Impacts of Urban Forestry's Small Trees Policies

- **Planting strips < 3' wide and cutouts smaller than 4' X 6'**
- **Nursery stock size**

The Environmental Services Tree Program focuses on three main program areas: providing services equitably to meet the needs of diverse and traditionally underserved communities, managing stormwater sustainably, and protecting human health by reducing urban heat island. Urban Forestry's new small trees policies will affect our ability to achieve gains in each of these three focus areas. The following articulates the benefits provided by small trees and quantifies the ramifications of prohibiting their use in City right-of-way.

Equity Concerns

In 2011, the City of Portland established the Office of Equity and Human Rights (OEHR) with Ordinance No. 184880. In the ordinance, City Council declares that, "[a]chieving equity requires the intentional examination of policies and practices that, even if they have the appearance of fairness, may marginalize individuals or groups and perpetuate disparities or injustices." In their 2015 Annual Report, OEHR notes that "[g]overnment institutions have a special role to ensure that all people have access to the opportunities necessary to satisfy their essential needs, advance their well-being, and achieve their full potential."

The ban on planting street trees in planting strips < 3' wide and cutouts smaller than 4' X 6' removes 34,077 street tree planting spaces (12%) from our inventory of 289,759 spaces. Of all *available* street tree planting spaces in our database (121,278), 17% are subject to the ban, 96% of which are in low-canopy, low-income areas and communities of color (Table 1). It is our responsibility to identify and challenge policies that reinforce inequitable treatment and institutional racism. The planting ban is such a policy.

Low-canopy, low-income areas and communities of color have lower street tree stocking level (55%) and more narrow planting strips (13%). Here, available planting spaces subject to the ban make up 25% of all of the available planting spaces, equating to the lost opportunity to add 140 acres of tree canopy where it is needed the most. For those properties not in low-canopy, low-income areas and communities of color, street trees outnumber available planting spaces 2:1, stocking level is 69%, and 11% of available planting spaces are subject to the ban (Table 1).

The Environmental Services Tree Program (ESTP) is working on a new five-year contract with community nonprofit and partner, Friends of Trees, for community outreach and education and community-implemented tree planting, monitoring, and structural pruning services. The contract is scheduled to begin June 1, 2016. The RFP set a goal of 75% service delivery in historically underserved, low-canopy areas with low-income residents, communities of color, and vulnerable populations. Of the 79,170 available planting spaces in these target communities, 25% (19,793) are subject to the ban (Table 1). As a result, Friends of Trees is unlikely to be able to meet the 75% service delivery metric, resulting in less outreach and education, less community engagement, and fewer trees planted. This outcome is in direct conflict with the city's policies around advancing equity for all residents as well as the goals of the *Comprehensive Plan*, *Portland Plan*, *Climate Action Plan*, *Climate Change Preparation Strategy*, *Portland Watershed Management Plan*, *Urban Forestry Management Plan* and the ESTP.

Table 1. Attributes of street tree planting spaces in Portland's low-canopy, low-income areas and communities of color compared with well-canopied areas with less poverty and less diversity.

	Low-canopy, low-income areas and communities of color	Areas that are **not** low-canopy, low income, or communities of color
Street tree stocking level *The proportion of all the street tree planting spaces that have trees in them*	55%	69%
Properties with planting strips < 3' wide *Properties in low-canopy, low-income areas and communities of color are 13x more likely to have planting strips < 3' wide.*	13%	1%
% of available planting spaces in these areas subject to the ban *One-fourth of all the empty street tree planting spaces in low-canopy, low-income areas and communities of color are un-plantable because of the ban.*	25%	11%
Average # of available planting spaces per property *Four times more planting spaces in low-canopy, low-income communities and communities of color do not have trees in them.*	0.80	0.19
Acres of tree canopy not planted because of the ban *The planting ban will prevent 140 additional acres of tree canopy from being planted in low-canopy, low-income neighborhoods and communities of color.*	140.0	4.2
Acres of tree canopy not re-planted because of the ban *The planting ban will prevent 97 acres of tree canopy from being re-planted when the trees die in low-canopy, low-income neighborhoods and communities of color.*	97.2	1.5
% of available planting spaces subject to the ban that are in these areas *Nearly all of the available planting spaces subject to the ban are in low-canopy, low-income areas and communities of color*	96%	3%

Stormwater System Impacts

The ESTP plants trees for clean rivers, healthy watersheds, and livable, sustainable communities. A primary focus of our work is in the city right-of-way to maximize stormwater management over city-managed impervious surface. The planting ban will limit our ability to manage stormwater with trees in city rights-of-way (Tables 2 and 3), and may have implications for MS4 and TMDL compliance, as trees planted are reported in our compliance documents.

Table 2. Impacts to current and future stormwater system improvement projects from the ban on planting street trees in planting strips <3' wide and cutouts smaller than 4' X 6'.

	CURRENT PROJECTS			FUTURE PROJECTS		
	Tabor	Alder	HS3	NW	NE	**TOTAL**
% of available spaces subject to the ban	22%	27%	8%	38%	30%	**25%**
Acres of canopy not planted	6.2	5.8	0.4	3.3	1.5	**17.2**
Acres of canopy not re-planted	1.5	1.8	0.3	2.0	0.8	**6.4**

Table 3. Impacts to increasing urban forest canopy cover in the combined and separated systems from the ban on planting street trees in planting strips <3' wide and cutouts smaller than 4' X 6'.

	Combined System	Separated System	Combined and Separated Systems
% of available spaces subject to the ban	22%	8%	17%
Acres of canopy not planted	119	25	144
Acres of canopy not re-planted	55	9	64

Benefits of Small-Stature Street Trees

The benefits provided by urban trees are readily estimated using iTree Design or a similar tool that estimates the environmental and aesthetic benefits provided by trees then monetizes those values. While a helpful tool to put the urban forest on the balance sheet, the benefits provided by small-stature street trees are undervalued by this method. Many of the virtues of trees are difficult to quantify; however, studies show we benefit from the presence of trees in many ways, including reduced crime and improved human health outcomes (see Research Findings below).

Opportunity cost is not typically considered in tree benefit quantifications. Given the City's desire to increase tree canopy cover and to provide equitable urban forest benefits in low-canopy, low-income areas and communities of color, what is the opportunity cost of banning street trees in planting strips < 3' wide and cutouts smaller than 4' X 6' when 96% of banned planting spaces are in these geographies? The ban prevents low-canopy, low-income areas and communities of color from enjoying the benefits provided by street trees. Possibly UF's intention is to simply not regulate trees planted in strips <3' wide and cutouts smaller than 4' X 6'?

Findings from Research into Human Dimensions of Portland's Urban Forest

- The presence of street trees increased the sale prices of houses in east Portland neighborhoods by an average of $8,870 and reduced time on the market by an average of 1.7 days (Donovan and Butry, 2010).
- A tree in front of a house increased the house's sale price by an average of $7,130. The tree's benefits spilled over to houses within a 100-foot radius, increasing their combined value by $12,828 (Donovan and Butry, 2010).
- Citywide, street trees add $1.1 billion to Portland's property value, or $45 million a year. Annual maintenance costs of $4.6 million are a small fraction of the trees' value and are mostly borne by property owners (Donovan and Butry, 2010).
    - Using data from Portland's Urban Forest Canopy Assessment and Public Tree Evaluation, this averages to $18.60 per street tree per year and $558.09 per street tree for 30 years. For the 34,077 planting spaces subject to the ban, this amounts to a loss in benefit of more than $630,000 per year and $19 million over 30 years.

- Regarding the effect of trees on crime in Portland, OR, Donovan and Prestemon (2012) found that the presence of street trees is associated with decreased crime occurrence. The authors suggest that, "trees may indicate that a neighborhood is more cared for and, therefore, a potential criminal is more likely to be observed by an authority."
- Donovan et al. 2011 considered the effect of trees on birth weight outcomes. They found that "[g]reater tree canopy cover within 50 m of a house, and proximity to private open space, were associated with a reduced risk of SGA [small for gestational age]…SGA [is a] major [cause] of neonatal and infant mortality as well as contributing to health problems later in life (Hack et al., 1995)."

Climate Change and Urban Heat Island Concerns

The *Climate Action Plan* (2015) recognizes that, "[a]ll populations are affected by climate change, but not all communities have the same ability to respond. As a result, some are more vulnerable than others. In Portland, communities of color and low-income populations experience disparities that result in disproportionate vulnerabilities to the impacts of climate change. These disparities include greater risk of poor health, reduced access to quality affordable housing, limited access to transportation options and parks, higher mortality rates and other legacies of inequitable public policies. By pursuing climate resilience, the City and County seek to ensure that the benefits of taking actions to prepare for climate change are shared by the whole community and across multiple generations" (p. 25).

The *Climate Change Preparation Strategy* (2014) directs us to, "[c]onsider vulnerable populations living in urban heat islands when making decisions about tree planting. . .," and to ". . .address tree canopy disparities in neighborhoods where vulnerable populations live" (Actions 1g and 1i, p. 17). Although PPR is a lead partner on both of these actions, the ban on planting street trees in strips < 3' wide and cutouts smaller than 4' X 6' does not support them, as 96% of the 34,077 spaces subject to the ban are in low-canopy, low-income areas and communities of color.

Climate Action Plan (2015): Actions to be completed by 2020:

13A Tree Programs — Continue tree planting and expand tree preservation and maintenance programs and incentives. a) Focus on low-canopy neighborhoods and neighborhoods with populations at higher risk of adverse outcomes of urban heat island effects. b) Explore options for public and private partnerships to help reduce or share the cost of tree planting and maintenance.

> The planting ban removes 25% of the available street tree planting spaces in low-canopy, low-income areas and communities of color in direct opposition to this action. Although this action directs the ESTP to focus on low-canopy neighborhoods and neighborhoods with populations at higher risk of adverse outcomes of urban heat island effects, and we have operated using this strategy for eight years, the planting ban impedes our ability to do so.

13B Canopy Targets — Revisit urban forest canopy targets: a) Take into consideration goals for carbon sequestration, resiliency to climate change impacts, and equitable distribution of tree-related benefits across the city. b) Address tree age, species diversity and tree distribution, in addition to expanding overall canopy coverage.

> Our ability to meet the 'equitable distribution of tree-related benefits' goal included in multiple city plans is negatively impacted by the planting ban. Because the planting ban removes 25% of the available planting spaces from low-canopy, low-income areas and communities of color, it negatively impacts our ability to meet tree canopy cover goals as well.

13C Tree Code — Fund and implement the new Tree Code (Title 11, Trees) and other code and customer service improvements adopted through the Citywide Tree Project to emphasize the preservation of healthy trees, sustain the urban forest over time, encourage native and climate resilient trees and increase canopy in tree-deficient areas. Monitor tree canopy changes due to development, including in infill areas, and determine if policy and rule changes are needed.

> Action 13C directs the city to increase canopy in tree-deficient areas. The planting ban impedes our ability to do this by removing 25% of available street tree planting spaces in these target geographies.

14A Decrease Urban Heat Islands — Decrease the urban heat island effect, especially in areas with populations most vulnerable to heat, through strategies such as revegetation, tree preservation, planting and maintenance, depaving and porous pavement, green infrastructure like bioswales and ecoroofs, and site development performance standards.

> The planting ban impedes our ability to increase urban forest canopy—and thereby the deleterious impacts of Urban Heat Islands—where it is most needed. Our ability to address Action 14A in an equitable manner is hampered by the planting ban.

14L Habitat Connectivity — Protect and connect floodplains and other diverse habitats that support biodiversity, including birds and other wildlife species needing to alter their range.

> The Intertwine's *Regional Conservation Strategy* (2012) recognizes that "narrow corridors, hedgerows, field margins, fencerows, and street trees can improve connectivity for some songbirds, small mammals, and other species during various life cycle stages. . .However, many birds seem reluctant to cross gaps wider than 50 meters. Increasing the amount of habitat distributed throughout the landscape and strategically addressing gaps within the matrix can help these species' movement."
>
> Street trees play a critical role in bridging habitat gaps in the right-of-way. Fernandez-Juricic (2000) found that out of 24 bird species that inhabited a local park in Madrid, Spain, 14 of those species were also observed on tree-lined streets, and a significantly greater number of species was found on tree-lined streets than on streets with no vegetation. Tree-lined streets enable movement among habitat patches like parks and natural areas. For this reason, the *Regional Conservation Strategy* recommends incorporating semi-natural features such as vegetated riparian areas, stormwater

treatment facilities, green roofs, street trees, and edible gardens throughout the urban landscape.

In Defense of Small-Stature Trees

Multiple city plans and goals recognize the need to expand and enhance Portland's urban forest to maximize the myriad benefits our urban trees provide. Although the stature of trees planted in strips <3' wide and cutouts smaller than 4' X 6' is small, these trees provide necessary, if modest, benefits both locally and citywide. The ESTP plants the right tree in the right place. When we plant small-stature street trees, it is because they are the right tree for the location. Portland has considerable limitations to planting large-stature trees, particularly in the ROW. 40% of available street tree planting locations are narrower than the City's standard furnishing zone width (4') and may only be planted with small-stature species. For these reasons, small-stature trees are a key tool for increasing urban forest canopy where it is needed most: in low-canopy, low-income areas and communities of color.

In the document, 'Portland Street Tree Planting Strip Minimum Size Requirements A Comparison and Guide,' Urban Forestry argues that the 3' planting strip width provides the "minimum biotic space trees need to be viable and effective components of productive and well-managed urban tree infrastructure;" however, only planting strip width is used to indicate "minimum biotic space." Planting strip length and available soil volume are not considered. When soil volume is compared for planting strips of multiple widths containing UF-approved tree species, it is the tree in the <3' strip that has the relatively greatest adequate soil volume (Appendix A: Available Soil Volume vs. Adequate Soil Volume for Street Trees).

Street trees in narrow planting spaces are at increased risk of damage from car doors because of their proximity to the curb. Creative solutions to damage by car door include an outreach and education campaign, arbor guards (which protect from mowers and string trimmers as well), and protective devices like stakes that provide a visual cue as well as a physical barrier.

An additional critique of small-stature trees is their longevity. Small-stature species are often understory species whose strategy is relatively rapid growth with a relatively short life span. Although the reduced life span means a shorter replanting interval, small-stature trees are less expensive to maintain and remove since they are not very large, and they do not cause catastrophic damage to people and property when they fail. The expense of removing and replanting a small-stature tree is modest. Given the alternative of no tree, a small-stature tree is a worthwhile investment.

Time Is of the Essence

The recession that began in 2008 hit the nursery industry hard, and now there is a severe shortage of trees to plant. Says Nancy Buley, Director of Communications, J Frank Schmidt and Son Co., "[t]he shortage of trees in the 1.75-3" caliper range is nationwide and not just a regional problem. It is, of course, due to the greatly reduced planting of liners during the recession. In fact, we are just at the front edge of the shortage. Time – and a healthy economy – will heal the shortages. But don't expect to be able go to the tree store and order on demand. This dire shortage will continue for several more years - 2018–2020?" (See email communications and 'Sold Out' article). PPR Horticultural Services Supervisor, Heather McKillip, stated that, although their group "only purchases about 300 trees/year, [they] have [their] own challenges finding material that meets size and species requirements."

Title 11 sets planting size requirements for street trees at 1.5", 2.0", and 2.5" for single-family residential, multi-family residential, and all other zoning, giving the City Forester the discretion to allow different sizes. ESTP staff and contractors have had difficulty finding suitable planting stock of size, and we requested City Forester discretion. The City Forester denied our request and would rather see no trees planted than trees that do not meet her BMP, citing vandalism concerns and suggesting that trees of the required size are treated in the nursery, so they establish better. The ESTP shares concerns about vandalism and will replant undersized trees that are vandalized before they meet the size BMP. Nancy Buley knows of no special treatment beyond the benefit of time and recommends employing a pruning program when planting smaller-caliper trees (trees <3-4" caliper). Fortunately, we have a pruning program.

We are in an untenable situation. We cannot meet the City Forester's BMP because we cannot get the planting stock we need. However, it is crucial we continue planting trees to meet multiple city goals. Nancy Buley advises that "if [we] cannot find the larger size trees in the diversity of species and cultivars [we] seek, then it seems that a review of BMP may be in order." The best time to plant a tree was 20 years ago; the second best time is now. We cannot stop planting trees until the nursery industry recovers. We need to act.

Appendix A: Available Soil Volume vs. Adequate Soil Volume for Street Trees

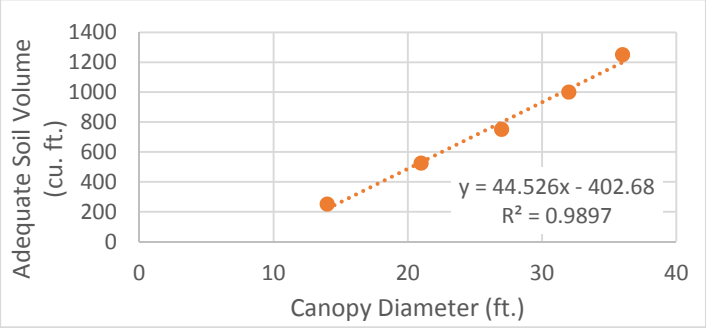

Figure 1. Adequate soil volume as a function of tree canopy diameter. The relationship described by the trendline y = 44.526X – 402.68 is re-created from Deeproot's *Recommended Soil Volume for Urban Trees* (http://www.deeproot.com/blog/blog-entries/our-recommended-soil-volume-for-urban-trees)

Research suggests a relationship between tree growth and soil volume (see attached reference list compiled by James Urban). Figure 1 models the canopy diameter-soil volume relationship, demonstrating that larger-diameter trees need more soil volume than smaller-diameter trees.

Providing adequate soil volume for trees surrounded by hardscape (e.g., street trees), however, is a challenge. Street tree planting spaces are, in most cases, too small to provide the soil volume a tree needs to grow to full maturity and thrive. In addition, planting the "right tree in the right place" means planting larger-stature species in wider planting strips to maximize the extent of the urban forest canopy.

The tables below show the relationship between actual open soil volume and adequate soil volume. The final column shows that, while actual open soil volume is inadequate in all planting strip widths, **it is the least inadequate for 2.5 ft. wide planting strips whether the planting strip is 10 ft. long (a large cutout) or 50 ft. long (a property frontage).**

Table 1. Available (open) soil volume and adequate soil volume for typical trees approved for planting in street tree planting strips of 2.5, 3, 4, 6, and 8.5' width, assuming 3' rooting volume and 50' planting strip length.

Strip width (ft.)	Strip length (ft.)	Strip depth (ft.)	Open soil volume (cu. ft.)	Typical tree type	Canopy diameter (ft.)	Canopy cover (sq. ft.)	Adequate soil volume (cu. ft.)	***Actual as % of adequate***
2.5	50	3	375	crape myrtle	20	314	487.84	***76.9%***
3	50	3	450	Japanese snowbell	25	490.625	710.47	***63.3%***
4	50	3	600	Halka ginkgo	40	1256	1378.36	***43.5%***
6	50	3	900	coast redwood	40	1256	1378.36	***65.3%***
8.5	50	3	1275	Douglas-fir	50	1962.5	1823.62	***69.9%***

Table 2. Available (open) soil volume and adequate soil volume for typical trees approved for planting in street tree planting strips of 2.5, 3, 4, 6, and 8.5' width, assuming 3' rooting volume and 10' planting strip length.

Strip width (ft.)	Strip length (ft.)	Strip depth (ft.)	Open soil volume (cu. ft.)	Typical tree type	Canopy diameter (ft.)	Canopy cover (sq. ft.)	Adequate soil volume (cu. ft.)	***Actual as % of adequate***
2.5	10	3	75	crape myrtle	20	314	487.84	***15.4%***
3	10	3	90	Japanese snowbell	25	490.625	710.47	***12.7%***
4	10	3	120	Halka ginkgo	40	1256	1378.36	***8.7%***
6	10	3	180	coast redwood	40	1256	1378.36	***13.1%***
8.5	10	3	255	Douglas-fir	50	1962.5	1823.62	***14.0%***

References

Buley, Nancy. Email communication with Jennifer Karps. March 23, 2016.

City of Portland, Office of Equity and Human Rights. 2015. Annual Report.

Donovan, G.H., and D.T. Butry. 2010. Trees in the city: Valuing street trees in Portland, Oregon. *Landscape and Urban Planning* 94: 77-83.

Donovan, G.H., and J.P. Prestemon. 2012. The effect of trees on crime in Portland Oregon. *Environment and Behavior* 44: 3-30.

Donovan, G.H. et al. 2011. Urban trees and the risk of poor birth outcomes. *Health and Place* 17: 390-393.

Fernandez-Juricic, E. 2000. Avifaunal use of wooded streets in an urban landscape. *Conservation Biology* 14: 513-521.

Portland Parks & Recreation. 2007. Portland's Urban Forest Canopy Assessment and Public Tree Evaluation.

McKillip, Heather. Email communication with Matt Krueger. January 19, 2016.

Schamberger, Lance. Email communication with Jennifer Karps. March 25, 2016.

The Intertwine Alliance. 2012. *Regional Conservation Strategy for the Greater Portland-Vancouver Region*. A. Sihler, editor. The Intertwine Alliance, Portland, OR. www.theintertwine.org

References Related to Tree Soil Volumes (from James Urban)

Arnold, H.F. 1980. Trees in Urban Design. Van Nostrand Rheinhold Co. New York, N.Y. 168 pp.

Bakker. J.W. 1983. Growing Site and Water Supply of Street Trees. Groen, 39(6)205-207.

Bassuk, N. J. Grabosky, and P. Trowbridge, Department of Landscape Architecture, Cornell University. 2005. Using CU-Structural Soil™ in the Urban Environment. Urban Horticulture Institute Cornell University.

Bühler, O. , P. Kristoffersen, and S. U. Larsen. 2007. Growth of Street Trees in Copenhagen with Emphasis on the Effects of Different Establishment Concepts. Arboriculture Urban Forestry 33(5): 330-337.

Cervelli, J.A. 1984. Container Tree Plantings in the City. Journal of Arboriculture 10(3):83-86. Helliwell,

D.R. 1986. The Extent of Tree Roots, Arboriculture Journal 10:341-347.

Jim, C.Y. 2001. Managing Urban Trees and Their Soil Envelopes in a Contiguously Developed City Environment. Environmental Management 28(6): 819–832.

Kent, D., S. Shultz, T. Wyatt, and D. Halcrow. 2006. Soil Volume and Tree Condition in Walt Disney World Parking Lots. Landscape Journal 25:1–06.

Kopinga, J. 1985. Research on Street Tree Planting Practices in the Netherlands. Proceedings of 5th Annual METRIA Conference. Pennsylvania State University, University Park, PA.

Kopinga, J. 1991. The Effect of Restricted Volumes of Soil on the Growth and development of Street Trees. Journal of Arboriculture 17(3): 57-63.

Kristofferson, P. 1999. Growing Trees in Road Foundation Materials. Arboricultural Journal 23: 57-76.

Lindsey, P. and N. Bassuk. 1991. Specifying Soil Volumes to Meet the Water Needs of Mature Urban Street Trees and Trees in Containers. Journal of Arboriculture 17(6): 141-149.

Lindsey, P. and N. Bassuk. 1992. Redesigning the Urban Forest from the Ground Below: a New Approach to Specifying Adequate Soil Volumes for Street Trees. Arboricultural Journal 16, 2539.

Loh, F. C.W., Grabosky, J. C. and N. L. Bassuk. 2003. Growth Response of Ficus Benjamina to Limited Soil Volume and Soil Dilution in a Skeletal Soil Container Study. Urban Forestry & Urban Greening: 2(1):53-6. Available from http://www.hort.cornell.edu/uhi/research/articles/UrbForUrbGr%282%292003.pdf

Moll, G. and J. Urban. 1989. Giving Trees Room to Grow. American Forests. May/June 61:64.

Neely, D. and G. Watson (eds). 1998. *Landscape Below Ground II*. International Society of Arboriculture, Champaign, Illinois. 265pp.

Perry, T.O. 1980. The Size, Design and Management of Planting Sites Required for Healthy Tree Growth. Proceedings of 3rd Annual METRIA Conference. June.

Perry, T.O. 1985. Planting Sites for a 3" Caliper Tree with Room to Grow. Proceedings of 5th Annual METRIA Conference. May.

Smiley, E.T., L. Calfee, B. R. Fraedrich, and E. J. Smiley. 2006. Comparison of Structural and Noncompacted Soils for Trees Surrounded by Pavement. Arboriculture & Urban Forestry 32(4): 164-169.

Urban, J. 1989. New Techniques in Urban Tree Plantings. Journal of Arboriculture 15(11): 281284.

Urban, J. 1992. Bringing Order to the Technical Dysfunction Within the Urban Forest. Journal of Arboriculture 18(2): 85-90.

Urban, J. 2008. Up By Roots: Healthy Soils and Trees in the Built Environment. International Society of Arboriculture. Champaign, IL.

Vrecenak, A, J. and L.P. Herrington. 1984. Estimation of Water Use of Landscape Trees. Journal of Arboriculture 1012):313-319.

Watson, G. W. and D. Neely (Eds.) 1994. *The Landscape Below Ground: Proceedings of the International Workshop on Tree Root Development in Urban Soils*. International Society of Arboriculture, Savoy, Illinois.

Watson, Gary W. 2002. Soil Replacement: Long-Term Results. *J. Arboriculture* 28:229-230.