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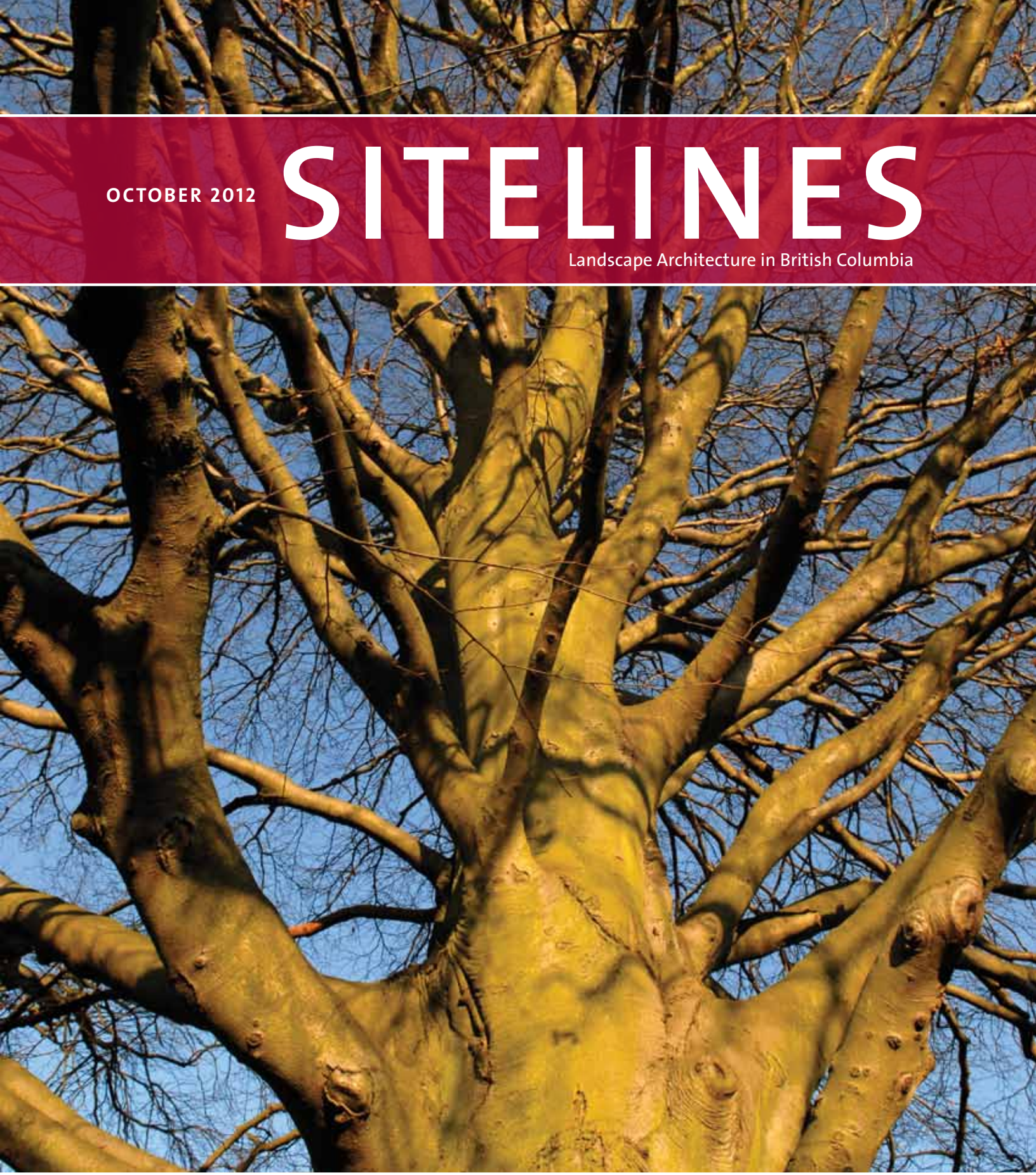

TREES IN THE URBAN LANDSCAPE

Trees in the Urban Landscape | Up By Roots | Reversing the Trend of Urban Deforestation in the UK | Sustainable Urban Forest Management Planning | Economics of City Trees

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By Julian A. Dunster, RPF, MCIP, ISA Certified Arborist,
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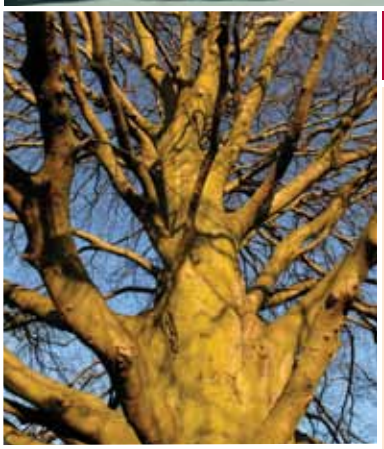
All images courtesy
of Julian A.Dunster.

TREES *in the Urban Landscape*

They surround us in most urban landscapes. They help to define how your designs will mature, and yet, they are increasingly at risk on many fronts. Trees have many roles to play beyond an aesthetic dressing that softens the hardness of the built environment. Benefits include shade, screening, greenery, tracery, air quality improvements, storm water retention, framing of views, added value to property, carbon storage, and overall urban ambience. Yet, successful long-term creation and maintenance of the urban forest requires so much more than simply plopping trees in the ground.

In this special issue we explore the challenges of growing trees in urban areas. Some of these challenges are longstanding. Poor nursery stock, poor installation practices, and yes, poor design work mean we waste both time and money and don't see the benefits that were promised. But, lurking in the background is another challenge of a much larger magnitude: climate change. Major shifts in local and regional weather patterns will bring equally major shifts in the design standards required. ►

Tree-lined residential street – Palo Alto, CA.



Copper beech at sunset.
Image courtesy of Julian A. Dunster.

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Continued from page 3.

For decades there have been predictions of what may happen. I recall hearing the forest ecologist Dr. Jerry Franklin predict, about two decades ago, that if it occurred, an early warning would be decline of the western red cedar and western hemlock in the native Pacific Northwest forests. It's here. The US Forest Service is now documenting ongoing decline in the backwoods. More obviously, look at the red cedars in the Lower Mainland—sparse foliage, drab foliage colour, dieback, and in some cases they die. The long hot dry summers are creating drought conditions in urban areas that are unprecedented within the last few hundred years of record keeping in North America. The mountain pine beetle, which may be the largest pest epidemic in the world, has killed off pine in the forests and the urban landscape. Its outbreak is attributed to climate change or, the lack of long bitingly cold winters. Similar stories are now well documented around the world.

Quite how we can deal with these massive changes is uncertain. In this issue we explore a few different aspects. James Urban, FASLA, ISA, looks at what trees really need to flourish—it's called soil. If you have not seen his book *Up By Roots*, you need to get it, read it, and start practicing the lessons learned.

Philip van Wassenaer discusses urban forestry plans and the underlying principles needed. More information can be found in the newly released Canadian Urban Forestry Strategy at www.treecanada.ca/site/?page=publications_download&lang=en. From the UK, Jeremy Barrelll, FArborA, CBiol, FICFor, FRICS, outlines changes taking place in the nursery industry so that trees are "fit for purpose" not just "fit for profit"; a change that will become increasingly important as the results of climate change become more obvious. Dr. Kathleen L. Wolf, looks at the value added benefits of urban trees and outlines some of these.

It is far from a comprehensive review—more of a small start to give an introductory flavour. Yet, as I work with the design professions on construction sites, and planning and design projects, I am constantly aware of how little effort is made to ensure long-term success for our urban trees. Trees need to be more than window dressing. They can provide many long-term benefits. That will only happen if we improve standards, nursery quality, planting, and after care specifications, and above all, understanding that trees need a whole lot more care and thought than we currently give them.

That starts with the design professionals, and the way that you plan for the trees to develop in the landscape. With better practices on many fronts we can move towards a lasting legacy for future generations. SL

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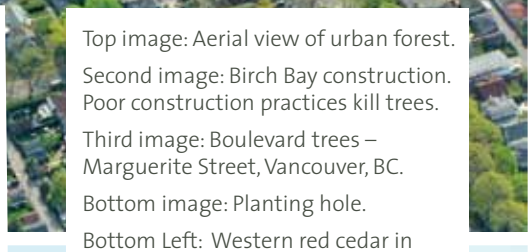


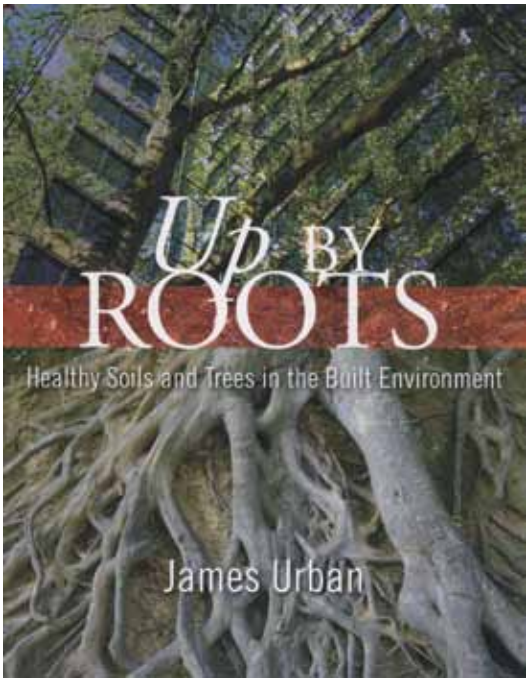
Top image: Aerial view of urban forest.

Second image: Birch Bay construction. Poor construction practices kill trees.

Third image: Boulevard trees – Marguerite Street, Vancouver, BC.

Bottom image: Planting hole.

Bottom Left: Western red cedar in deck by garage.



Up By Roots: HEALTHY SOILS AND TREES IN THE BUILT ENVIRONMENT

By James Urban, FASLA, ISA

A large-canopy tree is not only beautiful—it also benefits its community. It provides shade and shelter, protects air quality, and reduces air temperatures, water runoff, and human stress. A street, lined with such trees, is a desirable place to live and work, and a community with many large trees is attractive to visitors, residents, and businesses.

Growing large-canopy trees is a worthwhile investment and a cornerstone of today's movement toward sustainable communities. Yet the designers of today's built environments continually make mistakes that doom their trees to failure. We wouldn't hesitate to condemn an engineer who designed a building without being sure the columns would support its weight. Yet we allow designers to populate our landscapes with trees that have little chance to grow to canopy height.

The success of a tree is fundamentally linked to the soil in which it grows. Seems obvious, doesn't it? Yet this simple idea has had trouble taking root (so to speak) in the public realm.

To provide benefits to the community, trees must be put into built environments in entirely new ways. This introduction offers some basic principles for successful trees. If you find it useful, I encourage you to read the rest of *Up By Roots: Healthy Soils and Trees in the Built Environment* and to share this book and its ideas with the people who plan and maintain trees in your community.

Make the Space Right for the Tree

Ten years ago, James Patterson, then a soil scientist with the National Park Service, speculated that as many as, "90 percent of all urban tree problems are soil-related." Far too often, trees are planted in poor soil, soil with poor drainage, high levels of compaction, chemical imbalances, or other forms of contamination. With such disadvantages, trees are more likely to suffer disease, insect infestation, premature decline, and even death.

Some trees decline as a result of poor nursery stock or from inadequate or inappropriate maintenance. Yet in most cases, trees in good soils can overcome these problems. Without question, starting with proper soil is the most important factor in growing healthy trees.

The success of a tree is fundamentally linked to the soil in which it grows.

For years, the arboricultural profession has supported putting, "the right tree in the right place." This concept directs a designer to understand the planting site conditions, including soils, drainage, and aboveground conditions, and to find a tree species that matches those conditions. As soil in urban areas becomes increasingly degraded, there are fewer and fewer tree species that will grow in it. At some point on the road from the forest to "Main Street", soil becomes so poor that almost no tree is "right." The results are city streets with minimal species diversity, and inner-city areas containing limited numbers of poor-quality trees.

If the goal is to create a diverse urban forest with healthy trees, we must design soil environments with that goal in mind. After determining which trees best fit a project's aesthetic, environmental, and technical goals, we must adapt the project site to those trees' requirements. We must, "*make the space right for the right tree.*"

This approach does not assume a perfect world. Budgets, political issues, and physical restraints on soil improvements will still limit the number and quality of trees. Yet designers should no longer resign themselves to accepting difficult growing conditions. Instead, they must make a strong case so they can grow trees that meet the goals of the design. Budgets for soil and trees will need to be increased to provide a better ▸

balance between trees and other elements of the design. Design fewer trees, but make allowances for soil conditions to support each one as a healthy, long-lived specimen. We can thus significantly increase the number of tree species in the urban environment. Trees will live longer, require less maintenance, and provide the benefits expected when the tree was planted.

Trees Need Dirt

The fates of trees and soil are absolutely interlinked. Trees planted in urban areas by people who ignore their soil needs are likely to fail.

If you are hiring a design firm, landscape contractor, or an employee to undertake the planning, design, or installation of trees, make sure that they have knowledge of both soils and the biology of trees. Do not assume that they know these things just because they are landscape architects or landscape contractors. Despite the name, landscape architects get little training in plants, especially the biology of trees. Coursework in the science of soils is almost nonexistent.

If you are a citizen, make sure the people purchasing landscape design and maintenance services with your tax dollars are employing consultants trained in the science of trees and soils.

If you are a landscape architect, architect, engineer, or other professional who designs landscapes that affect the way trees grow, please read *Up By Roots* and use it as a desk reference. Attend seminars that include training in tree and soil issues, and read professional journals that discuss the science of trees and soils. Finally, adopt tree biology and soil requirements as an inspiration for your design philosophy.

Up By Roots is an approach to designing landscapes, but also an approach to thinking about the role of trees and landscapes in your community. A large, healthy tree is an investment in sustaining a healthier, more inviting world. SL

This extract is published with permission. Copies of Up By Roots are available from the International Society of Arboriculture at: www.isa-arbor.com/store/product.aspx?ProductID=12&CID=-1 or call 1-888 4722 8733.

Reversing the Trend OF URBAN DEFORESTATION IN THE UK

By Jeremy Barrell, FArborA, CBiol, FICFor, FRICS

Failed tree planting.
All images courtesy of Jeremy Barrell.

The UK has a robust national green belt planning policy that seeks to prevent urban extensions into rural areas and confine new development within existing settlement boundaries. This has been very successful at restricting urban sprawl and conserving our unique rural character, but it has put immense pressure on green space within our towns and cities. Trees have been one of the most obvious casualties because they are sensitive to change and their multiple benefits were significantly undervalued when balancing development priorities. Those losses of existing trees have been compounded by ineffective new planting that often dies or struggles to mature into fitting replacements. These combined impacts have gradually eroded our urban canopy cover to the extent that the UK's ability to adapt to climate change is becoming increasingly compromised.

In 2008, through the Climate Change Act (www.legislation.gov.uk/ukpga/2008/27/contents), the UK legally committed to mitigate the impacts of climate change through an ambitious target of an 80 percent carbon generation reduction on the 1990 levels by 2050. Additionally, the Act covered the importance of adapting the urban environment to make our living conditions more comfortable. In tandem with these strategic developments, there has been a mounting body of research evidence cataloguing the multiple benefits that trees provide, reinforcing their importance as an essential component of a healthy urban environment. As communities begin to appreciate the contribution of trees to their physical and psychological wellbeing, optimizing canopy cover is becoming an increasingly urgent priority. However, decades of urban deforestation has created a culture of complacency over the loss of trees, and reversing the current trend is proving a stiff challenge.

Historically, much of the tree loss arose directly through development activity, where existing residential and commercial plots were subdivided to increase the intensity of use and reduce the pressure to expand into rural areas. Mature trees take up lots of space and were often sacrificed or poorly protected in the drive to maximize development potential. More recently, improvements in the application of existing planning legislation and advancements in technical capabilities to install structures close to trees has significantly improved our performance on construction sites. We now know how to effectively protect important trees, which has made a significant contribution to slowing the rate of canopy cover loss.

Disappointingly, similar progress cannot be claimed for establishing new trees to replace those being lost. We know large numbers of new trees are being planted ►

because nursery sales are buoyant, but there is also visible evidence all around us that many never reach their full potential. They do not necessarily die, but they frequently struggle to develop into the healthy and mature trees needed to provide effective climate adaptation benefits. Moribund and small trees will not improve the resilience of our cities to the impacts of climate change, a realization that has prompted some detailed analysis of UK tree production and planting practices.

It seems that part of the problem lies with nursery production and the lack of control that the buyers have over the long term quality and viability of the product. Growing trees is a competitive business, strongly influenced by the need to maximize returns at the nursery gate. Producing the biggest tree in the shortest time, using the smallest amount of space, is a recipe for profit and has dominated conventional nursery practice. This has driven species selection towards the fastest growers, not the best survivors. On site, the buyer wants a tree that will cope with difficult growing conditions, establish with minimal maintenance, and live a long time. Although the new tree initially appears to be fit for purpose, because it has been grown to look good at the point of sale, it is often not well-equipped to adapt to difficult conditions, the weakest take years to decline or die and the delay is too long to seek redress. The length of time between supply and final tree death, often measured in decades, means that suppliers have continued to get away with growing trees for short term profit, while communities pay the long term price of failing to meet canopy cover targets because the new trees do not perform as expected.

Against this unsatisfactory background, arborists in the UK are welcoming the British Standards Institution (www.bsigroup.co.uk) announcement of a new British Standard being developed. *BS 8545 Code of Practice for trees: From nursery to independence in the landscape*, is being prepared by a panel of industry experts intent on identifying the main problems in the production system and offering best practice guidance for buyers looking for long term performance. With a target publishing date of 2013, hopes are high that this may offer a rare opportunity to break the suppliers' grip on this market and allow managers to buy trees that are fit for purpose, not fit for profit.

In response to these emerging pressures, UK nurseries are beginning to recognize that addressing these concerns provides a business opportunity and are investing heavily in offering solutions. Private enterprise is blazing the trail in an absolute absence of any valuable progress from any other direction. As a result, a series of innovative approaches are emerging, including:

- **STEM TAPER:** The traditional, profit-driven approach to growing trees makes good business sense, but it has a tendency to produce tall and thin stems with little taper, sometimes unable to stand without a stake! However, experience and emerging research is indicating that sturdy stems with a natural taper can improve survival after planting; a simple change that seems to make a big difference. Barcham Trees (www.barcham.co.uk) has been pioneering growing trees at wider spacing and retaining low branches to increase stem taper, and are hopeful this will give their product an edge in the market place.
- **LONG TERM TREE VITALITY:** Traditionally, the assessment of the quality of new trees was focused on physical characteristics (mainly size and structure), but these often have little bearing on the potential of the tree to successfully establish to independence in the landscape. Barcham, in association with Bartlett Tree Experts (www.bartletttree.co.uk), has been investigating whether tree vitality characteristics such as chlorophyll fluorescence, leaf chlorophyll content, and electrolyte leakage can reliably indicate tree health. The research is not yet published, but the hopes are that such measurements will form the basis for health certificates, adding an extra layer of confidence for the buyer that their tree investment has the potential to survive and thrive into the long term.
- **INTERACTIVE TREE SELECTION:** Big semi-mature specimens represent a significant investment and it is natural for buyers to seek assurance that each tree will produce the instant impact they want. Barcham believes that being able to see the tree you are going to buy is a marketing advantage, but you can decide for yourself at www.buythetreeyousee.com.

Without private enterprise working on these matters, there would be no progress (and in case there is any confusion, I have no business connections whatsoever with Barcham or Bartlett and so I have no vested interest in promoting them). The simple fact is that they are the only ones doing it – this is the cutting edge and it is not coming from researchers.

These initiatives demonstrate a significant break from traditional, purely short term profit-driven approaches to tree production. For the first time, buyers are articulating what they want for their money and growers are having to respond with creative ways of growing trees with better survival

Left: Barcham Trees.

Right: Urban deforestation.

potential. Indeed, the most visionary growers are already investigating a range of new ideas focused around producing a tougher tree that hits the ground running when transferred from nursery to the street. Reducing fertilizing regimes to grow trees more slowly, searching for new provenances that can better cope with urban conditions and reducing nursery watering to reduce reliance on post-planting maintenance, are all avenues with the potential to deliver significant improvements in new tree planting survival rates.

Although the UK got off to a bad start, those failures seem to have kick-started a new approach to street tree production, which can only improve our chances of adapting to the inevitable extremes that climate change will bring. SL

Jeremy Barrell is an international speaker and writer on trees, planning and climate change, based in southern England. www.barrelltreecare.co.uk.

SUSTAINABLE URBAN FOREST MANAGEMENT PLANNING

By Philip van Wassenaer

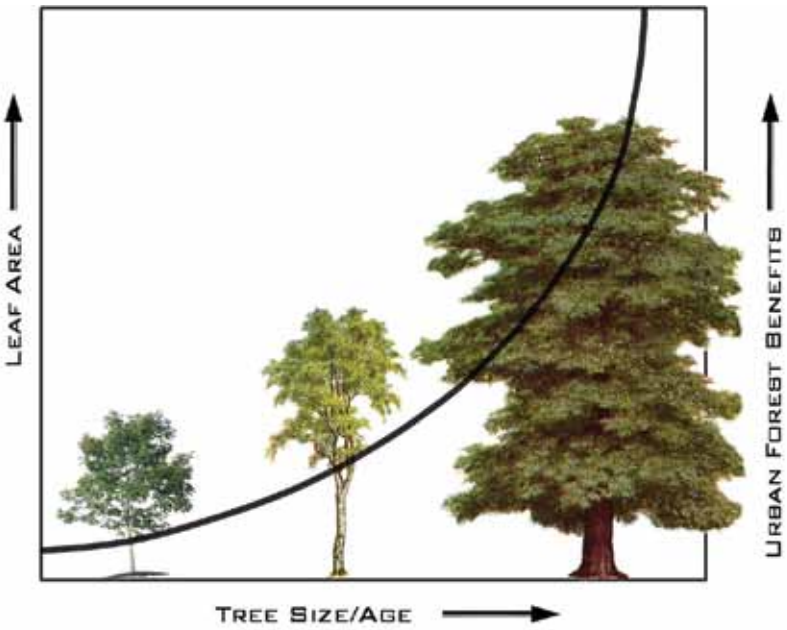


Figure 1: Demonstrating the exponential increase of benefits with increasing tree size.

The benefits provided by healthy and well-managed urban forests are far-reaching and extensively documented.[1, 2, 3, 4, 5, 6] There are, however, many challenges currently facing trees in urban and peri-urban areas. Generous estimates suggest that the average lifespan of a typical urban tree is 32 years and that many newly planted trees do not survive their first year.[7] A number of factors contribute to such dismally short life spans and, as a result, few urban trees are ever able to reach their full genetic potential to provide important social, economic, and environmental services for urban residents. Since these services or benefits increase exponentially as tree size increases (Figure 1), extending the lifespan of urban trees through good management is increasingly important for Canadian municipalities.

Cities and their surrounding areas are complex and dynamic entities. A wide range of decision-makers, stakeholders, and interest groups are active in setting the agenda in most communities, and urban forest managers must compete with other interests for limited resources. In spite of the additional challenges posed by invasive species, development intensification, climate change and other stress factors, a solution to effective urban forestry in this context lies in good planning that balances the need for immediate action with the need for a long-term vision. Effective planning can support the development and implementation of proactive, as opposed to reactive, management approaches in a strategic and collaborative fashion. Proactive management leads to tangible results in the form of increased operational efficiency, risk reduction, increased urban forest canopy and leaf area, and perhaps most importantly, the sustained provision of ecological, social, and economic benefits to urban residents and the greater environment.

Figure 2: Temporal framework for a strategic urban forest management plan.

The context for urban forest management today

The challenges to growing and maintaining healthy urban forests are numerous and, by necessity, must be addressed on a long-term horizon. Urban foresters must remember that they work on "tree time". Trees are a long-term investment, and successes and failures are rarely realized overnight because trees can take years to respond to stress factors or improvements designed to promote their health and longevity.

From a basic biological perspective, cities are difficult places to grow trees. Unlike in forests (where we all too often forget that trees come from), urban soils are typically of poor quality, limited in volume, and can be effectively sterile or even contaminated. Simply put, good soil is in short supply. Furthermore, trees must compete for space with various forms of built infrastructure, such as roads, buildings, and sewers.

Compounding the difficulties associated with poor-quality growing sites and inadequate soils is the reality of urban intensification and development. This influx of urban citizens places increasing stresses on existing trees and makes urban land a premium commodity. In many areas, planning regulations require intensification which paradoxically leaves little room for trees in the very places where they are most beneficial.

Finally, the additional stress factors presented by climate change will continue to affect urban forests.[8, 9, 10] In highly-urbanized communities, climate change-related events such as periods of extended drought, extreme winds, high tem peratures, and shifting species distribution patterns for both native and invasive species will further strain already-thin operating budgets.

Any efforts to proactively manage urban forests to provide the greatest amount of benefits requires a targeted, strategic approach that is collaborative in nature and considers the wide range of stakeholders with interests in urban forest sustainability.

A strategic framework for urban forest management planning

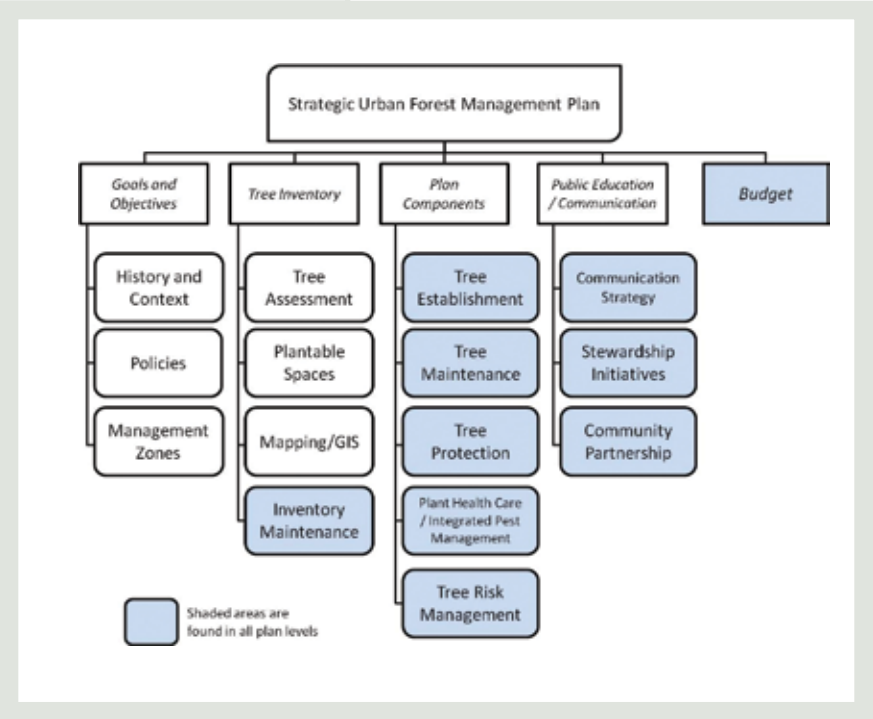
Trees in cities can be relatively slow to respond to physical damage and environmental changes, whether they are negative or positive. Similarly, municipal governments are rarely, if ever, able to quickly summon the financial and human resources necessary to make meaningful changes to urban forest operations and management. As such, a long-term planning horizon is needed in order to outline required action items, prioritize implementation, and accommodate long-term budget planning.

While a long-term planning horizon is necessary to achieve urban forest sustainability, shorter-term objectives and day-to-day operations must be supported by more readily implementable directives. This can be achieved through a three-tiered temporal framework (Figure 2) for urban forest management planning, wherein a *20-year strategic plan* is divided into four *five-year management plans*, which are further subdivided into *annual operating plans*.

The highest level of the urban forest management plan, the 20-year strategic plan, sets out the vision, goals, and objectives to be achieved by the end of the planning horizon. Nested within the 20-year strategic plan are four five-year management plans. This level of planning presents the opportunity to implement active adaptive management. This concept recognizes that urban forests are complex, dynamic entities and that while managers may not always be able to predict changes, they must be prepared to accommodate such changes while still ►

Typical components of a strategic urban forest management plan.

The key sections of a typical urban forest management plan are outlined below.



URBAN FOREST / TREE INVENTORY – An inventory is an essential tool for the development of management strategies as it will identify details of the structure of the urban forest, which are necessary for the planning of management activities to achieve specific goals.

TREE ESTABLISHMENT – Innovative approaches to providing suitable tree habitat should be identified and recommendations to implement them should be developed.

TREE MAINTENANCE – Objectives to enable a transition from reactive to proactive management, including grid pruning, regular inspection, etc., should be developed.

TREE PROTECTION – This section should review current practices and threats related to tree protection and the municipal development approval process (if applicable) with respect to trees and tree protection.

PLANT HEALTH CARE (PHC) AND INTEGRATED PEST MANAGEMENT (IPM) – PHC is a proactive approach to tree management that strives to increase the health and vigour of trees such that their natural defence mechanisms will protect them. IPM includes similar aspects, with a focus on reducing pesticide use and managing and monitoring pest populations.

TREE RISK MANAGEMENT – Liability is a major concern for urban forest managers. The plan should commit to developing a tree risk management strategy tailored to available resources and tolerance for risk.

OUTREACH AND PUBLIC ENGAGEMENT – Effective communication is a vital part of urban forest management. Therefore, an educational communications and outreach program for the community must be developed and implemented to strengthen urban forest management efforts.

BUDGET – The initial budget available to the urban forest management process will help to focus or prioritize the issues that can be addressed. Sources of funding, as well as opportunities for resource sharing, should also be identified. Currently available resources should not prevent the development of progressive initiatives and recommendations.

MONITORING – The plan should also include mechanisms for monitoring the implementation of recommendations and assessing successes and shortcomings. A criteria and indicators based approach can be utilized to fulfill this requirement.

working towards broader goals for the management of the resources in their care. The final level of planning is the annual operating plan, which directs day-to-day operations and can be used to project budget requirements for all aspects of maintaining the urban forest.

Key urban forest management elements

Several key themes and issues should be addressed as components of any urban forest management plan. The content and scope of each plan component can vary depending on a variety of factors specific to the community undertaking the planning process. These factors may include: the community's urban forest objectives; its historic, current, and anticipated land use cover; the degree to which it has already begun to undertake urban forest management; available resources; the level of stakeholder and community interest; and the willingness of the community and its residents to invest in the local urban forest. ►

Concluding Remarks

This article describes a temporal and contextual framework for strategic urban forest management planning and the key components of an urban forest management plan. This approach is being implemented in various municipalities across Canada.

The challenges to urban forests are clear and undeniable. It is our hope that more communities, institutions, and landowners recognize the value of a strategic and collaborative approach to urban forest planning so that future generations might enjoy all of the important benefits that trees provide us with today. SL

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Further Reading

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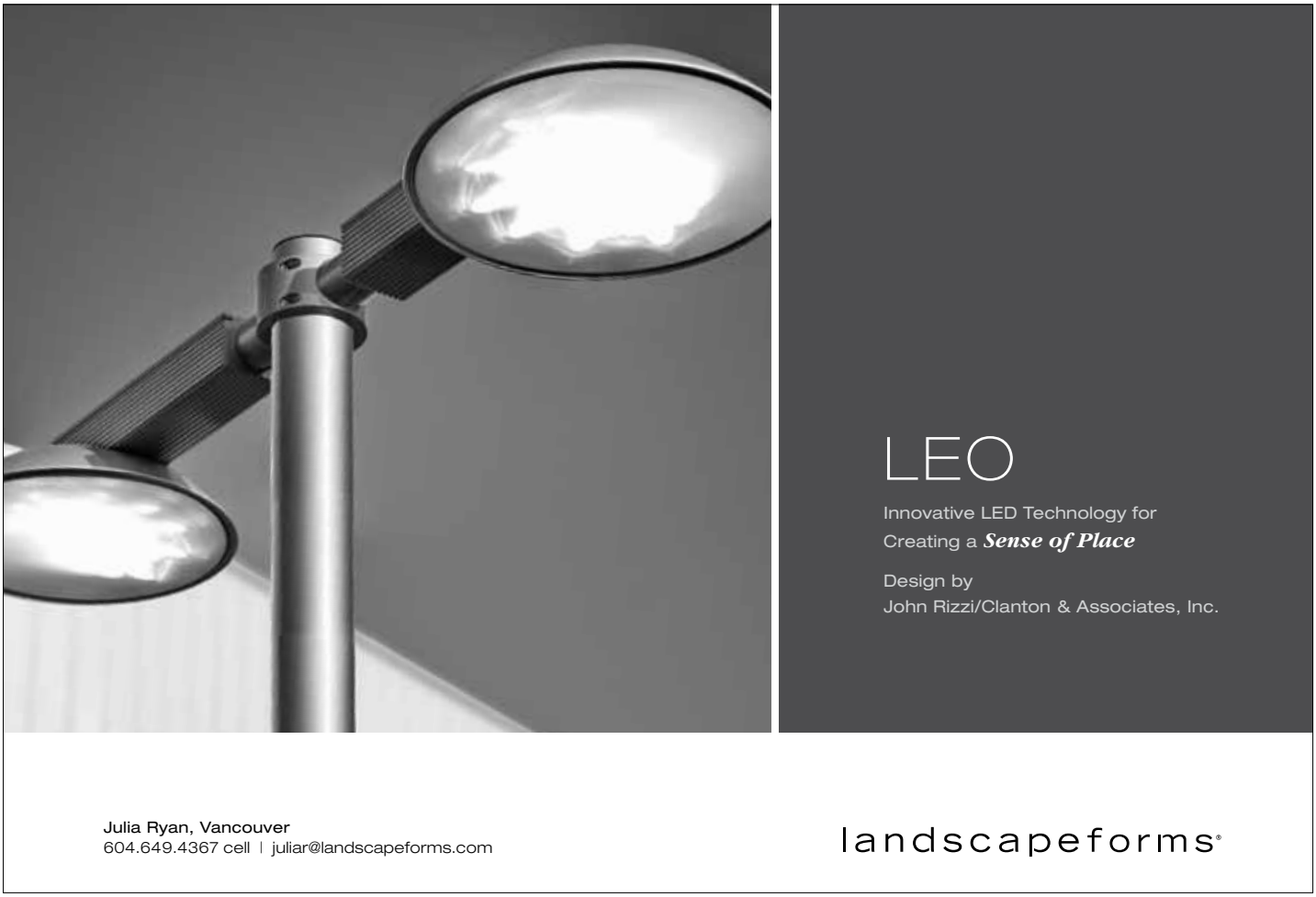

Elms - Prince George, BC.

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Economics *of* CITY TREES

The urban forest provides many economic values. City trees are generally not grown and harvested for products that can be bought and sold on markets. But they do provide many intangible services and benefits that economists estimate as non-market values. Here are evidence-based examples.

Residential Property Values

Most valuation studies have focused on residential property value. Hedonic pricing is used to capture the proportion of property prices that are derived from the non-use value of trees and other landscape elements. Although there have been a few exceptions, properties with trees are generally preferred to comparable properties without trees, with the trend across studies being a price increase of about 7 percent. Street trees appear to add value even to adjacent properties, up to 100 feet away in one study. Table 1 shows results across several studies.

In more recent studies the *proximate principle* describes how homes adjacent to naturalistic parks and open spaces are valued from 8 to 20 percent higher than comparable properties.[i] Also, having adjacent street trees positively affects home values and time on market for sales[ii], while yard trees are associated with both higher property values and rental rates. [iii, iv, v]

Table 1: Contribution of Trees to Property Valuations

PRICE INCREASE	CONDITION
2 percent	Mature yard trees (greater than 9-inch dbh)
3 percent	Larger street trees
3 to 5 percent	Trees in front yard landscaping
6 to 9 percent	Good tree cover in a neighbourhood
10 to 15 percent	Mature trees in high-income neighbourhoods

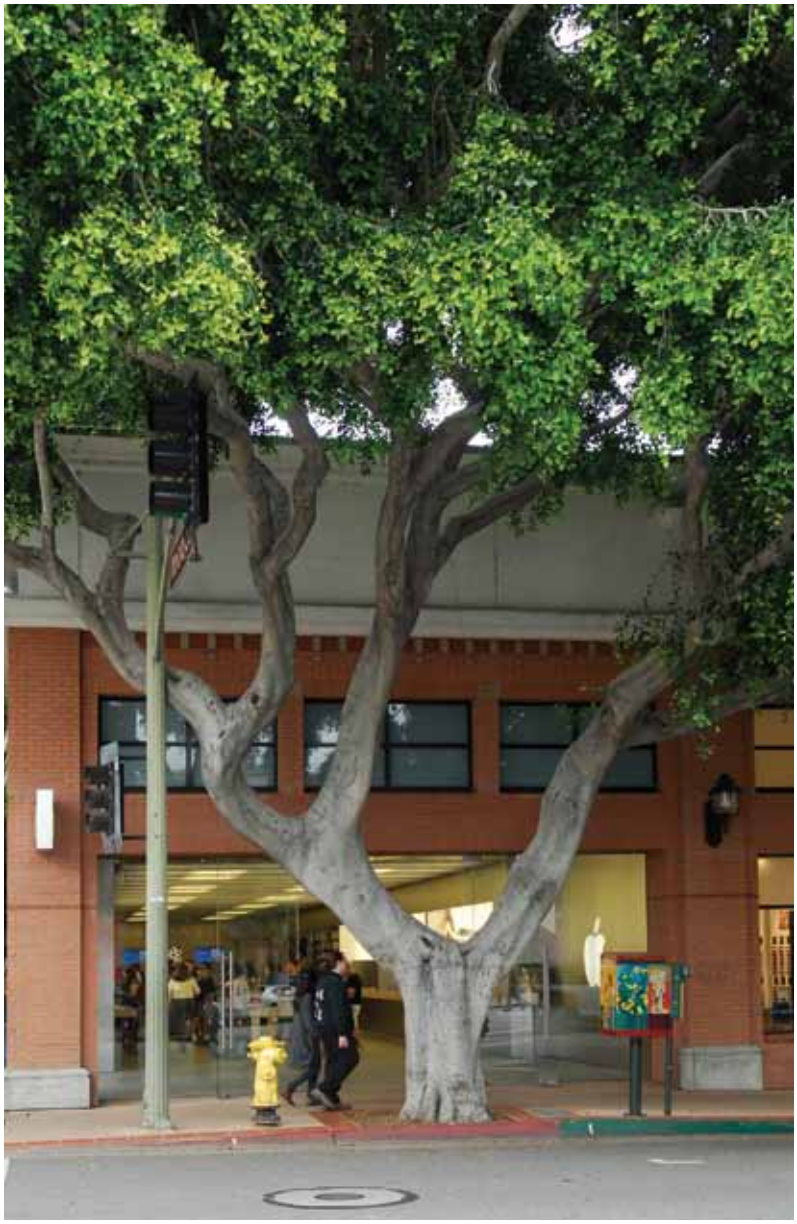
Retail Shopping

Retail merchants are often concerned that trees block the visibility of their shops and signs. They may focus on the near-term direct costs (such as pruning and debris clean up), and overlook the more indirect and long-term benefits of a quality urban forest. Contingent valuation studies indicate the potential returns from investing in trees in retail and commercial districts. A series of studies measured how shoppers respond to the urban forest across different business settings. Shoppers and visitors compared places with high quality urban forest canopy to similar places that were kept up well but did not contain trees. Survey participants are then asked what they would be willing to pay for a set of goods and

Table 2: Trees and Higher Stated Prices for Retail Goods and Services

PRICE INCREASE	CONDITION
9 percent	Goods and services in forested business districts in small cities
11 to 12 percent	Good and services in forested business districts in large cities
9 percent	Goods and services in landscaped strip malls
7 to 11 percent	Goods and services in retail districts adjacent to vegetated freeway rights-of-way
23 percent	Homes within 1/4 mile of "excellent commercial corridors

Tree-lined retail area - San Luis, Obispo, CA.



services in each, and their responses were statistically compared. Generally, shoppers are willing to spend more when shopping in the midst of trees in a variety of retail settings (Table 2).

Urban Greening and Public Health

Trees are the backbone of urban ecosystems. Trees define the quality and character of natural areas such as conservation open spaces, greenbelts, and riparian corridors. Constructed nature such as parks, streetscapes, community gardens, pocket parks, and recreation paths are all more preferred by people when they include trees.

In recent decades biophysical research has expanded our understanding of the environmental services of urban forests and other natural systems. Social scientists have also expanded our knowledge about nature's functions for people in cities. We now know that metro nature directly contributes to quality human habitat,[vi] and is profoundly important for health of mind and body. The website Green Cities: Good Health (http://depts.washington.edu/hhwb) represents a collection of more than 2,200 scholarly works that have been sorted into key topics about human health and well-being, each represented by a summary essay with citations.

For example, the public costs of treating diseases related to obesity are staggering. Urban greening helps reduce health risks. Living close to parks and other recreation facilities is related to higher physical activity levels for both adults and youth. [vii] Older people also benefit, as a study found that seniors that had nearby parks, tree-lined streets, and walkable spaces showed higher longevity over a 5-year study period.[viii] Stress is a major contributor to ill-health in modern times. Visual exposure to nature (that is trees, grass, and flowers) can effectively reduce stress, particularly if initial ►

stress levels are high.[ix] Mental restoration is also gained from spending time in an urban green space, and increased length of stay (up to 1.5 hours) increases the restorative effect.[x] Studies in Japan of *Shinrin-yoku*, or forest walking and breathing, have found effects of improved immune system response, lowered stress indicators, reduced depression, and lower glucose levels in diabetics.[xi]

In addition to physical well-being, nearby nature contributes to better mental health and improves one's capacity to be productive. Office workers with a view of nature are better able to attend to tasks, report fewer illnesses, and have higher job satisfaction.[xii] Outdoor activities can help alleviate symptoms of Alzheimer's, dementia, stress, and depression and improve cognitive function in those recently diagnosed with breast cancer.[xiii, xiv, xv] Symptoms of ADD in children can be reduced through activity in green settings, thus Active "green time" in parks reduces ADD symptoms in children, so may be an effective supplement to standard pharmaceutical treatments.[xvi]

This is but a small sample of the scientific evidence about health and well-being benefits provided by city trees and greening, many having economic consequences.[1] For example, increased worker productivity and school performance have implications for local industry and work force development. Nature-based healing and therapy may be reasonably priced supplements in human services programs. Perhaps the most promising valuation opportunity is the relationship of outdoor space and active living, given the high costs of treating chronic diseases associated with obesity (such as diabetes, heart disease, and stroke). Deferred costs are possible, as medical expenses are lower for people who do routine physical activity and exercise. The potential economic consequences of routine, nature based experiences and activity are enormous, when aggregated across regions, entire cities or the nation.

City trees and urban forests add aesthetic pleasure to our lives - and so much more. Increased property values and more vibrant shopping districts are the indirect returns of investing in high quality urban forests. More recently, scientific evidence points to the high value to local economies of human health and well-being as people experience nearby nature in their communities. Perhaps money does indeed grown on trees! SL

Kathleen Wolf, Ph.D. is a research social scientist with joint appointments at the University of Washington (Seattle) and USDA Forest Service, Pacific Northwest Research Station. Additional information and source articles about the economics of trees can be found at two web sites: Green Cities | Good Health (http://depts.washington.edu/hhwb/), and the Human Dimensions of Urban Forestry and Urban Greening (www.naturewithin.info/).

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Footnotes:

[1] A study at the University of Washington, School of Environmental and Forest Sciences is assessing the economic values of human health and well being benefits that are provided by urban forestry and urban greening.

Metro nature directly contributes to quality human habitat and is profoundly important for health of mind and body.

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