is in private ownership. The total 'green space' area where trees are or could be grown exceeds 50% of the LGA. Although collectively extensive this 'green space' comprises mostly small discrete spaces. Council controls only 12% of public green space and institutional landholders control 48% of the total private green space.
The continuing reduction of green-space area. Substantially increased dwelling footprints, a preference for pavement in place of pervious ground cover, and a greater allocation of private land and public footpaths to motor vehicles contributes to green-space reduction.
The generally poor condition of public trees. The overall condition of public trees is declining and trees are increasingly under threat from pests, diseases, adverse weather events and a changing climate. The generation of trees planted in 1930-40 is approaching the end of its urban life and will need replacement soon. There is a need to start planning now for the removal and replacement of these trees
The effects of urban consolidation Because of the nature of subdivision design and the increased area of new building footprints it not always possible to retain existing trees or to provide adequate space for future trees on the land. Where trees are retained there is a high rate of injury occurring during demolition and construction work. There is a generally high incidence tree injury and tree loss associated with the building and construction industry.
Utility and infrastructure works and other street and park maintenance practices often unsympathetic to trees. Clearances for power-line safety and trimming regimes are contrary to community expectations for maintaining street amenity. The retention of ageing private sewer systems contributes to increased liability claims against public trees.
Public safety and legal liability makes trees increasingly vulnerable in the prevailing 'climate of litigation' Risks may be increased by declining tree health and condition.
Problematic species selections derived from fire dependant natural systems have proven highly problematic. A high proportion of Councils tree maintenance budget is expended on servicing inappropriate street tree selections planted less than 30 years ago
Opportunities for planting large, long lived trees are reducing as development increases while at the same time community expectations for neighbourhood amenity are rising
Coastal salt exposure reduces the range of tree species that can be grown in City precincts and impacts buildings, vehicles and appliances.
Generally low skill levels and lack of formal qualifications in the regional tree services and consulting sector contributes to poor tree maintenance standards and a lack of quality advice for managing trees on private land.

Photo: One of the largest cultivated Fig trees in Newcastle – growing on former BHP land in Mayfield

He who plants a tree plants a hope.

LUCY LARCOM (1826-1893), U.S. POET.

5.0 GLOSSARY

Arboriculture is one of the branches of horticulture within the plant sciences. It is primarily concerned with the planting and care of trees, and may also include other woody plants such as vines, espaliers, climbing plants and shrubs

Biodiversity – literally 'biological diversity' - refers to the variety of life forms: the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity

Biomass is the organic matter produced by living organisms, including plants, animals, fungi and micro-organisms. It is largely held in woody stems, foliage and soil, and can be used as an indicator of carbon storage. It is measured in terms of mass (tonnes), or mass per unit area (tonnes per hectare).

Bushland is land on which there is vegetation which is either a remainder of the natural vegetation of the land, or, if altered, is still representative of the structure and floristics of the natural vegetation. [From *State Environmental Planning Policy No. 19—Bushland in Urban Areas*].

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

Canopy cover index is a numerical index that expresses the quantity of canopy cover present within a given tract of land as a proportion or percentage of the total area of that land. It provides an indicator of the spacing of tree crowns. Canopy cover index enables comparisons to be made between particular development sites, green space management units and suburbs, as well as with other cities.

Council Management Plan is an operational management plan required to be prepared annually by each council under Chapter 13 of the *Local Government Act 1993*. It outlines strategic directions and summarises proposed activities, objectives, targets, performance measures and resources required for at least the next three years.

Development control plan (DCP) is a type of plan that provides detailed non-statutory guidelines and criteria for the determination of development applications. It is prepared by the Council under the *Environmental Planning and Assessment Act 1979*.

Ecological processes are processes that play an essential role in maintaining the integrity and continuity of an ecosystem. Important ecological processes include water and nutrient cycling, soil formation, fire and evolution by natural selection.

Ecological setting is a means of categorising a given area or site based on the level of disturbance and the dominant ecological processes present. It provides a simple framework for formulating appropriate planning and management responses.

Ecosystem is a dynamic complex of plant, animal, fungal and micro-organism communities and associated non-living environment interacting as an ecological unit. Ecosystems comprise unique units with a recognisable floristic composition, substrate and position within the landscape. Urban areas can be viewed as comprising 'urban ecosystems', reflecting the fact that they are substantially mediated by human processes.

Ecosystem services refers to the life support functions and intangible aesthetic and cultural benefits that are conferred on humans through the operation of ecological processes. They include a wide range of cleansing, recycling and renewal processes, such as climate regulation, air and water purification, soil formation and renewal, waste decomposition and carbon absorption. These services are essential for the operation of social and economic systems, but as they generally cannot be traded like ordinary economic good and services, their value can only be inferred by indirect means.

Green space refers to space within or near an urban area that is capable of sustaining trees, vegetation, or a tree canopy. It includes:

- open spaces that are not built over by buildings or paved surfaces
- paved spaces over which a tree canopy can be established
- roof spaces that can support roof gardens
- wall spaces that can support vines, espaliers or other vegetation.

Green space can be categorised into three basic types depending on ownership, accessibility and land use characteristics: public green space, private green space and institutional green space.

Greening programs are programs concerned with the establishment, cultivation or care of trees or vegetation. They include programs involving:

- planting in streets, parklands, gardens and the like
- maintenance of trees, gardens and landscaping
- regeneration and restoration of native vegetation
- control of invasive species
- maintenance or restoration of supporting ecological processes.

Habitat is a biophysical medium or media:

- occupied (continuously, periodically or occasionally) by an organism or group of organisms; or
- formerly occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced.

Habitat connectivity is a measure of the degree of interconnection of habitat for a particular species.

Habitat corridor is an area of habitat that enables migration, colonisation and interbreeding of plants and animals between two or more larger areas of habitat. Habitat corridors may consist of continuous linear segments of native vegetation, or a sequence of discontinuous areas of habitat, such as feeding trees, caves, wetlands and roadside vegetation.

Habitat fragmentation is the process of progressive loss and isolation of habitat.

Indigenous: vegetation is indigenous if it is of a species of vegetation, or if it comprises species of vegetation, that existed in NSW before European settlement. [from *Native Vegetation Act 2003*].

Institutional green space refers to green space that is owned by public or private bodies, and used primarily for a variety of institutional, utility or operational purposes. Public access to this land is usually not permitted, or is permitted subject to restrictions. It is maintained by various government agencies or private corporations. Examples include schools, tertiary education campuses, hospitals, mines, quarries, heavy industry, ports, airports, transport terminals, railways, freeways, utility establishments and easements, waste facilities, defence land, derelict and contaminated land.

Introduced species is a species that is not locally indigenous.

Local environmental plan (LEP) is a type of planning instrument under the *Environmental planning and Assessment Act 1979*. A LEP provides the broad framework for environmental planning and development control at the local council level, and outlines objectives, planning principles, urban structure, land use controls, approval criteria, and other matters. More detailed criteria are contained in a development control plan.

Locally indigenous species is a species that occurs naturally within a local area and which has genetic material deriving from that local area.

Microclimate means the climate of a confined space or small geographic area

Native means indigenous to NSW (or Australia).

NeighbourWood is a component of urban green space comprising trees forming a woodland structure (as distinguished from forest and rainforest) and which is an integral part of the local community as a result of community participation in its planning, establishment and care.

Private green space refers to green space that is private land, and which is used primarily for residential, commercial, mixed use or agricultural purposes. This land is usually not accessible to the public, and is maintained by individual private owners or occupants. Examples include private gardens and rural properties.

Public green space refers to green space that is public land, and which is set aside specifically for public recreation, nature conservation or public access purposes. This land is freely accessible to the public, and is owned and maintained by government agencies on behalf of the community. Examples include parks, sportsgrounds, cemeteries, bushland reserves and public streets.

Riparian land refers to land that adjoins or directly interacts with a body of water such as creeks, rivers, streams, estuaries, lakes and wetlands.

Sustainability is an approach to development that considers the needs of future generations whilst satisfying present day aspirations. Under the *Local Government Act 1993*, it is part of each local council's charter to promote certain principles of ecologically sustainable development relating to precautionary decision-making, intergenerational equity, conservation of biodiversity and valuation of resources.

Targets express measurable outcomes that are to be achieved by a given date or other predefined circumstance. They enable the success or effectiveness of actions to be appraised.

Urban forest refers to the totality of vegetation that:

- occurs within or near an urban area
- functions as a key element of urban ecosystem
- provides the urban community with multiple economic, environmental and social benefits.

The concept emphasises the collective contribution made by urban vegetation irrespective of its origin, ecosystem type, growth form, location or ownership. It highlights the need for a unified management approach to all vegetation within urban areas.

Urban Forestry is an integrative natural resource management approach recently developed to meet new, urban demands. It embodies a multidisciplinary approach to the planning and management of all forest and tree resources, ranging from street trees to peri-urban woodlands. Originated in North America during the 1960's and 1970's (ref - Konijnendijk, C. Nilsson, K. Randrup, T.B. Schipperijn, J. (Eds) (2005). Urban Forests and Trees – A reference Book. Springer-Verlag Berlin Heidelberg, The Netherlands.

Woodland refers to a broad category of vegetation in which the dominant trees are distinguished from those in forest and rainforest by their height, spacing and crown cover. Typically, woodland height ranges from 10-30 metres and crown cover from 10-30 percent. Woodland can been described generally as "ecosystems that contain widely spaced trees with their crowns not touching"

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National Urban Forestry Unit (UK), http://www.nufu.org.uk
Neighbourwoods research project, http://www.fsl.dk/euforic/
University of Copenhagen Forest and Landscape, http://en.sl.kvl.dk/forside.aspx

North America

United States Department of Agriculture (USDA):
Center for Urban Forest Research (Davis, California), USDA Forest Service, http://wcufre.ucdavis.edu/
Green Infrastructure (US DA), http://www.greeninfrastructure.net/
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North East Center for Urban & Community Forestry, USDA Forest Service,
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Australia

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http://www.waite.adelaide.edu.au/arboretum/
TREENET Tree Research and Education Network, Adelaide SA, http://www.treenet.com.au/index.asp
NSW Local Government Tree Resources Association (LGTRA): http://www.lgtra.com/
International Society of Arboriculture (Australian Chapter)
http://isaac.org.au/

7.0 APPENDICES

7.1 LOCAL GOVERNMENT ASSOCIATION URBAN FOREST POLICY

Adopted by the NSW Local Government Association, November 2003

Definition

Urban forest is defined as the totality of trees and shrubs on all public and private land in and around urban areas (including bushland, parkland, gardens and street trees) and is measured as a canopy cover percentage of the total area, and is recognised as a primary component of the urban ecosystem.

Background

The trees and large woody shrubs that grow anywhere within our towns and cities form what is referred to internationally as an urban forest. Urban forests are managed as a distinct entity by states in the European Community, the USA, and in many parts of Asia, but not in Australia.

The planned, systematic, and integrated management of urban trees is almost universally referred to as Urban and/or Community Forestry. In India it is called Social Forestry. Like its commercial counterpart production or commercial forestry, 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 including micro-climatic influence, stormwater management, oxygen production, pollution filtering, carbon sequestration, prevention of heat absorption, soil decontamination and biodiversity, as well as public and private amenity. 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 and need to be quantified to facilitate effective planning and decision making.

The NSW EPA Act (1979) provides the statutory means to preserve or secure the amenity provided by urban trees. The Act does not describe what amenities urban trees may be worth preserving for. The Act focuses statutory controls on to individual trees rather than on the trees collectively and thus there are numerous different and conflicting Tree Preservation Orders in NSW councils, none of which is capable of addressing the management of urban forests. The result is that NSW councils cannot effectively manage their urban forests to capitalise on the contributions they provide.

In 1978, responding to the destructive spread of Dutch elm disease, the United States Congress introduced the Community Forestry Assistance Act. The Act acknowledged the decline of trees across urban America and identified a need for education, research and funding to reverse the trend. The voluntary American Forests organisation has developed computer software that calculates the contribution of urban forests to storage of carbon, reduction of ultra-violet radiation, reduction of heat energy absorption, the absorption of suspended particulate matter from the air, and stormwater control. Urban ecosystem analysis software has provided US communities with the means to more adequately identify the contribution of their collective urban trees.

Urban ecosystem analysis calculations are derived from measuring the canopy cover of an urban area by the use of aerial photographs and optimal canopy densities have been identified as targets for strategic planning. For example, American Forests recommends 50% canopy cover in suburban areas to maximise the contributions of urban trees.

Research has also identified the positive role of trees in a social context such as improved recovery of hospital patients, rehabilitation of prisoners, and the reduction of violence in public housing estates.

By comparison, Australian states and cities do not recognise the collective ecological and social contributions of urban trees therefore impeding their progress towards achieving ecologically sustainable development. Virtually no research has been conducted on Australian trees for urban use despite an apparent public preference to utilise Australian species.

The future of urban trees in Australian towns and cities is particularly precarious at present because of the unprecedented litigation against tree owners within a climate of blame resting firmly on trees because they interact with inflexible and generally aging civil infrastructure. Utility providers and transport managers, responding to pressure from insurers, are seeking to eliminate urban trees from their infrastructure and their sphere of activity. At the same time, Australia's earliest urban tree populations are entering senescence and declining rapidly. The costs of removal and replacement are beyond the resources of most councils. Government assistance is essential if trees are to remain a part of the urban fabric, as they so rightly should.

This is therefore a critical time to embrace the concept of urban forestry in order to secure a future for urban trees, and for sustainable living in Australia, the most urbanised society on earth.

Vision for urban forests

By 2050 the extent and quality of urban forests will have achieved identified and agreed targeted canopy coverage and will be providing optimal benefits at acceptable costs.

To achieve this by 2010 trees in urban areas will be planted, maintained and managed according to urban forestry principles.

Goal

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, in a manner based on the principles of Ecologically Sustainable Development (ESD).

Objectives

1. To continually improve the knowledge and understanding of good urban tree and forest management by the community, government and industry.
2. To encourage and facilitate involvement by the whole community in the promotion and development of urban forests.
3. In conjunction with local, state and federal government, and the arboricultural industry, identify and undertake research that is relevant to Australian urban trees and forests, and which is urgently needed to achieve better planning and management.
4. To identify threatening processes on urban forests, and to review and improve policies, legislation and environmental planning instruments to ensure the best planning and management for urban forests in NSW.
5. To support the development of the arboricultural industry through a combination of education, legislation, membership of professional organisations, and adequate provision of appropriate arboricultural training and resourcing.

Urban forestry principles

All cities and towns will have an urban forest policy promoting and capitalising on the benefits of the urban forest whilst minimising the cost of such a forest. The policy would incorporate the following management principles:

Planned management

The optimum development of an urban forest will result from sound planning. A strategic plan is fundamental to achieving the optimum extent and quality of the urban forest.

Systematic management

Optimum outcomes from the urban forest will be attained when the resources invested in its management are adequate and are managed efficiently. A systematic approach to management of the urban forest will assist in providing the best cost – benefit outcomes.

Integrated management

The urban forest is an integral part of the urban form. Its management must be integrated with the management of the entire urban environment - built infrastructure and natural places. Managers from all disciplines must work in an integrated manner to achieve the best outcomes for urban areas.

Recommendations

The following recommendations, have been considered and endorsed by the LGA Executive to compliment and further develop the existing urban trees policy of LGA of NSW. The recommendations are that LGA:

1. Adopt the vision, goal, objectives and urban forestry principles above as the basis of an Urban Forests Management Policy.
2. Recognise that the arboricultural industry is a developing industry with the capacity to generate significant employment opportunities within a functional urban forestry management framework.
3. Recognise the Local Government Tree Resource Association as the professional organisation representing local government tree managers, and establish ongoing dialogue with this organisation.
4. Lobby the state government to investigate the need for, and benefits that would be derived from, the development of a joint, integrated inter-governmental approach that facilitates a planned, systematic and integrated framework to best manage trees within an urban forest structure. This urban forest planning framework will embrace the principles of Ecologically Sustainable Development (ESD), and recognise the inter-relatedness of water, soil and air quality issues with urban forest management issues.
5. Lobby the State Government to develop an urban forests management strategy, which addresses the objectives and incorporates the principles of this policy.
6. Lobby the state government to commit or secure funding for research into:
    a) The social, environmental and economic benefits provided by urban trees as individuals, as species and collectively as urban forests.
    b) The performance of Australian tree species under urban conditions, potentially with the view to developing Australian species that are better suited for urban use.
7. Lobby the state government to lobby the federal government to facilitate an inter-governmental approach to urban forestry legislation similar to that in the USA such as the Cooperative Forestry Assistance Act.
8. Lobby the state government to urgently investigate the need to regulate the arboricultural industry with a view to ensuring industry and public safety through:
    a) Suitable occupational health and safety standards in the arboricultural industry.
    b) Appropriate qualifications of people performing tree surgery, including tree removal, and associated tree work.
    c) Appropriate qualifications of consultants who assess, report or make recommendations on the health, safety and treatment of trees.
    d) Compliance with Australian Standards that relate to the arboricultural industry.
    e) Truth in all advertising that relates to tree surgery, removal or assessment.
9. Recommend that its member councils:
    a) Recognise the urban forest as a community asset with values and costs, that will maximise the benefits to the community if managed holistically in a strategic and systematic manner.
    b) Recognise the arboricultural industry, and support best practice tree planting and maintenance.
    c) Integrate tree management expertise with civil design and construction, and strategic planning.
    d) Adopt the urban forest principles identified in this policy.

10. That the LGA:
    a) Recognise the need to continue to develop this policy as information and resources become available.
    b) That the LGA endorse the continuation of a working group to further develop and implement this policy and associated action plan.

7.2 POLICY & LEGISLATIVE CONTEXT

Policies, plans & legislation relevant to Newcastle's urban forest

Category • Relevance to Newcastle's urban forest	Important examples
International agreements • Provide a foundation for national biodiversity policies and legislation • Affect the management of the Hunter Estuary wetlands	• UN Convention on Biological Diversity • Convention on Wetlands of International Importance ('Ramsar Convention') • China-Australia & Japan-Australia Migratory Bird Agreements (CAMBA, JAMBA)
Natural resource management policies and strategies • Set the broad framework for sustainability, natural resource management and biodiversity conservation • Express broad sustainability principles • Are concerned mainly with conserving natural ecological systems outside of urban areas • Except for NSW Local Government Association Policy, do not specifically address the management of urban forest	National policies and strategies: • Intergovernmental Agreement on the Environment (1992) • National Strategy for the Conservation of Australia's Biological Diversity (1996) State policies and strategies: • NSW Local Government Association Urban Forest Policy (2003) (see Appendix 7.1) • NSW Biodiversity Strategy (1999) • NSW Coastal Policy (1997)
Natural resource management legislation • Establishes processes for environmental planning, biodiversity conservation and natural resource management • Planning legislation provides tools for regulating development processes on private land • Local government, Crown lands and national parks legislation provides for management of public land through plans of management • Requirements under rural fire legislation to manage bush fire risk poses challenges for conserving urban bushland	National legislation: • Environment Protection and Biodiversity Conservation Act 1999 State legislation: • Environmental Planning and Assessment Act 1979 • Threatened Species Conservation Act 1995 • Native Vegetation Act 2003 • National Parks and Wildlife Act 1974 • Noxious Weeds Act 1993 • Rural Fires Act 1997
Public utility legislation: • Establishes framework for provision and operation of utility distribution systems • Gives utility operators various powers and immunities relating to trees • Conflicts between trees and utility services, and responses by infrastructure agencies are important urban forest issues	National legislation: • Telecommunications Act 1997 State Legislation: • Electricity Supply Act 1995; Electricity Supply (General) Regulation 2001 • Hunter Water Act 1991 • Roads Act 1993

Policies, plans & legislation relevant to Newcastle's urban forest

Category • Relevance to Newcastle's urban forest	Important examples
State environmental planning policies • Include instruments that regulate development within specialised habitat types • Are an important consideration for development affecting the Hunter Estuary Wetlands and uncleared land at the urban fringe	• State Environmental Planning Policy No. 14—Coastal Wetlands • State Environmental Planning Policy No. 44—Koala Habitat Protection Note: SEPP No. 19—Bushland In Urban Areas does not apply to Newcastle LGA
Regional plans & strategies • Determine regional directions for urban settlement, natural resource management and biodiversity conservation • Regional Strategy will broadly define the extent of the future urban footprint, and the extent to which urban growth will be accommodated through peripheral expansion and infill • Vegetation resources within urban areas are not closely considered	• Hunter Regional Environmental Plan 1989 • Lower Hunter Regional Strategy (in preparation) • Lower Hunter Regional Conservation Plan (to be prepared) • Hunter Central Rivers Catchment Action Plan (in preparation) • Lower Hunter & Central Coast Regional Biodiversity Strategy (in preparation)
Local policies & strategies • Determine local directions for public expenditure and investment, urban settlement, environment protection, natural resource management and biodiversity protection • Directed investment in urban forest can address a variety of objectives outlined in these documents, including objectives relating to economic development, biodiversity conservation, water management, air quality and carbon storage • Programs under this Strategy and Action Plan need to be reflected in the Council's Management Plan	• Newcastle Management Plan (ongoing) • Newcastle Urban Strategy 1998 • Newcastle Environmental Management Plan 2003 • Newcastle Biodiversity Strategy 2006 (draft) • A Sustainable Water Cycle Policy for Newcastle (2004) • Newcastle Coastline Management Plan 2003 • Newcastle Airshed Management Action Plan 2005 • Greenhouse Action in Newcastle Plan • Green Corridors and Landscape Precincts Plan 2005
Local planning instruments • Determine the location, design criteria and infrastructure needs of future development • Consent requirements for 'tree management' under the Newcastle LEP focus on maintaining existing individual trees, but do not provide a framework for maximising aggregate tree cover, nor do they address development processes that govern the removal of trees on private land • Contributions plans (section 94) are a potential option to finance investment in urban forest	• Newcastle Local Environmental Plan 2003 • Standard Instrument (Local Environmental Plans) Order 2005 (draft) • Contributions plans

Policies, plans & legislation relevant to Newcastle's urban forest

Category • Relevance to Newcastle's urban forest	Important examples
Technical & design guidelines • Provide guidelines on specialist issues such as landscape design, bush fire protection, risk management, biodiversity conservation, weed control and arboricultural practice • Updated landscape design principles and guidelines are required to address the issue of achieving greater compatibility between building design and the needs of trees	• Newcastle Development Control Plan 2005 (incl. technical manual relating to landscaping) • Coastal Design Guidelines for NSW • Planning for Bushfire Protection (RFS) • Australian Standard AS 4373-2006 Pruning of Amenity Trees NATSPEC Specifying Trees. Construction Information Systems 2003
Management plans • Specify programs of action for managing public land and individual privately-owned properties • Conservation agreements that are linked to management plans and financial incentives are a potential means of managing vegetation on large rural landholdings at the urban fringe (eg adjoining Hexham Swamp)	• plans of management for community land: Bushlands PoM, Heritage Places PoM, Playgrounds PoM, Sportsgrounds PoM • Kooragang Nature Reserve and Hexham Swamp Nature Reserve Plan of Management; Pambalong Nature Reserve Plan of Management • property vegetation plans and conservation agreements applying to private rural properties
Performance evaluations • Report on the extent to which the objectives and implementation measures have been achieved • There is scope for state of the environment reports to address urban forest issues, such as aggregate quantity, condition, and value of benefits provided.	• Annual state of the environment reports • Newcastle Sustainable Indicators Project • management audits for individual sites or properties

7.3 URBAN FOREST BENEFITS AND VALUES QUANTIFIED - SOME EXAMPLES

Microclimatic regulation

Trees can intercept up to 90% of solar energy falling on a building. *Source:* G.M. Heisler (1986) 'Effects of individual trees on the solar radiation climate of small buildings,' *Urban Ecology* 9: 337-359.

Shading plus transpirational cooling from leaves results in cooler air temperatures in summer, with areas having more vegetation and less surface sealing being up to 8º C cooler. *Source:* S. Pauleit and F. Duhme (2000) 'GIS assessment of Munich's urban forest structure for urban planning', *Journal of Arboriculture* 26(3): 133-141.

A 5% increase in canopy cover can reduce summer air temperatures by 1-2ºC. *Source:* E.G. McPherson and R.A. Rowntree (1993) 'Energy conservation potential of urban tree planting', *Journal of Arboriculture* 19(6): 321-331.

Increasing tree cover by 25% in Sacramento (California) and Phoenix (Arizona) is calculated to decrease mid-summer temperatures by 3-6ºC. Source: Miller, R.W. (1997). *Urban forestry: planning and managing urban greenspaces*. Second edition. Prentice Hall, New Jersey [pp.63-65].

Soil & water management

Trees act as mini-reservoirs intercepting precipitation, storing it on leaves and slowing its decent into the soil, assisting infiltration. Urban forest in Sacramento, California has been shown to intercept 11% of annual rainfall. *Source:* Q. Xiao, E.G. McPherson, J.R. Simpson and S.L. Ustin (1998) 'Rainfall interception by Sacramento's urban forest', *Journal of Arboriculture* 24(4): 235-244.

Air quality control

Air pollutant removal by trees in Sacramento, California has been estimated as 1,457 tonnes annually, with an annual value of US $28.7 million. *Source:* K.I. Scott, E.G. McPherson and J.R. Simpson (1998) 'Air pollutant uptake by Sacramento's urban forest', *Journal of Arboriculture*, 24(4): 224-234.

Carbon storage

Annual removal of atmospheric carbon dioxide by urban forest in Sacramento County, California has been estimated as 304,200 tonnes, worth US $3.3 million. *Source:* E.G. McPherson (1998) 'Atmospheric carbon dioxide reduction by Sacramento's urban forest', *Journal of Arboriculture*, 24(4): 215-223.

Economic

Energy savings

Trees planting can contribute to air-conditioning energy savings as high as 80%, but savings of 25-50% are more common. *Source:* A.K. Meier (1991) 'Strategic landscaping and air-conditioning savings: a literature review,' *Energy and Buildings* 15-16: 479-486.

Energy savings can be very significant at city, regional and national scales. This has been recognised in the USA through partnerships for tree planting involving citizens, power utilities and government agencies, including the Cool Communities and TREEPOWER programs. Source: R.W. Harris, J.R. Clark and N.P. Matheny (2004) *Arboriculture: integrated management of landscape trees, shrubs, and vines*, 4th ed., Prentice Hall, New Jersey [p.107].

Urban forest in Sacramento County, California, has been estimated to provide annual energy savings of about US $20 million. Total peak savings were about US $6 million, based on avoided costs from deferred investment in new generation capacity. *Source:* J.R. Simpson (1998) 'Urban forest impacts on regional cooling and heating energy use: Sacramento County case study', *Journal of Arboriculture* 24(4): 201-214.

Urban forest in California reduces air-conditioning energy use by 2.5% (worth US $490 million) and peak load use by 10% (worth US $780 million). *Source:* E.G. McPherson and J.R. Simpson (2003), 'Potential

energy savings in buildings by an urban tree planting programme in California,' *Urban Forestry & Urban Greening* 2: 73-86.

Property and rental value

A study on the effect of landscaping and trees on office rental rates in Cleveland, Ohio (USA) found a strong positive effect for those buildings with good landscape aesthetics and building shade, adding approximately 7% to the average rental value. *Source*: Laverne, JR and Kimberly Winson-Geideman (2003) 'The Influence of Trees and Landscaping on Rental Rates at Office Buildings', *Journal of Arboriculture* 29(5): 281-290.

Consumer behaviour

A US national survey evaluated public perceptions, patronage behaviour intentions and product willingness to pay in relation to presence of trees in streetscapes. Results suggested that consumer behaviour is positively correlated with streetscape greening. *Source:* Wolf, K.L. (2003) 'Social Aspects of Urban Forestry—Public response to the Urban Forest in Inner-City Business Districts', *Journal of Arboriculture* 29(3): 117-126.

Overall cost-benefit

Several benefit-cost analyses for urban forests have been undertaken. For Modesto, California, the total, benefits of US $4.8 million outweighed total costs of US $2.6 million to give a benefit-cost ratio of 1.85:1. *Source:* E.G. McPherson and J.R. Simpson (2002) 'A comparison of municipal forest benefits and costs in Modesto and Santa Monica, California, USA', *Urban Forestry & Urban Greening* 1: 61-74

Landscape Amenity

Evaluated as a simple landscape amenity the value of Vancouver's street trees was assessed at over $500 million. The city of Edmonton's 103,000 boulevard trees and 142,000 park trees were valued in excess of $800 million. The Toronto urban forest exceeds $16 billion. *Source:* Farr, K. (2004) 'Sustainable Development—Evolving Urban Forest concepts and Policies in Canada', Research Brief, Natural Resources Canada, 6 (4) .(http://policysearch.gc.ca/page.asp?pagenm=v6n4_art_09)

7.4 MEASURING URBAN FOREST

Measuring urban forest

The following table briefly summarises a number of important variables used in the description and quantitative measurement of trees and vegetation, and outlines their significance to managing urban forest.

Quantitative & other urban forest variables		
Variable	Explanation	Significance
Tree dimensions	Height, crown width, trunk diameter, etc.	These measures have an important bearing on the suitability of different species in particular urban settings.
Growth rate	The annual rate of growth in height, trunk diameter, etc.	Fast-growing species produce quick results, but often have only short life expectancies.
Life expectancy	The average age in years that a tree will survive before succumbing to injury, disease, pollution, old age, etc.	Varies between species, and is affected by local environmental conditions. Average life spans in urban areas are often much shorter than under natural conditions. Is an important consideration because it determines the rate at which trees need to be replaced in order to maintain the total stock of trees in a healthy condition.
Canopy cover (or crown cover)	The total area contained within the vertical projection of the periphery of tree crowns (or other overstorey).	Provides a measure of the extent of urban forest in absolute terms (hectares, square kilometres). The aggregate quantity of benefits provided by urban forest is notionally correlated with the amount of canopy cover. Can be determined by remote sensing, aerial photos and field surveys.
Canopy cover index	The quantity of canopy cover present within a given tract of land, expressed as a proportion or percentage of the total area.	Provides a measure of the spacing of tree crowns. The higher the index, the closer the distance between crowns. Can be used as a target for the amount of canopy cover to be attained within specific areas. It can be applied at a variety of geographical scales, such as for a development site, for a district or for an entire urban area. Note: canopy cover index does not measure canopy density or openness—it takes no account of leaf characteristics.
Leaf area index	The total area of one side of all the leaves contained within tree crowns, expressed as a proportion of the total area contained within the vertical projection of the periphery of the crowns.	Provides a measure of the amount of surface area available for rainfall interception, gaseous exchange and other ecological interactions. It is often employed in quantitative analyses. Varies between species due to differences in leaf characteristics.
Nutrient cycling	The annual inputs, outputs and storage of nutrients within the system.	Often employed in quantitative ecological analyses (for example, calculations relating to the storage of greenhouse gases).
Biomass	The amount of organic matter held in woody stems, foliage and soil. Can be measured as an absolute amount (tonnes), or as a spatial concentration (tonnes per hectare).	Provides an indicator of carbon storage.
Vegetation structure	Classification of vegetation according to the dominant growth forms (trees, shrubs, grasses, etc), their height and spacing.	Used to distinguish different vegetation communities.
Vegetation floristics	Characteristics of vegetation relating to its species composition and diversity.	Used to distinguish different vegetation communities.

Targets & Indicators

The following table lists six simple and provisional indicators that can be used to illuminate whether any improvements are being achieved in the quantity and quality of urban forest.

Indicators for evaluating urban forest improvement
Indicator 1: Canopy cover [hectares, square kilometres] Canopy cover provides an indicator of the quantity of urban forest, and thus of its general capacity to provide ecological, economic, social and aesthetic benefits. Significant expansion in such capacity will require commensurate increases in canopy cover. **Indicator 2: Canopy cover index** [proportion or percentage] Canopy cover index is a measure of the spacing of tree crowns, and thus provides a useful indicator of the relative proportion of canopy cover within different locations or settings. It can thus be used to make comparisons between particular development sites, green space management units and suburbs, as well as with other cities. Such comparisons will be necessary to identify locations with the greatest potential to accommodate and benefit from increased canopy cover. **Indicator 3: Biomass** [tonnes; tonnes per hectare] Biomass is the organic matter held in woody stems, foliage and soil. As well as a general indicator of the quantity of urban forest, it can be used in quantitative analysis of the removal of carbon from the atmosphere. This also requires some understanding of the likely longevity of removal. **Indicator 4: Age profile** [average or median age in years] The age profile of trees provides a broad indicator of tree health and whether the tree stock is being sustained on an intergenerational basis. Increasing median age indicates insufficient recruitment of young trees to replace ageing trees. This indicator is highly relevant to planted trees in streets and parklands. However, it also a relevant to many urban bushland communities due to the disruption of natural regeneration processes such as fire. **Indicator 5**: Public investment & expenditure [constant value $] Expenditure on urban forest programs provides a non-specific indicator of the level of organisational response and commitment. Because of historic under-investment, increased expenditure (in real terms) is likely to be required merely to maintain the existing stock of trees and vegetation. Net improvements will require further increases. **Indicator 6**: Habitat connectivity Habitat connectivity is a measure of the degree of interconnection of habitat. It is an important issue for managing remnant native vegetation in a unified manner across different land tenure units. Simple and practical options for measuring habitat connectivity need to be explored, such as percentage of habitat corridor length having adequate width, habitat condition and adequate protective measures (reserves, conservation agreements, etc).

7.5 EXTENT OF URBAN GREEN SPACE IN NEWCASTLE LGA

Extent of urban green space within the Newcastle local government area				
Category	Type of land	Area (ha)	% of UGS	% of LGA
Public green space	Bushland reserves	414.1	4.2%	2.2%
	Sportsgrounds	376.9	3.8%	2.0%
	Neighbourhood parks	428.6	4.3%	2.2%
	Total community land managed by NCC	1219.6	12.3%	6.3%
	Crown reserves managed by other bodies	Unknown	-	-
	NPWS reserves	3922.1	39.6%	20.4%
	Land in public roads not set aside for vehicles	Unknown	-	-
	Total public green space	5141.7	51.9%	26.7%
Private green space	Major landholdings	4770.6	48.1%	24.8%
	Private gardens and yards	Unknown	-	-
	Total private green space	4770.6	48.1%	24.8%
Total urban green space (UGS)		9912.2	100.0%	51.5%
TOTAL NEWCASTLE LOCAL GOVERNMENT AREA (LGA)			19234.0	100.0%