



Trees and Infrastructure

**TREE CITY USA®
BULLETIN**

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Whether they are considered part of a community's infrastructure or in conflict with it, trees are inextricably part of what makes a community livable. Compatibility with other infrastructure components should always be a goal — and it is an achievable one.

“Infra” is from the Latin word meaning “below.” Infrastructure in a community has come to mean that which creates the foundation for all else that makes life livable for residents. Traditionally, infrastructure refers to streets, water and sewer systems, power lines, and other facilities that are essential for all else to function. Today, a case can be made that trees belong on this list. Sometimes referred to as “green infrastructure,” trees are fundamental to making any community a pleasant and healthy place in which to live and work.

Like other components of infrastructure, trees provide a service. Unlike other components, these services — such

as controlling stormwater or reducing air pollution and energy consumption — increase over time. An older pipe deteriorates. An older tree retains more rainwater in its crown and sequesters more carbon in its trunk and branches and provides more shade. Of course, older trees reach a point of needing to be replaced, but until then, the value of their services grows and grows.

Another difference is that few residents emotionally connect with pipes or wires. Trees, on the other hand, provide important meaning and memories in our lives.

Not everyone embraces the concept of trees as infrastructure. It is hard to love a tree when the sidewalk lifts dangerously, or branches hide a vital street sign. In some cases, trees conflict with other important parts of the infrastructure. Fortunately, there are ways to prevent or reduce the conflicts, and this issue of the bulletin offers some suggestions.

Making Trees and Sidewalks Compatible

The conflict between street trees and sidewalks can be seen in almost every community in America. Both of these infrastructure features are essential parts of what make a community livable, so it is worth a careful look at ways to have both safe sidewalks and healthy trees.

START WITH THE RIGHT TREES

When new streets or sidewalks are being planned, or re-planting is necessary, it provides the golden (as in money-saving) opportunity to prevent future conflicts. A tree's diameter at maturity is a good guide to selecting what species should or should not be planted in the tree lawn (also called boulevards or planting strips) between the sidewalk and the street. Local conditions and specifications vary, but here is one general guide:

TREE LAWN WIDTH	PLANT TREES THAT MATURE
4'-6'	Small
6'-8'	Medium (if no overhead lines)
8' or more	Large (if no overhead lines)

- Less than 4 feet is generally insufficient space for growing trees, and a soil depth of at least 2 feet is important to help prevent lifting of sidewalks.
- Deep-rooted trees are best near sidewalks, and planting at the correct depth is important.

SIDEWALK MODIFICATIONS

Maintaining sidewalk width to meet requirements of the American Disabilities Act is important. So is the need to protect tree trunks and help keep their expansion from coming in contact with walkways. With planning, both needs can be met.



PROVIDE SPACE FOR THE ROOTS

An alternative to planting next to the street in narrow tree lawns is to plant on the far side of the sidewalk between the walk and house (if there is a front yard). There the roots will have more space to grow and are less likely to conflict with the sidewalk, street, or underground utilities.

In narrow tree lawns, parking lots, and in downtown areas where space is extremely limited, a major cause of tree decline and sidewalk conflicts can be prevented by providing an adequate growing environment for roots beneath the pavement. Part of the problem with trees in these locations is that when pavement is installed, compaction of the underlying soil is necessary to bear the surface material and weight of its traffic. Unfortunately, the compaction creates a hostile growing environment for healthy tree roots by restricting air and moisture. Now there are two research-based inventions available to solve the problem.

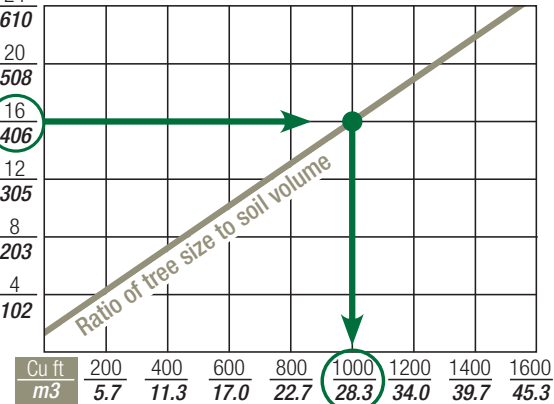
A GUIDE FOR SOIL VOLUME

Ultimate Tree Size

Crown Spread DBH-Trunk Diameter

Sq Ft m ²	Inch mm
1200	24
111	610
1000	20
92	508
800	16
74	406
550	12
51	305
350	8
32	203
150	4
14	102

Example: A 16 inch/406 mm diameter tree requires 1000 cu ft/28.3 m³ of soil.



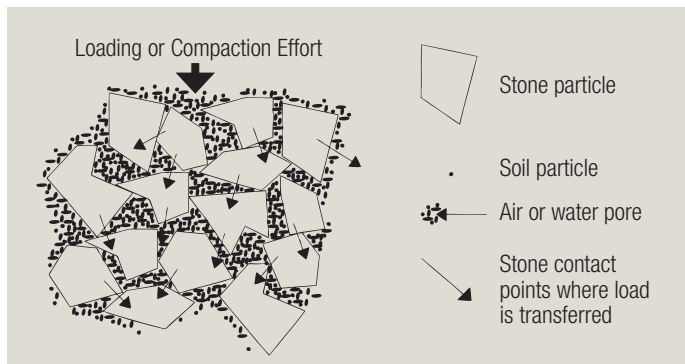
Soil Volume Required

How much root space is needed? Noted landscape architect James Urban has provided this chart to help determine the minimum amount of soil space needed for trees of various mature sizes.



C-U STRUCTURAL SOIL™

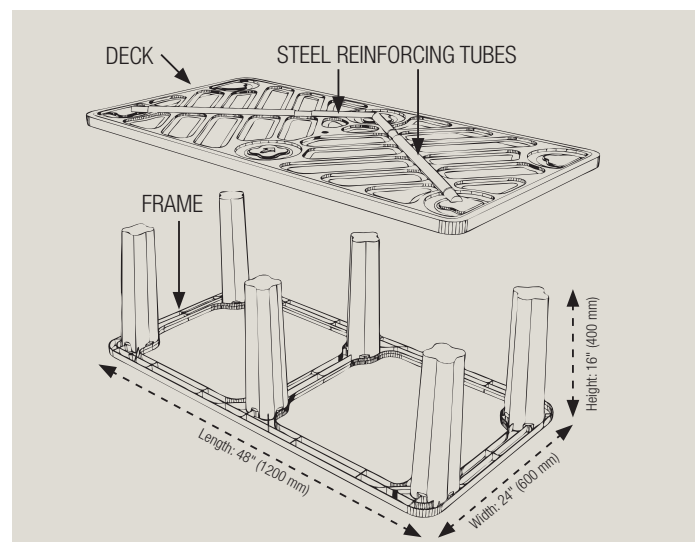
This is a patented product resulting from research at Cornell University's Urban Horticulture Institute. C-U Structural Soil™ is a mixture that contains .75"-1.5" angular crushed stone to provide the weight-bearing capacity. Clay-loam is added to provide a good growth medium in the spaces between the rocks. Hydrogel is also added to the mix to hold the soil to the stone surfaces rather than letting it completely fill the pores needed for aeration, or to compromise the weight-bearing job done by the stone. All is done by licensed producers to ensure adherence to the exacting standards of the formula.



SILVA CELLS

Silva Cells were developed by landscape architect James Urban of Annapolis, Maryland, and Deep Root Partners, LP of San Francisco.

The concept is a series of modular, interlocking "cells" that provide support for surface material and up to 92% of the space available for uncompacted soil and healthy root growth.

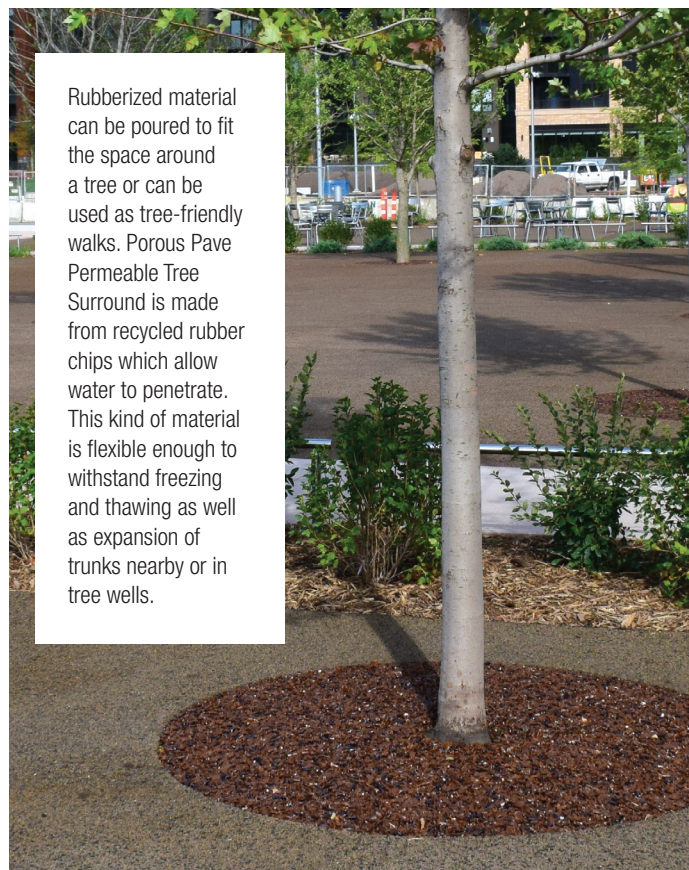


Sidewalk Compatibility (continued)

USE PAVERS AND GRATES — CAREFULLY

There are many ways to provide expansion space for sidewalk trees while at the same time providing adequate water and aeration.

Whatever is used to cover planting wells, have a plan for enlarging the cover as the tree ages and the trunk widens. Otherwise, the cover will damage and eventually kill the tree. Inspection and adjustment must be planned into the community forestry program just like pruning or watering.



Rubberized material can be poured to fit the space around a tree or can be used as tree-friendly walks. Porous Pave Permeable Tree Surround is made from recycled rubber chips which allow water to penetrate. This kind of material is flexible enough to withstand freezing and thawing as well as expansion of trunks nearby or in tree wells.



An attractive alternative to bare earth or loose mulch is to cover the soil with a layer of sand, then bricks or paving blocks. As the tree grows, the bricks or blocks must be removed to enlarge the growing space.



One method is simply to leave a patch of earth, sand, or decorative gravel, delineated and held in place by landscaping timbers or concrete.



Decorative grates are popular, but regardless of material (for example iron or plastic), cutting is essential — and often ignored — as the tree trunk expands.

Encourage Deep Root Growth

One way to reduce sidewalk conflicts is to encourage deeper root growth and to create barriers between roots and pavement.

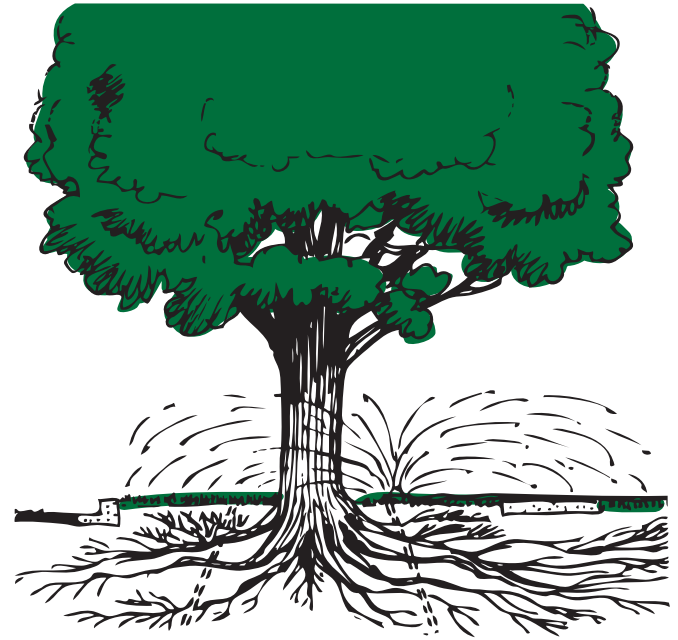
WATERING

Short, frequent waterings wet only the top few inches of soil and encourage roots to grow near the surface. Water longer and less frequently, letting the soil become moist to a depth of several feet. Drilling can aid deep watering. One inch of water per week is recommended, applied slowly within the entire drip line (area under the spread of the tree's crown) and just beyond. Holes 1–2 inches in diameter drilled under the tree will allow better penetration of water and oxygen.

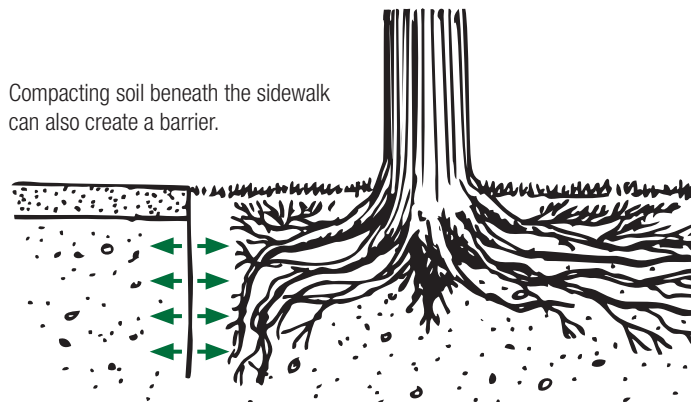
ROOT BARRIERS

Barriers force root growth downward. Research is beginning to show that in well-drained, loamy soils, the trick works. Where soil aeration is poor from either compaction or excessive water, roots sometimes quickly turn back up toward the surface after passing the barrier. However, the roots seem to be less massive when this occurs. Gravel surrounding planter-type barriers like the one shown in the photo on the right below may also help supply enough water and oxygen to greater depths to meet the needs of the roots and keep them deep.

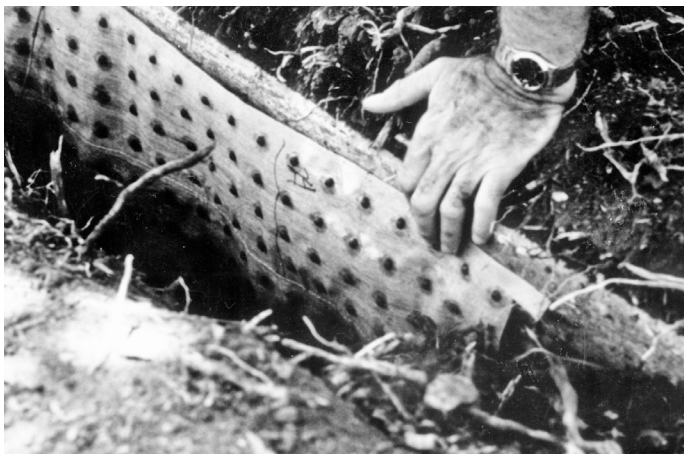
A variation of the solid barrier is a herbicide infused fabric that upon contact slows root growth by preventing cell division. The chemical is not taken up in the plant system like most herbicides, so there is no danger of killing the tree or spreading it to other trees through root grafts. The chemicals involved are said to be long-lasting, environmentally safe, and non-toxic to animals. The fabric is flexible and can be wrapped around drain pipes to prevent clogging or spread like a curtain to deflect growth from beneath sidewalk slabs.



Compacting soil beneath the sidewalk can also create a barrier.



Whether using a solid material or fabric available on the market, a barrier can help direct roots away from beneath sidewalks.



Living with Signs

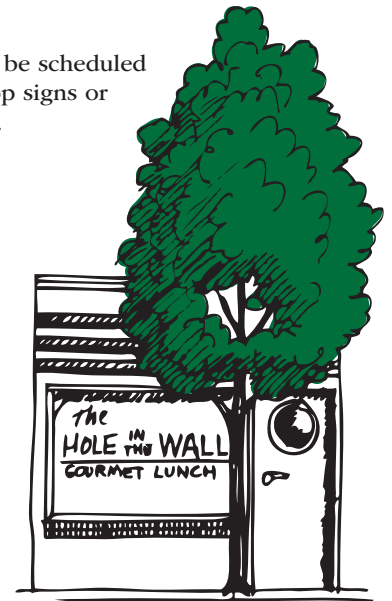
Signs are an integral part of any community and traffic signs are clearly part of the infrastructure. Blocking visibility can be a problem, but the right techniques can ensure both trees and signs can be utilized.

COORDINATE WITH OTHERS

When planting trees, rather than following a rigid spacing plan, allow for nearby stores, streetlights, and traffic signs and devices. No vegetation with foliage between 2 feet and 8 feet tall should be present within intersection sight triangles,

and regular pruning should be scheduled where trees might block stop signs or other traffic control devices.

Trees provide their usual ecoservices, but businesses in both cases benefit from cooperation. On the left, an adjustment in planting spaces prevented unwanted blockage of a business. On the right, pruning raised the crown of the tree above the business's identity and entrance.



TREES FOR NARROW SPACES

In many urban situations — both in business districts and residential areas — a tree with wide-spreading limbs could cause problems. Fortunately, many cultivars have been developed with narrow, or 'columnar' growth forms. These trees provide the beauty, diversity and practical benefits of popular species but with the additional attribute of being able to fit in confined spaces. This partial list is made available to the public by the City of Reno's Department of Parks, Recreation and Community Services and can serve as a starting point in many other cities. All trees listed have a spread of 15 feet or less at maturity.



Dawyck Purple Beech

Scientific Name	Common Name	Height at Maturity
<i>Acer platanoides</i> 'Crimson Sentry'	Crimson Sentry Maple	25'
<i>Acer rubrum</i> 'Armstrong'	Armstrong Maple	45'
<i>Acer saccharum</i> 'Barrett Cole' PP	Apollo Maple	25'
<i>Carpinus betulus</i> 'Frans Fontaine'	Frans Fontaine Hornbeam	35'
<i>Fagus sylvatica</i> 'Dawyck Purple'	Dawyck Purple Beech	40'
<i>Fagus sylvatica</i> 'Fastigiata'	Fastigate Beech	45'
<i>Ginkgo biloba</i> 'Princeton Sentry'	Princeton Sentry Ginkgo	40'
<i>Liquidambar styraciflua</i> 'Clydesform'	Emerald Sentinel Sweetgum	30'
<i>Liriodendron tulipifera</i> 'Fastigiatum'	Columnar Tuliptree	50'
<i>Pyrus calleryana</i> 'Capital'	Capital Pear	35'
<i>Quercus palustris</i> 'Pringreen' PP	Green Pillar Oak	50'
<i>Quercus robur</i> x <i>Q. alba</i> 'Crimschmidt'	Crimson Spire Oak	45'
<i>Tilia cordata</i> 'Corzam'	Corinthian Linden	45'

Sharing Space with New Technology

As our world shrinks and population grows, technology seems to be viewed as the answer to many of our needs and desires. Trees are sometimes overlooked or undervalued as society makes room for the endless new devices that become available.

SOLAR PANELS

As solar panels on home roofs or elsewhere on residential property become more common, a conflict with trees is likely to result. The legal aspects of shading a neighbor's panels are complex and vary from state to state. Generally, if a neighbor's trees exist before you add your solar panels, you had better re-think your options. If the trees are planted after you have panels, it is likely bad news for the tree planter. If the trees were planted first but are small and likely to grow to a height that will block the sunlight reaching your panels, better contact a lawyer for advice.

Access to sunlight will become more of an issue over time, and some states have passed laws like California's Solar Shade Control Act. Before planting or before installing solar panels, check state laws and local ordinances or homeowner association regulations. Regardless, an excellent suggestion is to talk with your neighbors about your intentions. Another option that can save friendships is to create a solar easement agreement (if it does not conflict with applicable laws). A properly written easement agreement ensures long-term access to sunlight and usually attaches to the property so a future owner will be bound by its conditions. In most cases, payment will be due to the party that agrees to not plant trees that will shade the neighbor's panels, or to remove or control the height of existing trees.

WHAT ABOUT THE ADVENT OF 5G TECHNOLOGY?

This is another thorny issue that has yet to be resolved in many areas through state laws or local ordinances. Worse, there are questions about human safety and the potential for ecological damage from this latest development in wireless telecommunication. Some have labeled the increasing digital signals "electrosmog" and claim it harms birds, insects, trees, and other living things. Others say the claims are baseless and the advantages, especially for cellphone connectivity, are worth the risks and additional towers (some disguised as trees). What is certain is that trees interfere with the invisible waves as they bring faster service into homes. Some cities, like Boise, Idaho, are addressing the issue on behalf of tree protection. For example, in Boise, before 5G equipment is added in a leafy neighborhood, plans must be submitted to the Planning and Development Services Department. They are then circulated to other departments, including the city forestry. If pruning is required, it must be done by a licensed tree care company with certified arborists on its crews. For tree removals, appraised values are determined and must be paid.

It appears that trees or tree limbs will need to yield to electromagnetic waves where trees interfere with transmission. The best advice is to consider this when selecting planting sites and insist that existing trees are pruned properly.



With cooperation and planning, trees and solar panels can be compatible.

5G and other wireless technologies present new challenges to trees in the urban forest.



Right Tree, Right Place

A discussion of the interaction of trees and other components of city infrastructure would take far more than the eight pages available in this bulletin. However, almost all the conflicts could be prevented by planting the right trees in the right places.

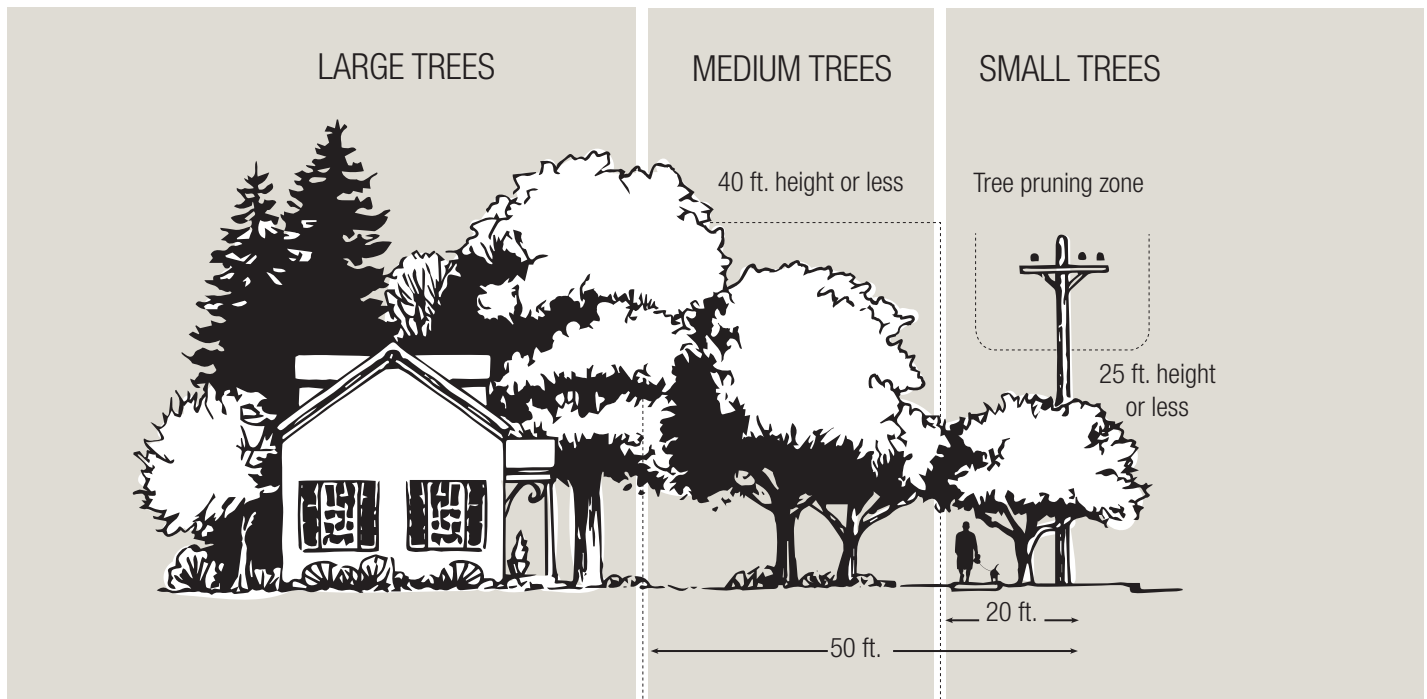
Trees in the urban landscape are likely to get more respect and more support if the financial benefits of placing the right tree in the right place are part of our public messages. The classic example involves trees and power lines. It is easy to point out the eco-benefits of trees, but sometimes the costs of maintaining poorly placed trees are not addressed. An enormous amount of time and expense goes into regular pruning of large trees to keep their branches safely away from energized lines. The reasons are (1) to prevent power outages and keep vital electricity going to homes and businesses uninterrupted, and (2) to keep children (or others who might climb trees) at a safe distance from energized lines.

Often, the pruning disfigures the natural appearance of the tree and arouses the ire of homeowners despite the best efforts of the utility workers. What a difference it would make if trees near overhead lines were simply selected based on appropriate height at maturity.

In addition to implementing the suggestions elsewhere in this bulletin, conflicts can be prevented by careful planning and considering these simple precautions:

- ✓ Know where rights-of-way exist across your property and plant accordingly.
- ✓ Avoid planting invasive trees or other invasive plant species.
- ✓ Select tree species that are not under attack by insects or disease in or near your area, and plant for diversity — no more than 5% from any one genus.
- ✓ Involve government units and community stakeholders in the selection of trees for downtown areas, neighborhood street plantings, and even new park trees.
- ✓ Include a knowledgeable arborist or urban forester on tree boards and in volunteer organizations.

The best solution to tree/utility compatibility is for the right tree to be planted in the right place.



FOR MORE INFORMATION

For direct links to more information related to the contents of this issue, please visit arborday.org/treecare.

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