



# Guide for Tree Selection, Planting, and Care





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### **Bill Elmendorf**

Joseph E. Ibberson Professor  
Urban and Community Forestry  
Penn State Department Ecosystem Science and Management  
Penn State University

### **Rachel Reyna**

Section Chief  
Pennsylvania Department of Conservation and Natural Resources  
Pennsylvania Bureau of Forestry  
Rural and Community Forestry Section

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## THE VALUE OF ECOSYSTEM SERVICES

A study of the value of open space in southeastern Pennsylvania identified many ecosystem services.

- \$61 million in annual stormwater management and water quality services
- an addition of \$16.3 billion to the value of housing stock which generated \$240 million annually in property tax revenues
- \$17 million in annual air pollution removal and carbon sequestration
- \$1.3 billion in health-related savings resulting from physical activity in parks and open space

Source: Delaware Valley Planning Commission

## STORMWATER UTILITIES

To help pay for the cost of stormwater management, the cities of Philadelphia and Lancaster have established stormwater utilities. These utilities collect taxes on the square feet of parking lots and other impermeable surfaces and provide tax credits for removal or mitigation of impermeable surfaces through better design, construction, and landscaping including bioretention areas, rain gardens, permeable paving, and tree planting.

See: [www.phila.gov/water/wu/stormwater](http://www.phila.gov/water/wu/stormwater)

## BETTER HEALTH

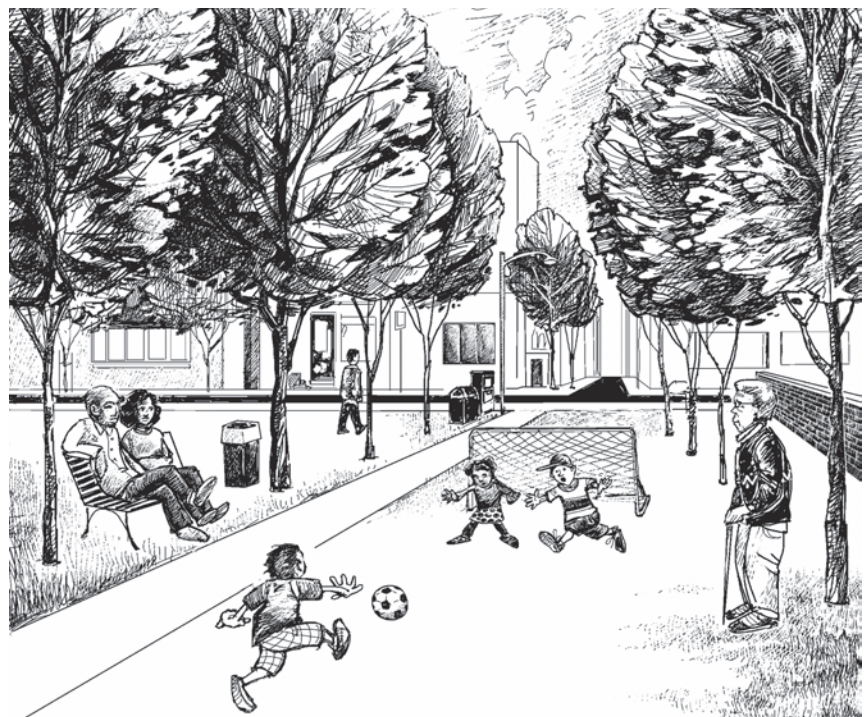
The California Department of Health estimated that physical inactivity costs the State \$13.3 billion a year in medical costs and lost productivity. According to those estimates, Californians could save more than \$1.3 billion in health-related costs if they lost five percent of their weight, collectively, over five years. Trees and parks provide opportunities for active exercise and passive recreation, which in turn helps people ease their stress, reduce their weight, and be healthier through increased exercise. Hospital patients recovering from surgery who simply viewed trees through their windows required less pain relief, experienced fewer complications, and left sooner than similar patients with a view of a brick wall.

Source: USDA Forest Service Changing Landscapes  
[www.landscapestewardship.org/changing-landscapes-factsheets-page](http://www.landscapestewardship.org/changing-landscapes-factsheets-page)

# The Importance of Trees to People and Communities

Trees provide many benefits to the 80% of Pennsylvanians who live in towns and cities. By supporting healthy environments, social and economic activity, and providing opportunities for volunteerism, trees and forests enrich people and increase the quality of life and community. Properly planted and cared for trees can:

- Provide beauty and help soften built-up places
- Offer families places where they can talk, visit, and express their love for each other
- Provide outdoor classrooms for children to explore and develop their human potential while learning about nature
- Help develop and protect people's sense of place and invoke pride and comfort in communities
- Provide opportunities for exercise, and help people improve health and recover from illness
- Reduce air conditioning needs and fuel costs for heating by cool shade and wind breaks
- Limit runoff and erosion and filter groundwater
- Provide biodiversity and habitat for birds and animals
- Increase home values and salability as well as a municipality's tax base
- Attract more customers that pay more for goods and services in downtowns



Trees provide many ecosystem services to communities.

Trees are only one part of natural resources found in communities. These resources are highly diverse, ranging from open space and greenways, to traditional parks, to woodlots, and to trees found in streetscapes and residential and business landscapes. Together they make up a community's "green infrastructure." When the landscapes that create green infrastructure are thoughtfully considered, properly planned, and well-managed, they contribute many valuable ecosystem services like stormwater management, recreation, and biodiversity. The value of this "bundle" of services is a main reason why street trees, parks, and other public landscapes should be adequately considered in municipal budgets and policy.

## Select Your Tree

Choose your tree wisely — it will provide benefits to you and your community for many years to come.

### AGE AND SPECIES DIVERSITY

A wide variety of genetic diversity provided by planting different tree species is essential for ecological and aesthetic health. Diversity not only adds interest and beauty, but it also protects landscapes from cataclysmic problems from exotic and domestic pests, disease outbreaks, and storms. Rely on species diversity to help avoid environmental, funding, and emotional disasters caused by mass tree die-off due to problems such as elm yellows, Dutch elm disease, and emerald ash borer. Never use a single species (monoculture) for large plantings on a street or in a park or neighborhood. Do not allow one tree species to dominate a shopping mall, campus, or alley of trees. It is recommended to plant three or four species of trees along a street. In an entire municipality, limit any species to 10 percent of plantings and limit any genus (a class of things with common characteristics such as all maple trees) to 20 percent.

Age diversity is established through annual tree removal and planting. As an example, if because of poor health or structure, two percent of a municipality's street trees are removed and planted each year, a 50-year difference in tree ages on any street can be created over time. Because large numbers of trees do not have to be planted or removed in a short time period, age diversity provides interest



Tree age and species diversity defends against catastrophe in the community forest.

### PLANT TREES TO

- Provide oxygen and clean air
- Screen undesirable views
- Frame attractive views and entryways
- Reduce noise pollution
- Manage stormwater and reduce erosion
- Cool the environment
- Provide wildlife habitat
- Increase property values and taxes
- Enhance downtown business and other commerce
- Reduce mental fatigue and stress
- Support community development and quality of life

### NATIVE OR NON-NATIVE TREES

Using natives reduces the likelihood of introducing the next bad non-native invasive plant like Norway maple or ornamental pear. Native trees can support biodiversity and local wildlife and insects. Native trees are particularly appropriate in and around parks and other large landscapes. But, in some places non-native trees may perform better than native; such as downtown sidewalk plantings. In these cases consider using non-native trees like ginkgo, honey locust, and London planetree that are already in fairly widespread use and not causing new problems.

### PLANT ORGANIZATION/ CLASSIFICATION

Trees and other plants are organized into groups using a hierarchical structure. The levels used in this organization are family, genus, and species. The following example uses red maple, *Acer rubrum*, to illustrate.

**Family:** Aceraceae contains all maple trees

**Genus:** Acer is a subset of Aceraceae that contains all maples with common characteristics

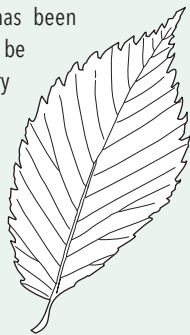
**Species:** rubrum specifies only red maple within the genus Acer

## CLIMATE CHANGE

Although Aldo Leopold discussed climate change in his 1949 conservation classic *A Sand County Almanac*, scientists have been seriously studying and discussing the idea of climate change since the 1960s. Along with politicians, they have argued whether, where, and how climates will change, the velocity of change, the ecological and social affects, and whether climate change is anthropogenic (human caused) or not? While the debate over scientific evidence to support wide spread climate change continues, urban foresters and arborists continue to consider different climates and microclimates when planning for tree planting. Harsh urban planting sites can have extremes in temperature, moisture, wind, light, soil conditions, and peoples' attitudes. Understanding these realities is crucial for successful tree planting and growth.

## ELM TREES

Over the past 25 years, researchers have been involved in selecting and breeding American elms for tolerance to Dutch Elm Disease (DED), and more recently elm yellows. Two cultivars, 'Valley Forge' and 'New Harmony' have exhibited good tolerance to DED, but are most likely susceptible to elm yellows. A number of cultivars from the Morton Arboretum, 'Accolade', 'Triumph', 'Danada Charm', and 'Commendation' are resistant to DED and may be resistant to elm yellows; although no documentation of this has been made. These trees should be planted selectively in very small numbers until resistance to elm yellows is proven.



and beauty, continued replacement and stability of tree canopy, and helps normalize yearly work and budgets.

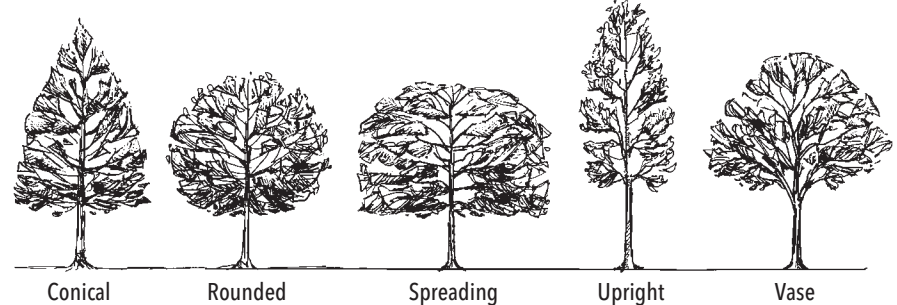
## COMMONLY AVAILABLE TREES

There are three types of trees commonly available at nurseries: balled-and-burlapped (B&B), container, and bare-root. Heavy B&B trees are often staked only for protection from vandalism and usually require less irrigation. Containerized and bare-root trees must be staked and require proper irrigation until well-established. All newly planted trees should be adequately irrigated during periods of dry weather.

### Advantages and Disadvantages of Different Nursery Trees

| TYPE                 | ADVANTAGE  | DISADVANTAGE   |
|----------------------|--|--|
| <b>B&amp;B</b>       | Less irrigation<br>Soil ball keeps roots moist<br>Large trees harder to vandalize<br>Staking not always needed | Heavy<br>Roots lost during transplanting<br>Time for root establishment<br>Removal of portion of wire basket |
| <b>Containerized</b> | Lighter<br>Easier to move and plant  | Irrigation required<br>Staking required<br>Girdling roots  |
| <b>Bare Root</b>     | Light<br>Easier to move and handle<br>Larger root system   | Irrigation required<br>Staking required<br>Roots can dry<br>Must be planted quickly                          |

## TREE FORMS



## CONSIDER YOUR CLIMATE

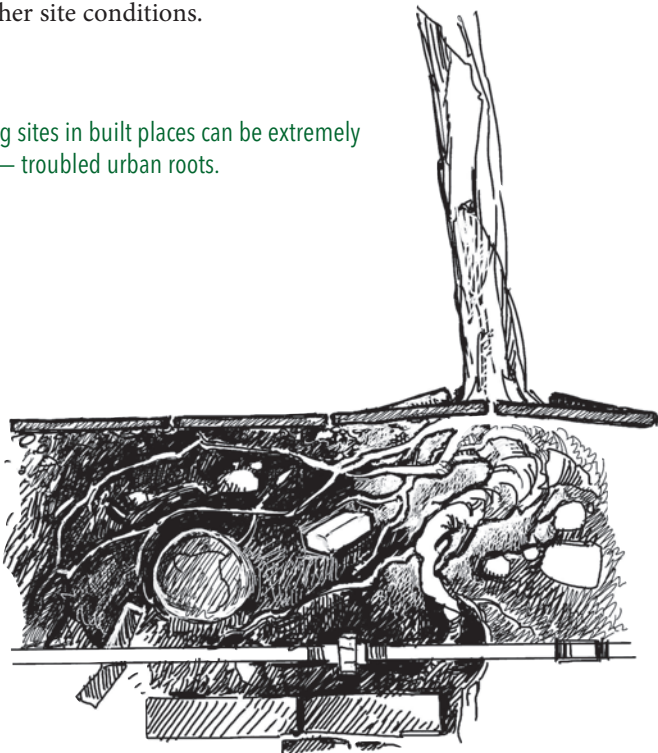
Use USDA Plant Hardiness Zone guidelines when selecting tree species for planting. Select tree species that will survive the coldest temperatures found in your USDA Plant Hardiness Zone (<http://planthardiness.ars.usda.gov/PHZMWeb/>). Pennsylvania hardiness zones range from zone 7a (0F to 5F) in the Philadelphia area to zone 5b (-15F to -10F) in Bradford, Indiana, and other counties. Southern magnolia and crape myrtle may grow in the Philadelphia zone, but in the rest of Pennsylvania it is too cold for these species. Warm hardiness, or the southernmost range of a species, is also an important consideration. For example, balsam fir and European birch will grow in the colder zones of Pennsylvania, but do not perform well in the warmer hardiness zones of the state.

Native trees growing in the forest have adapted to the climates of Pennsylvania, so they can be both cold- and warm-hardy. But, when planting trees, it is also important to consider where nursery stock has originated: red maple and other native trees hardy to Pennsylvania that are grown in southern nurseries are generally not genetically hardy to Pennsylvania climates and may not grow well.

## UNDERSTAND WHERE TO PLANT YOUR TREE

Understanding the site where trees will be planted and matching the proper tree species to the realities of that site is a vital decision for success. Many planting site realities exist both within a climate zone and in landscapes. While the overall temperature range of an area fits the hardiness zone, microhabitats, like a downtown business district or parking lot, are often hotter, dryer, windier, saltier, and have poorer, compacted soils than less developed places. Some microhabitats formed by buildings, walls, sidewalks and patios have hot reflective surfaces, cool shadows, and wind tunneling. Urban soils can be compacted, infertile, and dry. After assessing the realities of a planting site (soil, temperature, moisture, light), select trees for their ability to tolerate them. Sugar maple is not tolerant of deicing salt and does not do well in hot, dry sites. Littleleaf linden is not tolerant of hot, dry sites and is not a good tree for downtown planting cutouts. Ginkgo, honey locust, and London planetree are examples of trees that tolerate a wide variety of soil and other site conditions.

Planting sites in built places can be extremely tough — troubled urban roots.



## CHOOSE APPROPRIATE TREE SIZE

Mature tree size is often described as small (less than 30 feet in height), medium (30 to 45 feet in height), and large (greater than 45 feet in height). Small trees can be planted in places where space is limited, such as tree lawns 2 to 4 feet wide and under utility lines. Medium sized trees can be planted in larger places, such as tree lawns 4 to 6 feet wide. Large growing trees should only be planted in large places, such as tree lawns over 6 feet in width. Trees with mature tree heights of less than 30 feet are appropriate to plant under or near power lines. To allow each tree room to develop as it matures, the following distances between trees when planting along streets and in other rows should be considered:

**Small trees** ..... 25 feet apart  
**Medium trees** ..... 30 to 40 feet apart  
**Large trees** ..... 40 to 60 feet apart

## WHAT TO CONSIDER WHEN ASSESSING A PLANTING SITE

- Overhead and underground utilities
- Business and other signs
- Very wet or dry conditions
- Soil compaction and pollution
- Lack of soil volume and root and canopy growing area
- Soil pH (acidic, neutral, or alkaline)
- Use of structural or other engineered soils
- High temperatures and reflected heat from walls and windows
- Deep or day-long shade
- Heavy salt from deicing
- High winds between buildings
- Possibility of damage from lawn mowers and string trimmers
- Attitudes of people (do they want trees?)
- Likelihood of vandalism
- Ability to provide irrigation and other maintenance

## IMPORTANT POINTERS FOR TREE PLANTING

- Plant early in spring or fall
- Handle B&B trees gently
- Cut or loosen circling roots on container trees
- Protect bare root tree roots from drying out
- Cut and remove at least the top one-third of wire basket
- Do not use peat moss or other organic amendments
- Backfill with original soil or use high-quality top soil
- Lightly compact backfill with foot pressure
- Spread a 2 to 3 inch deep layer of mulch around the tree
- Keep mulch 2 to 3 inches away from the trunk
- Prune only dead or injured branches
- Remove tree wrap
- Stake only trees that require staking and allow for some trunk movement
- Do not use wire ties or garden hose in staking
- Irrigate all newly planted trees.

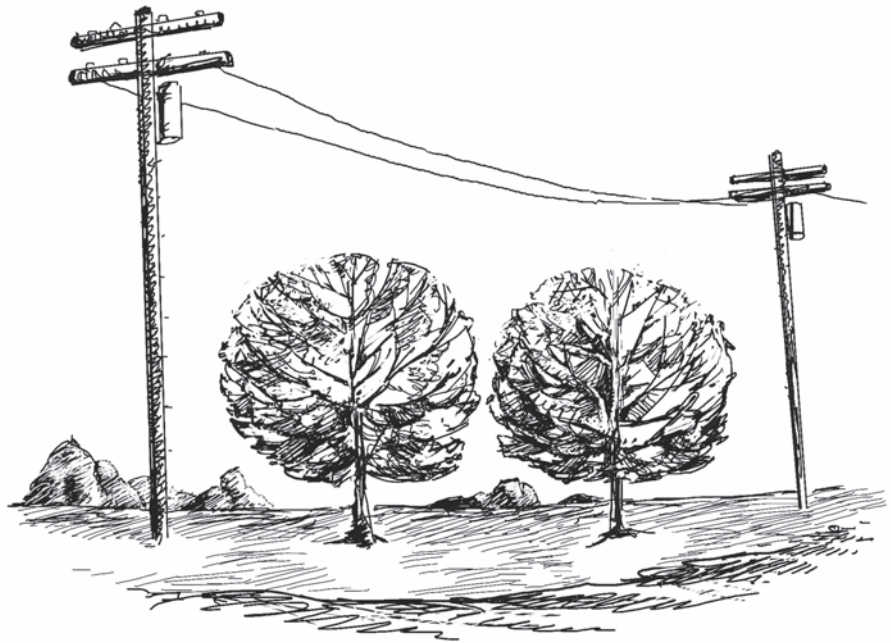
## WHAT TO CONSIDER WHEN DESIGNING WITH TREES

- Select trees that provide desired characteristics and services
- Look for special ornamental attributes (e.g., flower, fruit, fall color, bark, limb structure)
- Space trees properly as individuals or in natural-looking clusters
- Select trees with a size that enhances the scale of the site
- Plant trees that are tolerant of compacted soil, heat, drought, and other site conditions

## CONIFERS FOR PARKS AND OTHER VERY LARGE PLANTING AREAS

Conifers provide larger stormwater management values than deciduous trees. They are appropriate for very large planters or park landscapes.

- **Lacebark Pine**  
A very attractive tree that prefers sun and well drained soils. Tolerant of limestone soils.
- **Limber Pine**  
An attractive tree that prefers most, drained soils and full or partial sun.
- **Loblolly Pine**  
Easy to transplant and very adaptable to a wide variety of soils, but prefers acidic soil.
- **Norway Spruce**  
Prefers moist, acidic, drained soils, and full sun. Young trees may require irrigation.
- **Pitch Pine**  
Tolerant of salt, poor soils and able to survive the most unproductive sites.
- **Virginia or Scrub Pine**  
Performs well in poor dry soils where other pines will not grow.
- **White Pine**  
Prefers acidic, drained soils. Absolutely intolerant of salt spray or drainage.



Plant small growing trees under utility lines.

Because of quicker root establishment and function, smaller-sized nursery stock  $\frac{1}{2}$  to 1 inch in caliper (caliper is trunk diameter 6 inches above the ground) can grow quicker than and often catch up to larger sized and more expensive trees that are 3 to 4 inches in caliper. Because of concerns with vandalism and aesthetics, larger trees are used for street and park plantings, while cheaper, smaller size nursery stock is often used for riparian and other ecological restoration projects.

## CONSIDERING DESIGN ELEMENTS

Before selecting a tree, consider the characteristics and services the tree will provide. Ask some questions that only you can answer. Do you want fall color or spring flowers? Is interesting bark and branching habit during winter desired? How is the site used; will people primarily walk or sit beside the tree? Do you want shade, a screen, or an enclosure provided by tree canopy? Should the tree be evergreen or deciduous? Can an important entrance or exit be beautified? Do you want an informal look (different-sized trees planted together) or more formal (all the same sizes planted)?

Trees do not have to be planted only in straight rows. When possible, consider planting trees together in a cluster. The shared root space helps tree survival and the aesthetic effect will be more natural. Select trees whose mature size and shape help bring the built environment into a more human and natural perspective.

# Prepare Your Planting Site

Before a site can be prepared it must be analyzed using the categories provided on page 4. A common cause of new tree failure and death is compacted or poor soil. Before any tree planting, loosen soil through digging or cultivating. Existing soil that is full of construction debris or other rubble should be replaced with high-quality topsoil.

High (acidic) or low (alkaline) pH can be a problem in urban tree planting. Most trees prefer a neutral or slightly acidic pH and some trees such as red maple, pin oak, and red oak cannot grow in high-alkaline, limestone soils. It is important to use a soil test to measure pH. Soil pH cannot be corrected in the long-term by simply adding lime (make soil more alkaline) or granulated sulfur (make soil more acidic). If pH is a concern, plant trees such as zelkova, Kentucky coffee tree, ginkgo, and other species that tolerate alkaline pH and other harsh soil realities.

Trees are planted in many different places; from lawns and other spacious areas to confined sidewalk cutouts. Various planting sites have unique needs for site preparation and successful trees establishment and growth that are discussed below.

## PLANTING IN LAWNS, TREE LAWNS, AND OTHER SPACIOUS AREAS

For B&B and containerized trees, dig a rough-sided, saucer-shaped planting hole that is two to three times wider than the root ball (wider is better) and only deep enough to plant the tree even with or slightly higher than the existing soil grade. Do not dig a hole too deep and backfill because the underlying soil will settle and the tree will be planted too deep. The sides of the hole should slope gradually up to the surrounding grade. For bare-root trees, the planting hole must be wide enough so that roots can be placed in the hole without bending or kinking. For any type of tree, if the existing soil is of poor quality, dig the planting hole as wide as is reasonable and use high-quality topsoil to backfill.

## PLANTING TREES IN LIMITED SPACE: SIDEWALK, PATIO, OR OTHER CUTOUTS

Many people think larger volumes of soil and rooting space are required for tree planting in sidewalks (600 cubic feet for large trees such as oak). This doesn't have to be the case if you use careful species selection and new tree planting techniques. Small planting sites are a reality in many built-up places, but when considering that people want trees and tree canopy and the large cost of installing engineered soil systems such as Sylva Cells, if needed and desired, cutouts in sidewalks and patios can be as small as 5 feet long, 5 feet wide, and as deep as the root ball of the tree being planted. The volume of soil in this size pit can allow for a stress-tolerant tree such as honeylocust or ginkgo to grow and provide many desired benefits; although it may not be in perfect condition or reach full mature size or longevity. In all cases, larger planting/rooting areas and soil volumes provide for better tree health, growth, and longevity. In larger sidewalks and other tight planting areas, provide as much rooting area/soil volume as you can and carefully choose stress tolerant species. Loosen all soil within the sidewalk or other cutout to the depth of the root ball and plant the tree as described on pages 9–10. If the excavated soil is poor, or full of debris, replace with high-quality top-

## AMENDING SOILS

When planting trees, poor soil is replaced by a high quality top soil or an engineered soil like structural soil. Because organic material can hold too much water, especially in clay soils, and are prone to decay and sinking, adding large amounts of peat moss and other organic material to tree planting pits is not recommended. When soil amendment is required (e.g., converting old parking lot to landscaped area) it is done over a large area, not just in planting pits. These projects use a combination of soil ripping, top soil, organic amendments, fertilizer, and cultivation over a large area.

## PREPARE TO PLANT TREES IN SPACIOUS AREAS

- Loosen compacted soils as much as possible
- Test for soil pH and fertility
- Replace poor soils with a high-quality topsoil
- Locate trunk flare and do not plant tree too deep
- Dig a wide, saucer-shaped hole with rough sides
- Leave the soil undisturbed at the level the root ball will rest

## PLANTING TREES IN SIDEWALKS, PATIOS, AND OTHER CONFINED AREAS

- To provide adequate soil volumes, planting cutouts should be as large as possible
- Structural and sand soils can be used to increase soil volumes and rooting areas under sidewalks and patios
- Both structural and sand soils do not hold water well so drought-tolerant trees and irrigation must be used
- The use of BioChar, a charcoal soil amendment, may improve the properties of urban planting soils
- Larger tree-planting areas such as continuous planters can be engineered as rain gardens and bioretention basins



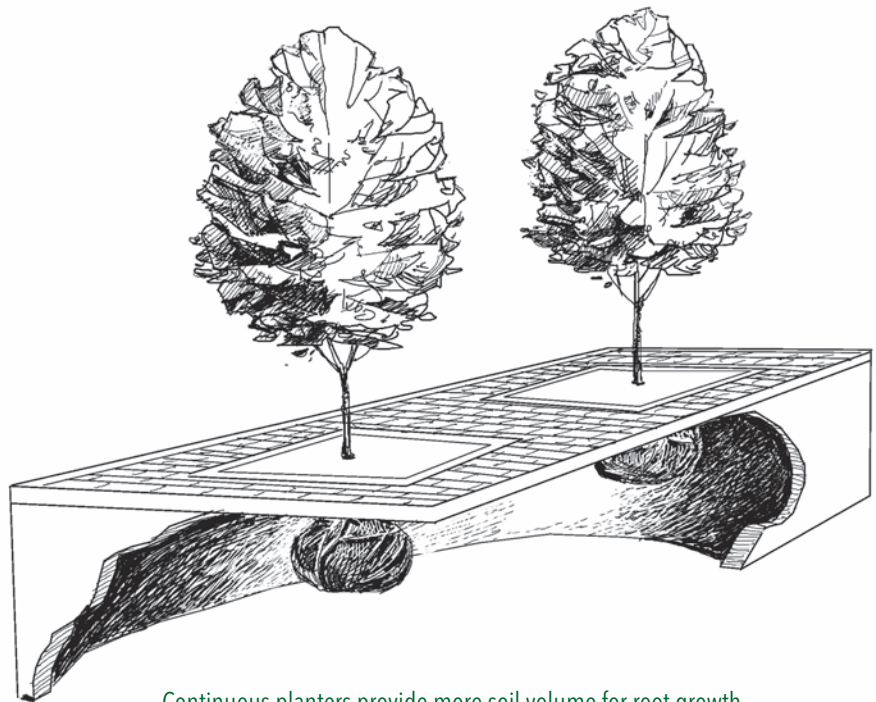
## WHY TREES DIE AFTER PLANTING

- Trees planted too deep- buried
- No irrigation of newly planted and young trees
- Too much mulch
- Damage from lawn mowers and string trimmers
- Loss of roots from root balls breaking apart or drying
- Air pockets, stones, or clumps of soil and turf in planting holes
- Compacted soils
- Planting hole to small
- Improper preparation of planting area
- Incorrect transportation, storage, and handling
- Use of herbicides to kill grass around tree

soil. The rooting area of sidewalk, patio, and other cutouts can be increased by using continuous planters and structural and other engineered soils discussed below.

## CONTINUOUS PLANTING AREAS

In wide sidewalk areas a continuous tree planter can be designed and constructed by providing a minimum 5-foot-wide planting/soil strip parallel to the curb. This planting area promotes root growth parallel to the curb and provides trees with larger, shared rooting areas in sidewalks and other paved areas. The planter can either be left open, planted with a ground cover or covered with porous concrete, pavers, or other porous material. The rooting area of these types of planters can be increased by using structural or sand soils under the concrete of sidewalk and other hardscape. This type of planter can be designed for parking lots and as bioretention areas. These areas are landscaped depressions or shallow basins used to slow and treat stormwater runoff.



Continuous planters provide more soil volume for root growth.

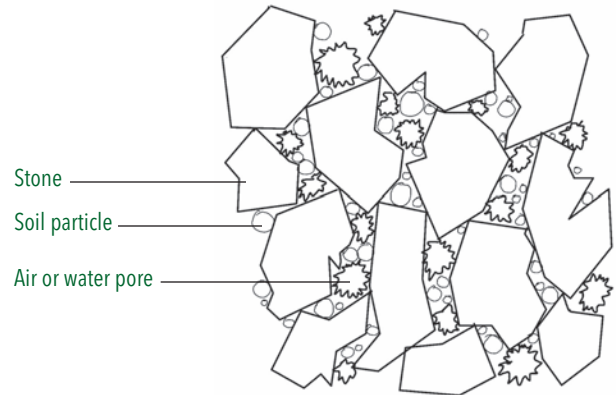
## STRUCTURAL SOIL AND OTHER ENGINEERED SOIL SYSTEMS

Structural Soil, which was developed at Cornell University, provides both a porous rooting area/soil volume and a load-bearing surface that can support asphalt, concrete, brick, or other hardscape. The three components of the measured soil mix are an angular crushed stone (to provide a load-bearing skeleton), a clay soil (to provide for nutrient and water-holding capacity), and a small amount of hydrogel (to bind soil and rock together). To provide the most cubic feet of rooting area in sidewalks, patios, or parking lots, structural soil should be used under as much cement or other hardscape as possible, not just near an individual planting pit. This will provide a load-bearing foundation for porous hardscape and allow the entire area under a sidewalk or patio to provide rooting area/soil volume for tree growth. When using structural soil to support surrounding hardscape, trees should be planted in cutouts or continuous planters filled with a high quality top soil.

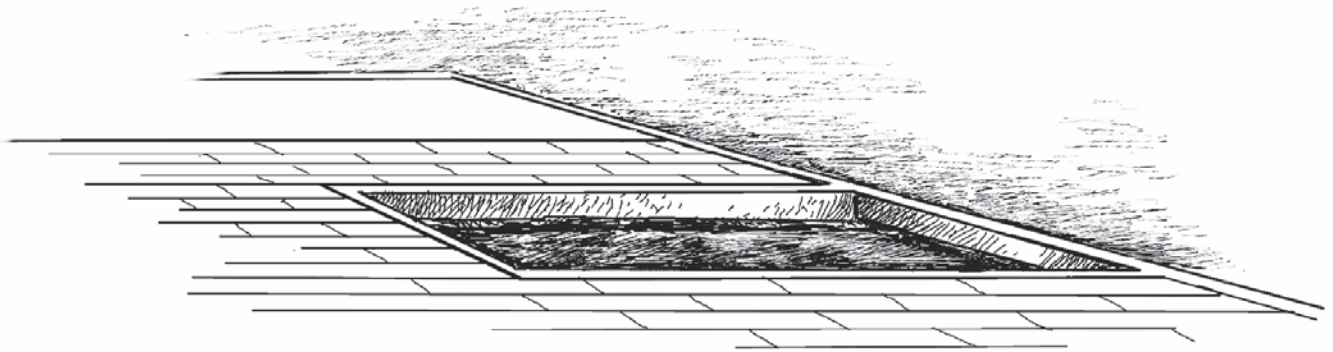
A number of soil scientists promote the use of engineered sand soils in and around continuous planters and in other large plantings. These soils compact to provide load-bearing surfaces, but also allow roots to grow. The design and engineering of sand soils is highly site-specific. Both structural and engineered sand soils can be infertile and dry which requires irrigation for newly planted trees. Soil fertility can be thought of as the ability of a soil to receive, store, and release nutrients and water.

Another engineering option is the Silva Cell. Though expensive (up to \$12,000 per tree) it does allow trees to grow larger and longer in difficult streetscape environments. Silva Cell is a modular suspended pavement system that provides soil volumes to support large tree growth. Each Silva Cell is composed of a frame and a deck that resemble stacked milk crates. Frames are 48 inches long x 24 inches wide x 16 inches high, and each cell holds 10

cubic feet of soil. Cantilevered and pier supported concrete sections with pre-cut tree pit openings placed over non-compacted topsoil have also been designed and used for larger tree plantings.



In structural soils, the stone lattice bears loading while the soil particle partially fills the lattice voids.



Structural soils can be used under porous hardscapes to increase rooting volume.

# How to Plant Your Tree

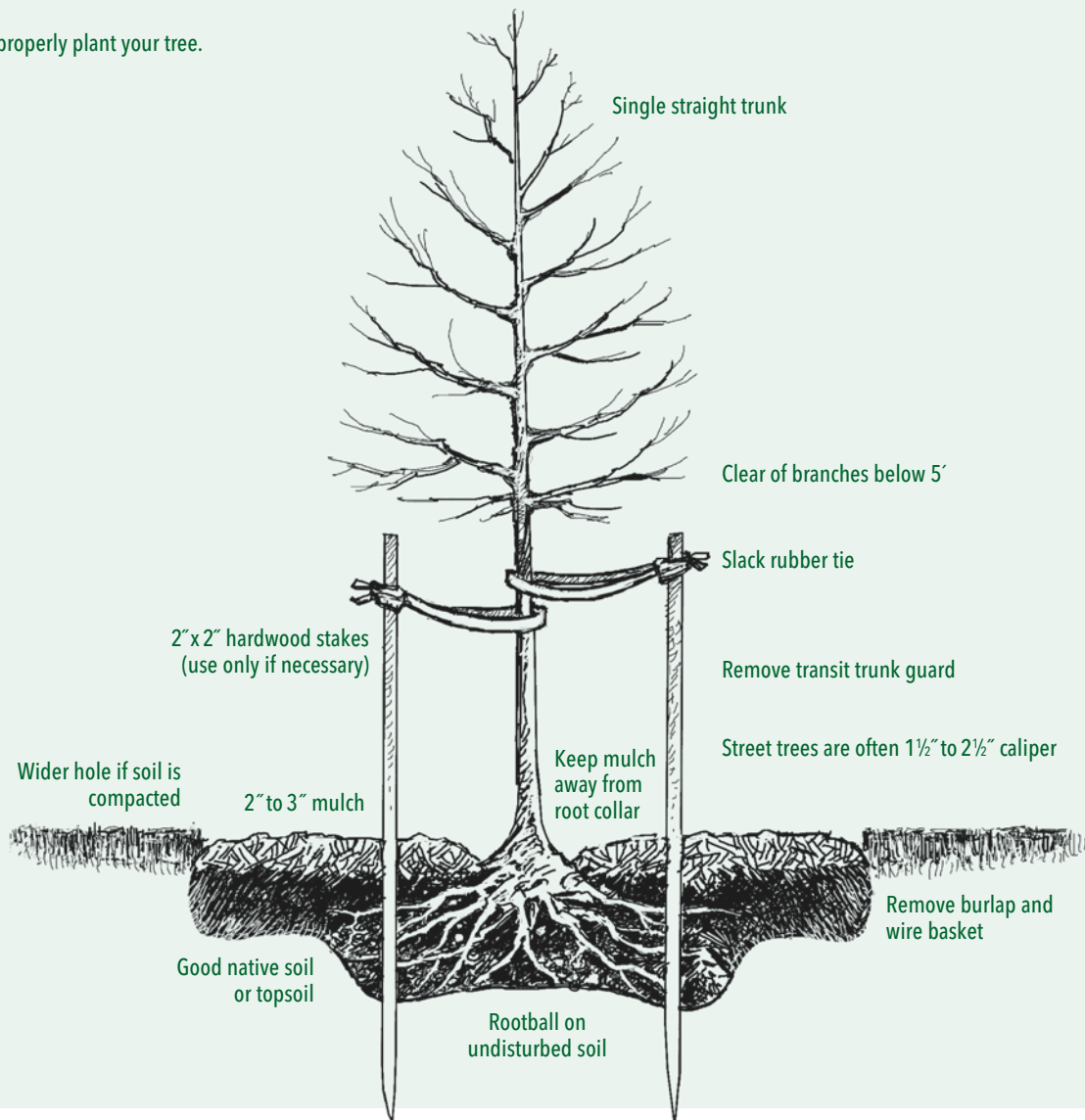
## WHEN TO PLANT: TIMING

The best time to plant most trees is in the early spring and fall, but because of increased mortality some trees, such as all bare root nursery stock, as well as oaks, zelkova, tulip poplar, and dogwood, should not be planted in fall. If planted early in the fall, the tree will begin some root growth, while planting in the spring allows for an entire growing season before the tree goes dormant. When planting in spring, wait until soils are unfrozen, but plant early enough so tree roots can begin to grow before the hot, dry summer. If needed, B&B and containerized nursery stock can be planted after leafing-out in late spring or early summer, but correct irrigation must be provided. In all cases, do not forget to water your trees during hot, dry weather.

## HOW TO PLANT: THE PLANTING PROCESS

Techniques for planting B&B, container and bare-root trees do not differ greatly. Remove any tree wrap used to protect the tree trunk during transit and gently place a B&B tree into the planting hole to avoid breaking the root ball. Always handle a B&B tree by the root ball- not by the tree trunk. If the root ball falls apart, many small roots are damaged or desiccated and the roots cannot adequately absorb water and nutrients. A common cause of new tree death and failure is planting too deep. Because of cultivation at the nursery, B&B trees may have soil piled on top of the root collar (where the tree trunk flares out to the roots), causing trees to be planted too deep. Identify the root collar on all trees and plant the tree at a height at which the

How to properly plant your tree.



flare is even with or slightly above surrounding soil. The large roots of the newly planted tree should be about one inch underground. If the root collar cannot be found after removing burlap and a small amount of loose soil, the tree should not be planted. Once a B&B tree is in the hole, cut and remove all twine from the trunk and either cut and remove or slide burlap to the bottom of the hole. To prevent root girdling (cutting off of circulation) of tree roots in wire baskets, cut and remove at least the top one-third, or two tiers, of wire and remove it from the planting pit. Be careful, especially if children are involved in planting, the ends of cut baskets are very sharp.

Containerized trees are grown in a lightweight artificial soil media and can have some amount of circling roots around and within the container. Gently cut or break-up circling roots to promote root growth into the surrounding soil. If a tree has been growing in a container for too long and there are too many circling roots, it should not be planted.

Because there is no soil to protect roots, bare root tree roots are very susceptible to drying out before planting. Use tarps, bags, irrigation, and shade to protect bare-root tree roots from heat and desiccation before planting. Bare root trees should be planted as quickly as possible and planting bare root trees requires extra planning, especially when using volunteers. When planting bare root trees, spread tree roots evenly without kinking in a saucer

shaped hole. Immediately cover with soil and water immediately and during periods of heat and low rain.

Attempt to backfill all planted trees with the soil you removed from the planting hole. If the soil is poor, or full of debris, use high quality topsoil similar to the surrounding soil. For containerized and B&B trees, backfill two-thirds of a planting hole then lightly compact the soil with foot pressure. Continue backfilling until the hole is filled up to the root collar.

After your tree is planted, stake, mulch, irrigate, and prune as discussed in *Establish and Care of Your Tree* below.

#### TREE RISK ASSESSMENT

As trees grow larger and heavier, tree risk assessment is important, especially in landscapes where tree failure may hurt people or damage property. Risk is the combination of the likelihood of an event and the severity of potential consequences. Tree risk is assessed so that a tree can be removed or treated before any failure of roots, trunk, or branches resulting in consequences takes place. When assessing tree risk, possible targets, site factors, tree health and species profiles, common loads or forces on a tree, and defects and decay of branches, trunk, root collar, and roots are all assessed. Tree risk assessment categorizes risk by the likelihood of a tree part failure, the likelihood of a failure striking a target, and the consequences of a tree part striking a target.

## Establish and Care for Your Tree

In general, newly planted trees take about one year per inch of trunk caliper (trunk diameter 6 inches above the ground) to become established with sufficient root growth. A large 3 inch caliper tree will require irrigation during dry weather for three years. Proper mulching is very important and helps a tree become established and grow.

For establishment, newly planted trees need as many leaves as possible to provide for maximum photosynthesis which fuels root establishment and growth. At planting, prune only dead or broken branches. Prune newly planted trees to enhance and correct branch structure over a number of years, not all at once. Do not fertilize trees at planting. Wait until the second or third year when the tree roots can uptake the fertilizer and to avoid burning young roots. Irrigate all newly planted trees.

Don't forget about your tree! Many people care for trees

for the first month after planting, but trees need care for much longer. Your tree is an investment that will provide many benefits in the future. For good establishment and growth, continue to irrigate, mulch, and protect your tree from vandalism, lawn mowers, string trimmers, and other hazards.

#### STAKING

Because of their weight most B&B trees do not need staking. Staking is necessary for containerized and bare root trees and may be necessary for B&B if trees are very large, planted on slopes, planted in a very windy area, or require protection from vandalism. Stake trees properly by hammering two tall stakes into the ground beyond the root ball area. Secure the tree with flexible, soft ties. Provide 1 inch of play in ties to allow the tree to move which helps develop a strong trunk and root system. Remove the stakes

and ties after 6 to 12 months. When stakes and ties are not removed, the ties can girdle (cut off circulation) the tree trunk. Wire ties or rubber garden hose should not be used.

### **WATERING**

To ensure root establishment and growth of a new tree, water correctly. A 2 or 2½-inch caliper tree should receive 25 to 40 gallons of water each time it is irrigated. The need for watering increases during hot, dry weather, but gradually decreases in successive years as a tree's roots becomes established. Water should be applied slowly and deeply until it reaches the bottom of the root ball; not just the top few inches of soil. This can be done by using large perforated containers called TREGATORS or by using 5-gallon plastic buckets with several small holes in the sides, close to the bottom. When using a hose, allow the water to trickle out for at least an hour, and move the hose several times. Watering young trees is extremely important, but it's just as important not to water too much. Excessive watering, combined with poor drainage, deprives roots of oxygen and can kill them. The symptoms of overwatering are the same as those for drought: wilting, loss of leaves, and poor growth.



TREGATORS provide newly planted trees adequate water during hot, dry periods.

### **MULCHING**

Mulch is important and will vertically amended soils over time. Spread a 2 to 3 inch layer of composted, coarse mulch around the base of a tree to help conserve moisture, reduce soil compaction, reduce weeds, and protect from lawnmowers and string trimmers. For oaks, maples, and other deciduous trees, the best material for mulch is course, composted deciduous wood chips. For conifers,

Lawn mowers, string trimmers, and over mulching kills trees.



needle straw and coarse composted pine chips can be used. Never pile a cone or volcano of mulch around a tree! Rodents and insects will over-winter in mulch piles and feed on the trunk. Overly thick mulch piles prevent water and air from reaching tree roots and can cause problems with fungal diseases. Don't use geotextile or plastic sheets under mulch because they impede the passage of air and water, inhibiting root growth and function.

### **MULCHING DONE RIGHT**

- Apply no more than 2 to 3 inches of mulch around, but not touching, the tree trunk
- Do not apply mulch cones or volcanos
- Mulch outward from a tree trunk to a reasonable distance; at least to the edge of the planting hole
- Maintain a 2 to 3 inch layer by removing and replacing old mulch annually
- Remove and replace mulch that has been compacted by pedestrian or other traffic

### **FERTILIZING**

Do not apply fertilizer during the first year after planting. Fertilizer may burn tender roots, promote top growth before the root system becomes well-established, or simply be leached from the soil before roots can uptake it. If required, based on the results of a soil test, fertilize the second or third year after planting. A soil test determines how much nitrogen (N), phosphorus (P), and potassium (K) are present in a soil. These nutrients are important in tree growth and condition. A bag of fertilizer lists three numbers on the package that tell you the amount of NPK that is provided; for example, 10-8-6. The first number is the percentage of nitrogen, second the percentage of phospho-

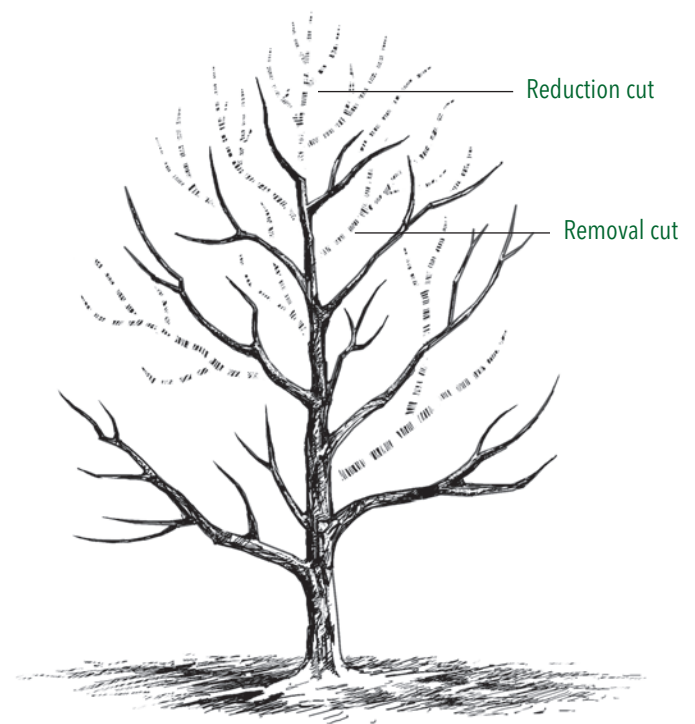
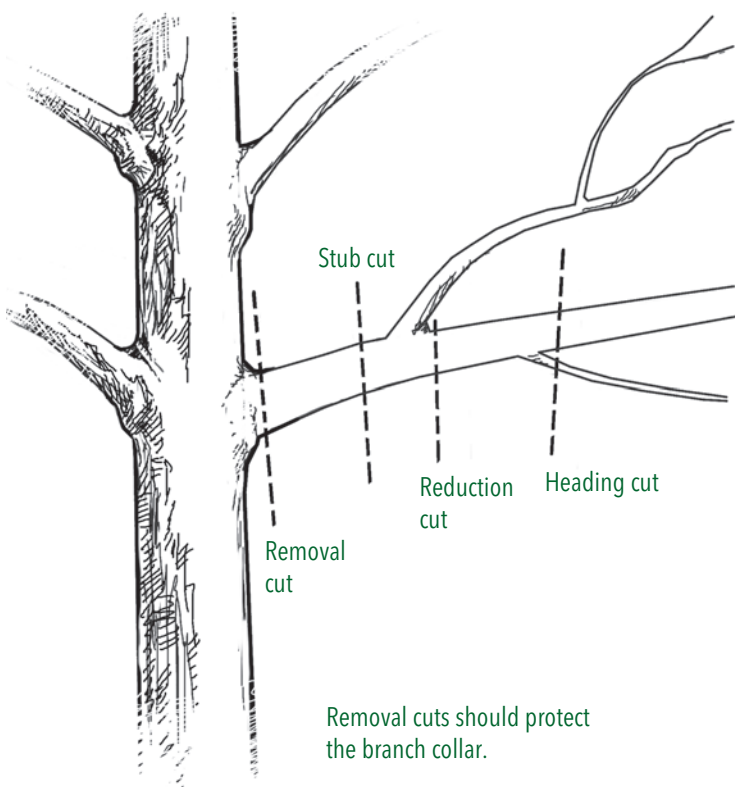
rus, and third the percentage of potassium. To protect roots and provide for reasonable top growth, use a slow-release fertilizer that has a low proportion of nitrogen, such as 10-8-6. For newly planted trees, recommendations for the amount of fertilizer are based on the number of cubic yards of canopy. Recommendations for larger, older trees are per 1,000 square-feet of canopy. One simple recommendation is to evenly spread two cups of 10-8-6 fertilizer under the canopy of young trees.

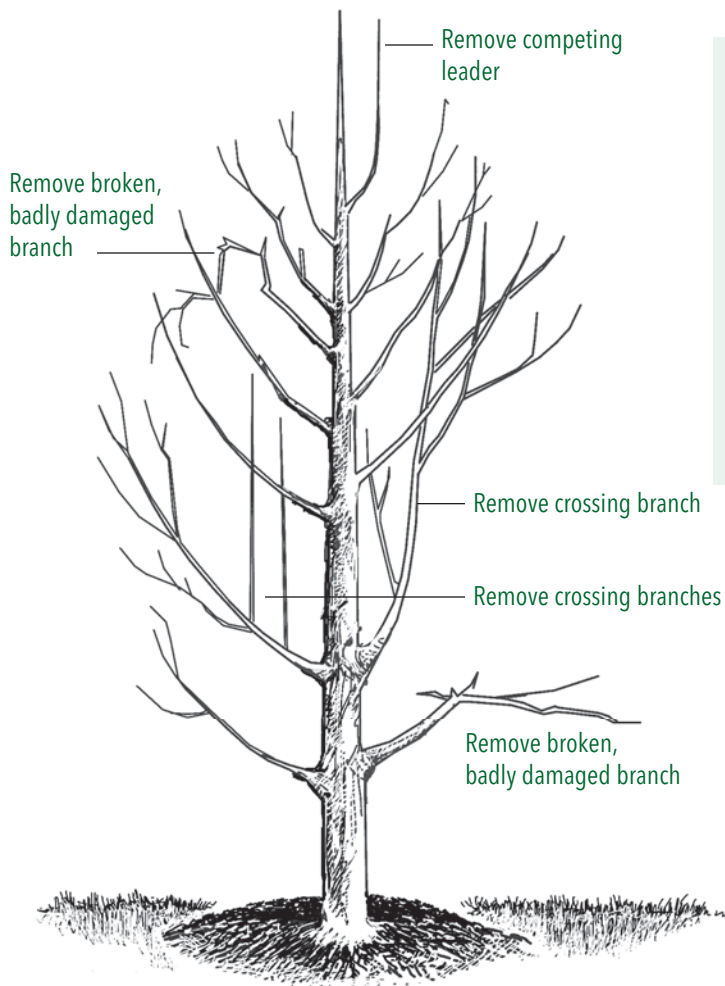
## PRUNING

Trees do not “heal.” They generate new cells in new places and compartmentalize. Trees use chemically and physically altered cells, such as thicker cell walls, to limit the spread of decay (CODIT or Compartmentalization of Decay in Trees). As a result, trees tend to internalize decay in the wood of trunks and limbs. Trees produce new cells in wound wood to cover, not heal, wounds. In some places on trunks and limbs trees grow reaction and response wood (denser wood and increased diameter of stems) to provide for strength in trunks and limbs in response to gravity, wind, and other common forces. Correct pruning supports a tree’s ability to remain healthy and limit decay and other structural problems like poor branching unions. It also helps trees better resist the forces of wind, snow, and ice.

Only removal cuts that remove a limb at its origin on trunk or branch and reduction cuts that shorten a limb back to a limb large enough to resume growth and hormonal dominance (prune back to a limb that is at least one-third the diameter of the limb being pruned) should be used in pruning. Heading and stub cuts that are used to “top,” shear, or round-over trees should never be used on live trees and only used when a tree is being removed. Pruning should never leave stubs and should always protect and enhance the natural form of the tree. Understanding and using proper pruning practices is essential; poor pruning results in decay and other damage that will cause major limb breakage and other problems over the life of the tree.

Pruning is a common and important tree maintenance activity for both younger and older trees. Pruning a younger tree is done to remove dead and diseased branches and to help develop or train a strong and permanent branch structure typical of the species of tree. Newly planted trees need as many leaves as possible to support photosynthesis and growth. Prune young trees sparingly immediately after planting, removing only dead and damaged branches. Wait to begin necessary corrective pruning (removing crossing branches that grow back into the center of the tree, and narrow branch unions not typical of the





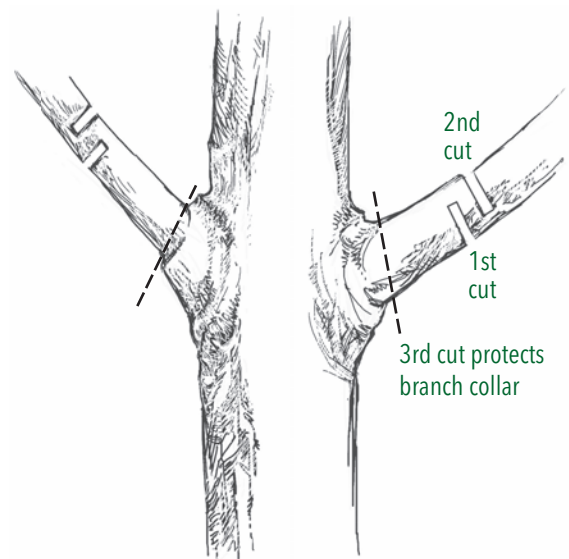
### IMPORTANT TIPS FOR TREE PRUNING

- Remove dead, diseased, and broken limbs anytime
- Avoid pruning in spring when leaves are emerging
- Prune after leaves are shed and in summer after new leaves have hardened
- Do not prune conifers in the heat of summer
- Wait to begin corrective pruning and training until after the first two years of growth
- Use natural target pruning and the three-cut method
- Prune with sharp tools appropriate for the branch size
- To avoid problems with decay, do not apply wound dressing or paint

Prune young trees judiciously.

species) and training until two seasons of growth. As a rule, small pruning cuts do less damage to a tree than larger cuts. This is one reason why proper pruning (training) of young trees is critical. Waiting to prune a tree until it is mature is expensive and often creates the need for large cuts that are prone to decay. Pruning older trees is done to remove dead, damaged, and weak branches and to properly distribute limbs and foliage that supports structure, health, and growth.

Judicious and strategic pruning is essential on trees of any age. Learn where and how to properly make pruning cuts before picking up a pruning tool. Each pruning cut has the potential to hurt tree structure and health, so always have a reason before making a cut. Always protect the limb's branch collar (the weaving of branch and trunk wood) by using natural target pruning. Use the three-cut method for any branch you cannot support with your free hand (usually 1 inch or larger in diameter). This method prevents bark stripping. To complete the three-cut method:



The three-cut method should be used to remove large branches.

- 1) Saw a notch on the underside of large limbs several inches from the trunk.
- 2) Next, on top of branch, make your next cut just beyond the undercut to remove the bulk of the branch.
- 3) Make the final cut outside the bark collar.

Although forest trees grow quite well with only nature's pruning, landscape trees require a higher level of care to maintain their health, structure, and aesthetics.

# Common Problems to Avoid

Poor care is a main cause for unhealthy and dead trees. In newly planted trees, insects and diseases are not usually primary reasons for unhealthy and dead trees. Typically, insects and diseases are secondary agents that attack already weakened, wounded, or improperly cared for trees. In order to maintain healthy trees, whether young or mature, it is necessary to properly care for trees and to avoid some basic mistakes in tree care.

## SOIL COMPACTION

When soil is excessively compacted, even from foot traffic, soil structure is destroyed, leaving no soil pores for the movement of oxygen and water that is necessary for the health and proper function of tree roots. Eliminate traffic and the storage of materials over the root systems of trees.

## WIRE BASKETS, TWINE, AND TREE WRAPS

Wire baskets and twine left on newly planted trees are common causes of girdling. Root and trunk girdling will gradually cut off the flow of water and nutrients to tree leaves causing poor growth and death. Tree wrap left on after planting is a haven for insects. Remove all twine and tree wraps and at least one-third of wire baskets at time of planting.

## EXCESS MULCH

A 2 to 3 inch layer of composted mulch is sufficient. Too much mulch causes problems with fungal diseases, rodents, and adequate soil moisture. Water and air will not penetrate crusted or compacted mulch. Old mulch, or mulch subject to foot traffic, should be raked or replaced annually. Add mulch to maintain a 2 to 3 inch layer only as old mulch decomposes or is removed.



Too much mulch kills trees.



Do not bury or damage roots during construction.

## TRUNK, BARK, BRANCH, AND ROOT DAMAGE

Any damage to the structure of the tree provides an entry point for insects and diseases that cause decay. Always use correct pruning standards. Keep lawn mowers and string trimmers away from the base of trees by proper mulching. Do not fasten animals or bicycles to trees or put nails into a tree trunk.

## LAWN AMENDMENTS AND CHEMICALS

Some fertilizers, amendments, and weed killers beneficial to lawns may be taken up by tree roots and can harm or kill a tree. Do not use chemicals such as Dicamba near desirable trees known to be sensitive to that chemical. Be careful with the application of Glyphosate, a wide-spectrum herbicide found in many weed killers, around exposed roots, trunks, and tree wounds. Consider a compatible ground-cover treatment, such as mulch, for weed control around trees.

## DOGS

Dog urine has high concentrations of urea and is highly acidic. It causes soil, root, and trunk damage. Discourage dogs from repeatedly targeting trees. Dog chains and chewing can kill trees.

## SALT DAMAGE

Salt (sodium chloride) used on roads and sidewalks for deicing damages soils and trees. Salt causes tissues to dry out and die and also causes problems with the ability of a tree's roots to absorb nutrients. Trees sensitive to salt — including red and sugar maple, pin oak, and littleleaf linden — should not be planted where salt is being used,



where salt-laden snow is piled, or where salt runoff accumulates. Salt spray from roadways will kill foliage in trees such as white pine.

### SOIL GRADE CHANGES

Adding or removing soil, as well as cultivating or tilling, in a tree's root zone, can damage roots. Excess soil on top of roots reduces oxygen and water movement and availability. Since many tree roots are in the first 6 to 12 inches of soil, removal of soil also means roots are ripped and removed. Avoid any grade change. Be aware that a root system may spread far beyond the furthest branch (drip

line) of a tree. Some trees, such as beech, tulip poplar, white pine, white oak, and dogwood, are extremely sensitive to any grade change.

### WOUND DRESSING

When a tree is wounded or pruned, do not treat it with wound dressing. Because of increased light and air and decreased damage to growing tissues, a tree can best cover and compartmentalize wounds when dressings are not used.

## Diagnosing Tree Problems

Tree condition is a combination of tree health and structure. Both symptoms and signs are used to diagnose problems with tree condition. A symptom is the result of a problem, like dead leaves and crown dieback. A sign is the problem itself, like an insect or the fruiting body of a fungus. Common symptoms of poor health include poor yearly twig and leaf growth, smaller leaves, crown dieback, and poor growth of wood around wounds. Common symptoms of structural problems include decay in trunks, limbs, and roots (often hard to see), narrow branch unions, severe lean, and long, heavy horizontal branching. Because the circulatory system of a tree (phloem and xylem) is under the bark on the outside of a tree's trunk, a tree can be very healthy, but have severe structural problems because of interior decay columns, poor branch architecture, and other problems. Symptoms and signs can help identify tree problems and their treatment.

### ROOT FLARE

Does the tree enter the ground with a natural flare or swelling? No root flare means a tree may be suffocating because soil has been filled around its trunk and roots. No root flare may also mean that there is a girdling root restricting the movement of nutrients, water, and sugar.

### ABNORMAL LEAF SIZE

Tree leaves smaller than normal in size for a species may indicate root decay or injury, soil compaction, or drought. Leaves larger than normal, especially on root suckers, or sprouts, can also indicate root or soil problems.

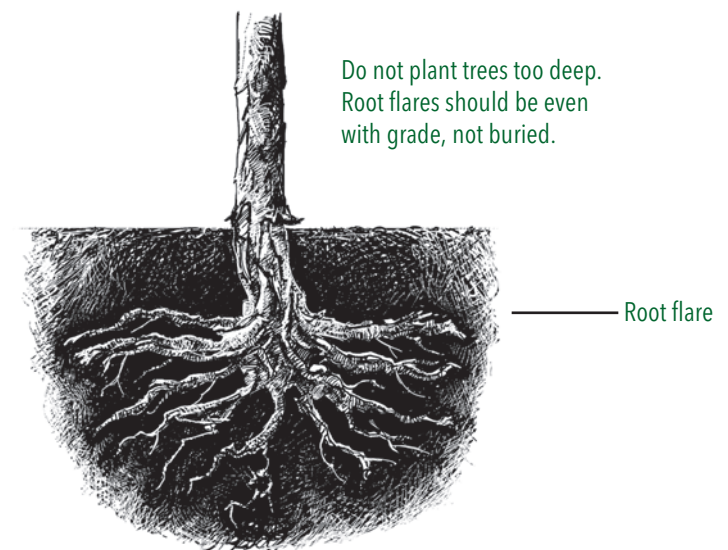
### TRUNK SCARS AND CRACKS

Wounds on trunks and limbs of older trees may indicate hidden decay columns. Look for ragged scars from prun-

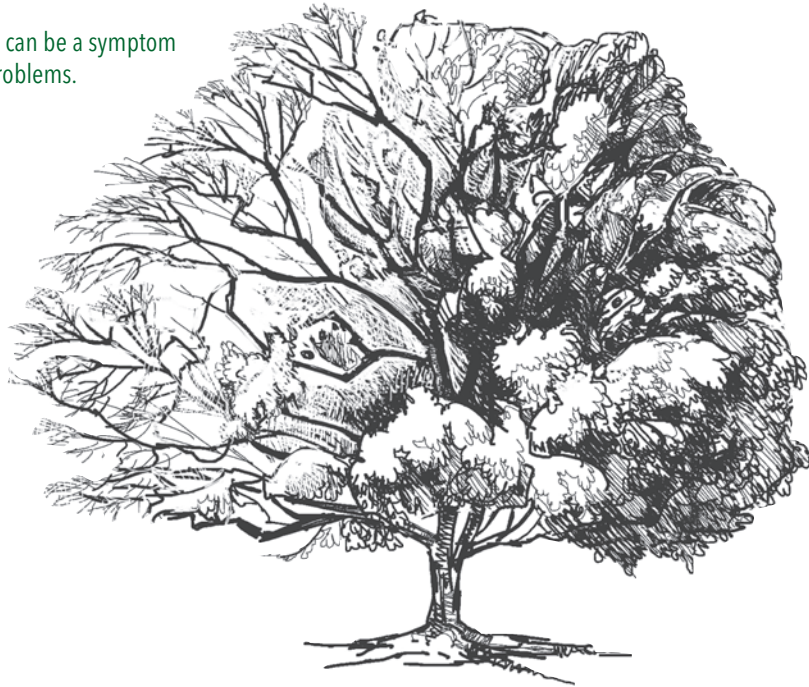
ing, automobile, or other injuries that have not covered with wound wood. Deep horizontal cracks in a trunk or limb of an older tree may indicate interior decay.

### TEARING AND CUTTING ROOTS

Tree roots grow where there is air, nutrients, moisture, and healthy soil. Although trees can develop deeper root systems if soil and moisture conditions allow, tree root systems typically grow in the top 24 to 36 inches of soil and the vital small absorbing roots are mostly in the top 12 inches. Roots are easily damaged. Cuts, fills, cultivating/tilling, and sidewalk and street placement can compact soils and cut and rip roots. Lateral trenches placed for underground utilities can remove all roots on one side of a tree. Avoid root damage by proper placement of construction and the use of boring and engineering tools such as retaining walls and pier foundations.



Dieback in a tree canopy can be a symptom of root or other health problems.



### **CROWN DIEBACK**

Search the tree's canopy for dead leaves, twigs, or branches. This type of dieback may indicate old age, insect or disease infestation, lack of water, soil compaction, or root damage or decay. Crown dieback caused by root decay can take several years to become apparent; long after the roots have become well-decayed and structurally weakened.

### **YELLOW FOLIAGE**

The general yellowing of a leaf at a time other than autumn, often called chlorosis, can be caused by a variety of factors including insects, diseases, too much or little water, and nutrient deficiencies caused by pH imbalances in the soils. Trees such as red and pin oak and red maple planted in alkaline/limestone soils will continue to show poor growth and yellow foliage because of a lack of iron. If problematic soil conditions exist, plant trees tolerant of high pH or other soil problems.

### **STICKY SUBSTANCE OR OOZE DRIPPING FROM LEAVES OR TRUNKS**

Insect honeydew is usually the waste product of insects such as aphids, lace bugs, or scale feeding on a leaf. While this dirty, aggravating problem can be controlled by planting a tree species that insects are not attracted to or insecticides, insects causing honeydew may not harm the tree. Ooze from trunks and limbs can be an indicator of interior decay.

### **INSECTS**

Large populations of insects may or may not damage a tree. Some insects may only cause aesthetic problems, or happen at a time of year that cause few problems, such as very late in the growing season. Inspect your trees on a regular basis, looking for an insect or defoliation and other symptoms. If you suspect an insect pest, collect the pest and the symptoms and take them to your local Penn State Extension office for identification and proper control recommendations.



A new insect threat: the spotted lanternfly.

### **DISEASES**

Some tree species are more or less susceptible to disease. Symptoms of disease include rapid loss of leaves and quick or long-term crown dieback. Root decay caused by fungus and systemic diseases such as elm yellows and oak wilt are very difficult to treat. Diseases can be reduced by: planting trees that are not susceptible to diseases such as oak wilt and Dutch elm disease, keeping trees in good condition through proper planting, irrigation, and pruning; avoiding soil compaction and grade changes, and protecting from lawnmower and other damage.

# Tree Commissions and Civic Involvement

## IMPORTANCE OF TREE COMMISSIONS

Through Pennsylvania's Borough and Township Codes, municipal tree commissions have been authorized to develop street and park ordinances and approve tree removal permits in Pennsylvania since 1907. Most of Pennsylvania's 2,562 Pennsylvania municipalities have modest budgets for street and park trees and have no municipal forester or arborist. They rely on the "sweat equity" of concerned and involved citizens engaged in tree commissions, and other authorities, boards, and commissions, to move programs and places forward.

## SAMPLE OF TREE COMMISSION DUTIES FROM PENNSYLVANIA BOROUGH AND TOWNSHIP CODES

- Develop a street and park tree ordinance
- Review and approve/deny street tree planting, removal, and pruning permits
- Act as an appeal body for permit decisions by municipal staff
- Review development landscape plans
- Conduct a tree inventory
- Make recommendations of tree species for planting in public areas
- Make recommendations for controlling diseases and pests damaging trees
- Provide arboricultural standards for tree maintenance and removal
- Provide public education and volunteer programs
- Prepare a community tree plan
- Prepare an annual report of activities
- Prepare an annual work plan and budget
- Prepare and accept grants and contributions

## MODEL STREET AND PARK TREE ORDINANCES

### Ferguson Township

[www.ferguson.township.pa.us/ordinances/chapter25](http://www.ferguson.township.pa.us/ordinances/chapter25)

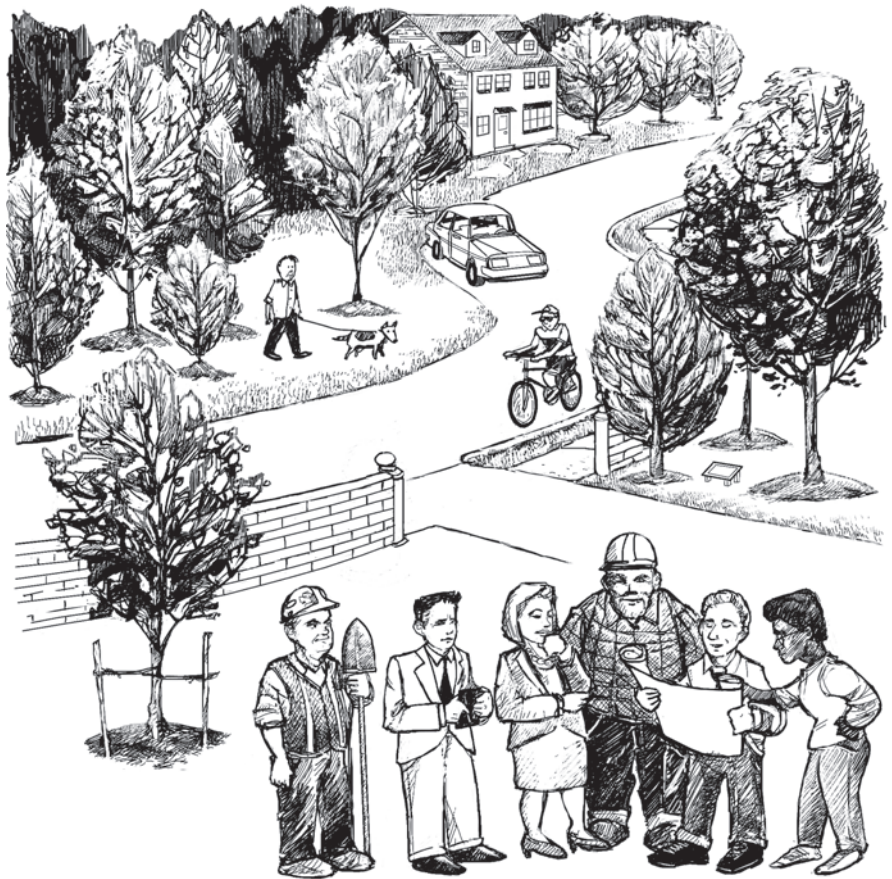
### City of Lancaster

<http://ecode360.com/8121544>

### State College Borough

[www.statecollegepa.us/index.aspx?NID=911](http://www.statecollegepa.us/index.aspx?NID=911)

The entire community and its visitors will benefit from a well-planned and managed community forest. Maintaining the green infrastructure of a safe and healthy forest requires the support of informed and involved citizens, elected officials, and municipal staff. Many citizens and elected officials are hesitant to pay for a community tree program because they do not understand the benefits of trees including human health and increased property values. Public engagement in decision-making, education, and volunteer projects help people understand and support community trees. Through Pennsylvania's Borough and Township Codes, municipal tree commissions have been authorized to develop street and park ordinances and approve tree removal permits in Pennsylvania since 1907. A municipal tree commission is a great way to foster community responsibility and support.



Tree commissions and other concerned people help support and fund municipal tree programs.

# Street and Park Tree Ordinances

The authority for municipalities to enact street and park tree ordinances is provided by the Pennsylvania Borough and Townships Codes. These ordinances are enacted to define and establish the authorities, responsibilities, and procedures for the care of public trees and landscapes. They are used to enact both a municipal tree commission and a permit process for the planting, pruning, and removal of public trees. Tree ordinances can help formalize the relationship between citizens and municipalities to provide for proper tree planting, care, and protection in the best interest of the community and the trees.

Financial responsibility for the planting and removal of municipal street trees varies. Most street and park tree ordinances place responsibility and cost of street tree removal and planting on the abutting property owner. This often makes managing public trees more contentious and difficult compared to when the municipality bears or shares the cost. Some municipal ordinances recognize the public value of street trees and place the responsibility of planting, pruning, and removal on the municipality.

Before you begin any work on a street or park tree it is important to understand local requirements and obtain proper permits. People who perform pruning and other tree work without a proper permit, or improperly damage or remove a street or park tree, typically face both a non-traffic summary offense and restitution to the municipality for the value of the tree removed or damaged. Be especially careful when planning tree work near utilities. Only a qualified arborist with proper training should remove or prune trees near energized lines. State law requires that before any digging for tree-planting takes place you call “PA One Call” at 811 to find out about the location of underground utility lines.

## REASONS TO ENACT A STREET AND PARK TREE ORDINANCE

- Protect and increase property values, stormwater management, and other ecosystem services
- Ensure proper species selection and that the right trees are planted in the right places
- Ensure proper pruning and other tree care
- Protect trees from improper removal and construction damage
- Manage tree risk and increase safety
- Lessen storm damage and cleanup
- Lessen damage to sidewalks and sewers
- Help ensure reliable electricity
- Avoid obstruction of motorist views and signs

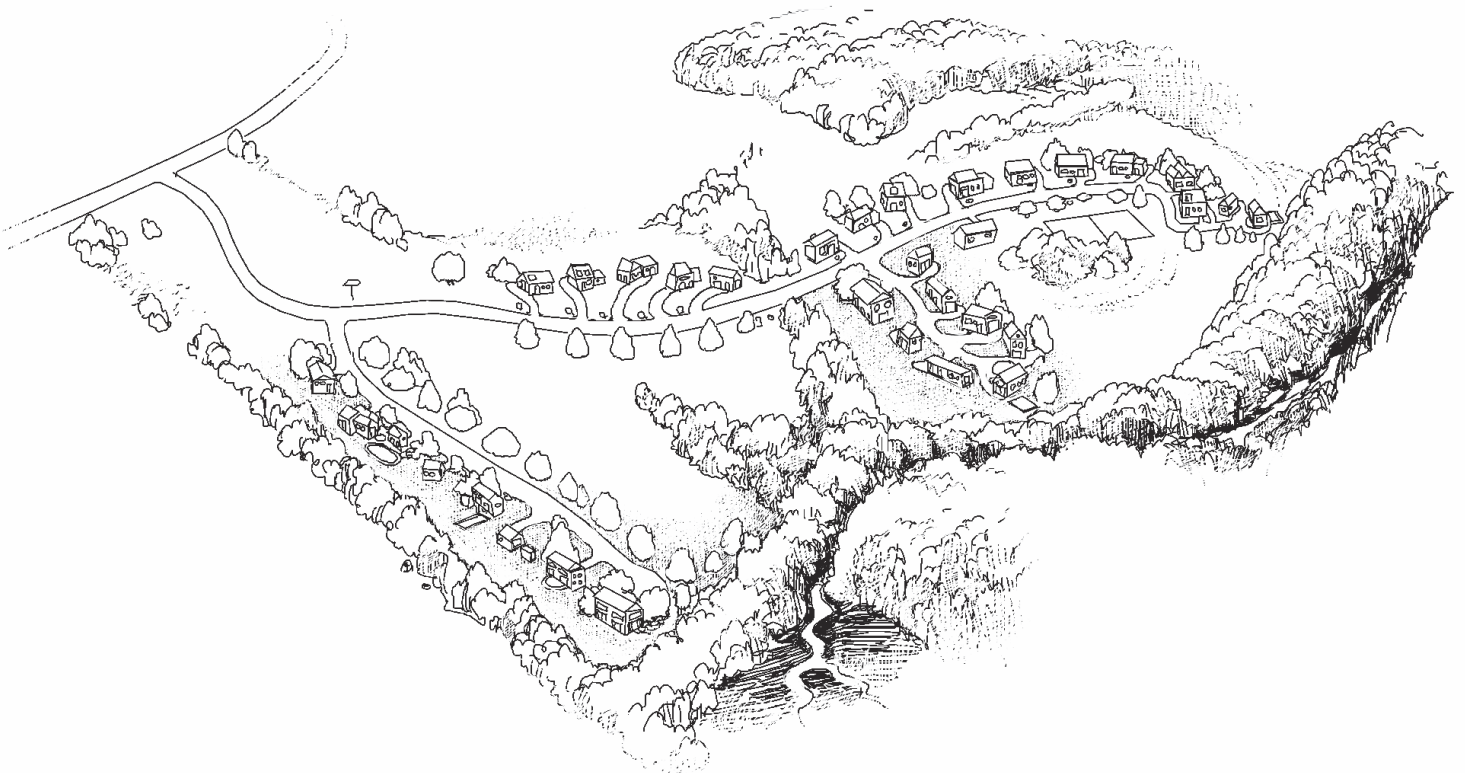
## PROVISIONS OF STREET AND PARK TREE ORDINANCES

- Authorize a municipal tree commission
- Ensure the completion of a community tree plan
- Establish a permit review and appeal process for tree removal, planting, and pruning
- Provide arboricultural standards for proper tree care
- Provide a list of trees that can and can't be planted
- Provide for tree protection during construction
- Provide for communication with utility companies
- Provide for enforcement and restitution for unpermitted tree removal and pruning

# Municipal Zoning and Subdivision and Land Development Ordinances

The authority for municipalities to enact zoning and subdivision and land development ordinances (SALDO) is found in the Pennsylvania Municipalities Planning Code. Zoning and SALDO ordinances can be used to develop conservation subdivisions that consolidate development density, and to conserve riparian areas, woodlots, and worthy trees in subdivisions and other types of development. Many municipalities place requirements for the landscaping of parking lots and other development within the sections of SALDO or zoning ordinances. Stormwater management requirements for the provision of permeable surfaces and planting and preservation of trees and vegetation are also commonly placed in SALDO and zoning ordinances.

Zoning and SALDO Ordinances can do many things including: require developments to have parking lot trees and other landscaping; protect worthy trees and woodlots on private property during development; require the conservation of open space in subdivision development; require stormwater management plans including the use of trees and landscaping; limit grading, tree removal, and other development in riparian areas and on steep slopes; provide for replacement of trees removed during development; and provide landscape credits, increased density, and other incentives for developers to preserve trees and other nature elements.



Municipal zoning and subdivision and land development ordinances can be used to cluster diversity and preserve trees and other resources in subdivisions.

## SMALL DECIDUOUS TREES

Mature height under 30'

Minimum tree lawn 2'

Suitable under wires

|                                  |   | Native to Pennsylvania<br>Form | Some salt tolerance | Harsh urban conditions | Fall color<br>Flowers | Notes   |
|----------------------------------|---|--------------------------------|---------------------|------------------------|-----------------------|---|
| <b>Crabapples</b>                |   |                                |                     |                        |                       | general — select for disease resistance and street tree form; plant in full sun                         |
| 'Adams'                          |   | R                              | ●                   | ●                      | ●                     | pink flowers  |
| 'Centurion'                      |   | U                              | ●                   | ●                      | ●                     | rose-red flowers; unusual form  |
| 'Donald Wyman'                   |   | S                              | ●                   | ●                      | ●                     | white flowers   |
| 'Indian Magic'                   |   | R                              | ●                   | ●                      | ●                     | deep pink flowers   |
| 'Prairiefire'                    |   | R                              | ●                   | ●                      | ●                     | deep pink flowers   |
| 'Red Jewel'                      |   | U                              | ●                   | ●                      | ●                     | white flowers   |
| 'Sentinel'                       |   | V                              | ●                   | ●                      | ●                     | pale pink flowers   |
| 'Spring Snow'                    |   | R                              | ●                   | ●                      | ●                     | white flowers; fruitless  |
| 'Sugar Time'                     |   | R                              |                     |                        |                       | white flowers   |
| <b>Cherry</b>                    |   | R                              |                     |                        | ●                     | general — sensitive to pollution, drought and disease; plant in deep moist soils                        |
| Chokecherry – 'Shubert'          |   | R                              |                     |                        | ●                     | can be short lived (10-20 years); reddish-purple flowers  |
| Flowering – 'Accolade'           |   | R                              |                     |                        | ●                     | can be short lived; rosy-pink flowers   |
| Flowering – 'Okame'              |   | U                              |                     |                        |                       | pink flowers  |
| Japanese Flowering – 'Amanogawa' |   | R                              |                     |                        | ●                     | upright tree with pale pink flowers   |
| Japanese Flowering – 'Kwanzan'   |   | V                              |                     |                        |                       | tolerates drought better; deep pink flowers   |
| <b>Dogwood</b>                   |   | R                              |                     |                        | ● ●                   | general — sensitive to salt and drought; select for disease resistance; prefers some shade              |
| Constellation – 'Rutcan'         |   | V/R                            |                     |                        | ● ●                   | attractive white foliage and flowers  |
| Eastern                          | ● | R                              |                     |                        |                       | not resistant to dogwood anthracnose  |
| Kousa                            |   | S                              | ●                   | ●                      | ● ●                   | disease resistant; many cultivars; beautiful white flowers and foliage                                  |
| <b>Eastern Redbud</b>            | ● | S                              |                     |                        | ●                     | attractive small tree with red flowers; prefers shade; acid or alkaline soils                           |
| 'Alba'                           | ● | U                              |                     |                        | ● ●                   | attractive white flowers  |
| 'Forest Pansy'                   | ● | R                              |                     |                        | ● ●                   | purple leaves   |
| <b>Hawthorn</b>                  | ● | R                              | ●                   | ●                      | ● ●                   | general — sensitive to many diseases; tolerates range of sites and stresses; select street tree form    |
| Green – 'Winter King'            |   | R                              | ●                   | ●                      | ●                     | vase-shaped; few thorns; white flowers; persistent fruit  |
| Lavalle                          |   | U                              | ●                   | ●                      | ●                     | dark green foliage; white flowers   |
| Thornless – 'Inermis'            |   | R                              | ●                   |                        |                       | white flowers; persistent fruit   |
| Washington – 'Ohio King'         |   | V                              |                     |                        | ●                     | white flowers; persistent fruit   |
| Washington – 'Princeton Century' |   | R                              |                     |                        | ●                     | white flowers; persistent fruit   |
| <b>Magnolia</b>                  |   |                                |                     |                        |                       | general — sensitive to scale insects and drought; attractive white flowers; select for street tree form |
| Galaxy                           |   | U                              |                     |                        |                       | prefers full sun and rich, moist, acid soils  |
| Star                             |   | U/S                            |                     |                        |                       | small tree; plant in protected area with moist, acid soil   |
| <b>Maple</b>                     |   |                                |                     |                        |                       | general — susceptible to verticillium wilt  |
| Trident                          |   | S                              |                     |                        | ● ●                   | tolerates urban conditions; nice fall foliage   |
| <b>Serviceberry</b>              | ● | R/S                            |                     |                        | ● ●                   | general — very small tree/shrub; many cultivars; sensitive heat and drought; requires some shade        |
| 'Cumulus'                        | ● | R                              |                     |                        | ● ●                   | tolerates wider variety of sites and soils; white flowers   |
| 'Princess Diana'                 | ● | R                              | ●                   |                        | ● ●                   | yellow flower buds; white flowers   |
| 'Robin Hill'                     | ● | R                              | ●                   |                        | ● ●                   | white flowers; attractive fall foliage  |
| <b>Tree lilac</b>                |   |                                |                     |                        |                       | general — good tree for under power lines; susceptible to powdery mildew                                |
| 'Ivory Silk'                     |   | R/U                            | ●                   |                        |                       | more upright form; white flowers  |
| 'Regent'                         |   | R                              | ●                   |                        |                       | small tree-like form; white flowers   |
| 'Summer Snow'                    |   | R                              | ●                   |                        |                       | small tree-like form; white flowers   |

## MEDIUM DECIDUOUS TREES

Mature height 30' to 50'  
 Minimum tree lawn 3'  
 Most suitable under wires

|                                   | Native to Pennsylvania | Form | Some salt tolerance | Harsh urban conditions | Fall color | Flowers | Notes   |
|-----------------------------------|------------------------|------|---------------------|------------------------|------------|---------|---|
| <b>American Hophornbeam</b>       | ●                      | C    |                     |                        | ●          | ●       | sensitive to deicing salt; interesting bark                                     |
| <b>Birch</b>                      |                        |      |                     |                        |            |         | general — susceptible to bronze birch borer                                     |
| River Birch – ‘Heritage’          | ●                      | C    | ●                   |                        |            |         | better resistance to borer; chose street tree form; sensitive to alkaline soil  |
| <b>Carolina Silverbell</b>        |                        | R    |                     |                        |            | ●       | chose street tree form; sensitive to alkaline soil; white flowers               |
| <b>Cherry</b>                     |                        |      |                     |                        |            |         | general — species sensitive to pollution and stresses                           |
| Sargent Cherry                    |                        | R    | ●                   |                        | ●          | ●       | toughest of Japanese cherries; pink flowers                                     |
| Sargent Cherry – ‘Columnar’       |                        | U    | ●                   |                        | ●          | ●       | upright form; good for tight places   |
| Yoshino                           |                        | V    |                     |                        |            |         | choose street tree form; white flowers  |
| <b>Golden Rain Tree</b>           |                        | R    | ●                   |                        | ●          | ●       | flowers can be slippery on slopes; can localize as a weed                       |
| <b>Honey Locust</b>               |                        |      |                     |                        |            |         | general — tough urban tree  |
| ‘Imperial’                        | ●                      | V    | ●                   | ●                      | ●          |         | smaller growing   |
| <b>Hornbeam</b>                   |                        |      |                     |                        |            |         |   |
| American                          | ●                      | C/R  |                     |                        | ●          |         | good for small shady spaces; sensitive to drought and heat                      |
| European Hornbeam – ‘Fastigiata’  |                        | U/C  |                     |                        | ●          |         | upright form good for narrow places; sensitive to drought and heat              |
| <b>Horsechestnut</b>              |                        |      |                     |                        |            |         |   |
| Ruby Red Chestnut – ‘Briotii’     |                        | R    | ●                   |                        |            | ●       | sensitive to drought and heat; attractive red flowers                           |
| Ruby Red Chestnut – ‘Fort McNair’ |                        | R    | ●                   |                        |            | ●       | sensitive to drought and heat; pinker flowers                                   |
| <b>Maple</b>                      |                        |      |                     |                        |            |         |   |
| Hedge – True Species              |                        | R    | ●                   | ●                      | ●          |         | small with tree-like form; can localize as a weed                               |
| Hedge – ‘Queen Elizabeth’         |                        | R    | ●                   | ●                      | ●          |         | upright form; sensitive to cold; can localize as a weed                         |
| Shantung – ‘Norwegian Sunset’     |                        | U    |                     |                        | ●          |         | sun loving; drought tolerant; orange-red fall color                             |
| Shantung – ‘Pacific Sunset’       |                        | U    |                     |                        | ●          |         | sun loving; drought tolerant; orange-red fall color                             |
| <b>Oak</b>                        |                        |      |                     |                        |            |         |   |
| Sawtooth Oak                      |                        | R    | ●                   |                        | ●          |         | intolerant of alkaline soils; can produce large nutcrop; can localize as a weed |
| <b>Purple Robe Black Locust</b>   | ●                      | R    | ●                   | ●                      |            | ●       | weak branch structure; purple flowers   |
| <b>Sassafras</b>                  | ●                      | C/R  |                     |                        | ●          | ●       | prefers moist, deep soils; select street tree form                              |
| <b>Yellowwood</b>                 |                        | S    | ●                   |                        | ●          | ●       | weak branch structure; sensitive to drought; can have low branches              |

### NOTES

Names in single quotes indicate a cultivar or hybrid.

‘Spring Snow’ is Spring Snow Crabapple.

‘Queen Elizabeth’ is Queen Elizabeth Hedge Maple.

See web, *Landscape Tree Factsheets* (H. Gerhold), or *Manual of Woody Plants* (M. Dirr) for much more information and photos about cultivars and other trees.

### TREE FORMS



C = Conical

R = Rounded

S = Spreading

U = Upright

V = Vase

## LARGE DECIDUOUS TREES

Mature height over 30'  
 Minimum tree lawn 5'  
 Not suitable under wires

|                              | Native to Pennsylvania | Form | Some salt tolerance | Harsh urban conditions | Fall color | Flowers | Notes   |
|------------------------------|------------------------|------|---------------------|------------------------|------------|---------|---|
| <b>Bald Cypress</b>          | ●                      | V/C  |                     |                        | ●          |         | sensitive to alkaline soils; reddish fall color   |
| <b>Blackgum</b>              | ●                      | C    |                     |                        | ●          |         | beautiful orange/red fall color; sensitive to alkaline soils  |
| <b>Catalpa</b>               | ●                      | R    | ●                   |                        |            | ●       | weaker branch structure; large leaves; white flowers  |
| <b>Dawn Redwood</b>          |                        | C    |                     |                        | ●          |         | similar to bald cypress; less sensitive to alkaline soils   |
| <b>Elm</b>                   |                        |      |                     |                        |            |         | general — no elm resistant to elm yellows; plant in very small numbers; many cultivars and hybrids        |
| 'Accolade'                   |                        | S    | ●                   |                        |            |         | good resistance to Dutch elm disease  |
| 'New Harmony'                |                        | S    | ●                   |                        |            |         | good resistance to Dutch elm disease  |
| 'Valley Forge'               |                        | S    | ●                   |                        |            |         | good resistance to Dutch elm disease  |
| <b>Ginkgo</b>                |                        |      |                     |                        |            |         | general — tough urban tree; all have beautiful yellow fall color  |
| 'Autum Gold'                 |                        | C    |                     | ●                      | ●          |         | select male trees only; limited fruit   |
| 'Lakeview'                   |                        | C    |                     | ●                      | ●          |         | select male trees only; conical form  |
| 'Princeton Century'          |                        | U    |                     | ●                      | ●          |         | select male trees only; upright form  |
| <b>Hackberry</b>             | ●                      |      |                     |                        |            |         | general — tough urban tree  |
| 'Prairie Pride'              | ●                      | R    | ●                   | ●                      | ●          |         | rugged tree; good branch structure  |
| 'Magnifica'                  | ●                      | R    | ●                   | ●                      | ●          |         | better resistance to leafhoppers  |
| <b>Hardy Rubber Tree</b>     |                        | R    | ●                   | ●                      | ●          |         | cold sensitive — can be killed by cold winters  |
| <b>Hickory</b>               |                        |      |                     |                        |            |         | general — prefers moist soils; nuts can be messy  |
| Bitternut                    | ●                      | U/R  |                     |                        | ●          |         | better for moist sites; intolerant of drought   |
| Pignut                       | ●                      | R    | ●                   |                        | ●          |         | better for dryer/harsher sites  |
| Shagbark                     | ●                      | R    |                     |                        |            |         | interesting bark; fairly adaptable  |
| <b>Honeylocust</b>           |                        |      |                     |                        |            |         | general — tough urban tree  |
| 'Shade Master'               | ●                      | S    | ●                   | ●                      | ●          |         | vigorous growth, less fruiting and thorns; yellow fall color  |
| 'Skyline'                    | ●                      | S    | ●                   | ●                      | ●          |         | upright branching; better yellow fall color   |
| <b>Japanese Pagoda Tree</b>  |                        | R    |                     |                        |            | ●       |   |
| 'Regent'                     |                        | R    |                     |                        |            | ●       | some resistance to leafhoppers; smaller growing; white flowers  |
| <b>Japanese Scholar Tree</b> |                        | R    |                     |                        |            | ●       | fruit can be messy; white flowers in summer   |
| <b>Katsura Tree</b>          |                        | C    |                     |                        | ●          |         | select street tree form; drought sensitive  |
| <b>Kentucky Coffeetree</b>   |                        | S    | ●                   | ●                      | ●          |         | tough urban tree; seed pods can be messy  |
| 'Espresso'                   |                        | S    | ●                   | ●                      | ●          |         | less pods than true species   |
| <b>Linden</b>                |                        |      |                     |                        |            |         | general — typically on cool moist sites; aphids can be messy  |
| American Basswood            | ●                      | C/R  |                     |                        | ●          |         | somewhat sensitive to drought and salt; fragrant yellow flowers   |
| American — 'Redmond'         | ●                      | C/R  |                     |                        | ●          |         | conical form; sensitive to drought and salt; intolerant of salt; fragrant yellow flowers                  |
| Littleleaf — 'Glenlevin'     |                        | C    |                     |                        | ●          |         | conical form; fast growing; sensitive to heat and drought; fragrant yellow flowers                        |
| Littleleaf — 'Greenspire'    |                        | C    |                     |                        | ●          |         | more upright form; sensitive to heat and drought; fragrant yellow flowers                                 |
| Silver                       |                        | C    |                     |                        | ●          |         | conical; leaves dark green with silver underside; more resistant to aphids                                |
| Silver — 'Sterling'          |                        | C    |                     |                        |            |         | better tolerance to heat and drought; more resistant to aphids  |
| <b>Magnolia</b>              |                        |      |                     |                        |            |         |   |
| Cucumbertree                 | ●                      | C    |                     |                        | ●          |         | large dark green leaf; prefers moist, winter sheltered sites; tolerates alkaline soils; yellow flowers    |
| Southern                     |                        | R    | ●                   |                        | ●          |         | holds leaves all winter; cold sensitive; plant only in southeastern PA in sheltered placed; white flowers |



## LARGE DECIDUOUS TREES (continued)

Mature height over 30'  
Minimum tree lawn 5'  
Not suitable under wires

|                                 | Native to Pennsylvania | Form | Some salt tolerance | Harsh urban conditions | Fall color | Flowers | Notes   |
|---------------------------------|------------------------|------|---------------------|------------------------|------------|---------|---|
| <b>Maple</b>                    |                        |      |                     |                        |            |         | general — many cultivars and hybrids  |
| Red Maple                       | ●                      | R    |                     |                        | ●          |         | many cultivars; some may not be native  |
| Red – 'Autumn Flame'            |                        | R    |                     | ●                      | ●          |         | fast growing; brilliant red fall color  |
| Red – 'Bowhill'                 |                        | U    |                     |                        | ●          |         | orange to red fall color  |
| Red – 'October Glory'           |                        | R    |                     | ●                      | ●          |         | red fall color  |
| Red – 'Red Sunset'              |                        | R    |                     | ●                      | ●          |         | red to scarlet fall color   |
| Red/Silver – 'Autumn Blaze'     |                        | R    |                     | ●                      | ●          |         | beautiful red fall color; hybrid  |
| Red/Silver – 'Celebration'      |                        | R    |                     | ●                      | ●          |         | beautiful yellow to red fall color; hybrid  |
| Red/Silver – 'Scarlet Sentinel' |                        | U    |                     | ●                      | ●          |         | beautiful yellow to red fall color; hybrid  |
| <b>Oak</b>                      |                        |      |                     |                        |            |         |   |
| Bur                             | ●                      | R/S  | ●                   |                        |            |         | massive, stout tree; tolerates alkaline soils   |
| English                         |                        | R/S  | ●                   |                        |            |         | tolerates drought and slightly alkaline soils   |
| Red                             | ●                      | R    | ●                   |                        | ●          |         | fast growing after established; intolerant of alkaline soils; bacterial leaf scorch; reddish fall color |
| Shingle                         | ●                      | R    |                     |                        | ●          |         | intolerant of alkaline soils; reddish fall color  |
| Shumard                         |                        | C/R  |                     |                        | ●          |         | moderate to fast growing; intolerant of alkaline soils; brilliant red fall color                        |
| Swamp White                     | ●                      | R    | ●                   | ●                      | ●          |         | tougher than white oak; transplants better than white oak; orange-gold fall color                       |
| White                           | ●                      | R    |                     |                        | ●          |         | can be hard to transplant; red fall color   |
| Willow Oak                      | ●                      | S    | ●                   |                        |            |         | cold sensitive; requires acidic soil  |
| <b>Sweetgum</b>                 |                        | C/R  |                     |                        | ●          |         | requires acid soil; fruit can be messy; attractive reddish fall color                                   |
| 'Rotundiloba'                   |                        | C    | ●                   |                        | ●          |         | sensitive to cold; less fruit than true species; reddish fall color                                     |
| <b>Sycamore and Relatives</b>   |                        |      |                     |                        |            |         |   |
| American                        | ●                      | S    | ●                   |                        | ●          |         | attractive bark and structure; susceptible to anthracnose; yellowish fall color                         |
| London Planetree – 'Bloodgood'  |                        | S    |                     |                        | ●          |         | tough urban tree; high resistance to anthracnose; yellowish fall color                                  |
| <b>Tuliptree/Yellow Poplar</b>  | ●                      | U/R  |                     |                        | ●          | ●       | impressive tall growing tree; attractive yellow fall color  |
| <b>Zelkova</b>                  |                        |      |                     |                        |            |         |   |
| 'Halka'                         |                        | V    | ●                   |                        |            |         | better branch structure; planted as substitute for American elm   |
| 'Village Green'                 |                        | V    | ●                   |                        |            |         | better branch structure; planted as substitute for American elm   |

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# Notes

# Resources

## **Tree Pennsylvania/Pennsylvania Urban and Community Forestry Council**

Search for TreePennsylvania or use —  
<https://treepennsylvania.org>

## **Pennsylvania DCNR TreeVitalize Program**

Search for Pennsylvania TreeVitalize or use —  
<https://www.dcnr.pa.gov/Communities/CommunityTreeManagement/Pages/default.aspx>

## **Penn State Extension Urban Forestry Program**

Search for Penn State Extension Urban Forestry Program or use —  
<https://extension.psu.edu/community-development/urban-forestry>

## **USDA Forest Service Urban Forestry Program**

Search for USDA Forest Service Urban Forestry or use —  
<https://www.fs.fed.us/managing-land/urban-forests/ucf>

## **USDA Forest Service Environmental Planning Curriculum**

Search for Changing Landscapes-Forest Service or use —  
[https://www.fs.usda.gov/naspf/sites/default/files/publications/na-tp-01-14\\_changing\\_landscapes\\_combined\\_file\\_20180906.pdf](https://www.fs.usda.gov/naspf/sites/default/files/publications/na-tp-01-14_changing_landscapes_combined_file_20180906.pdf)

## **United States Park Service Urban Forestry Programs**

Search for United States Park Service Urban Forestry or use —  
<https://www.nps.gov/subjects/urban/index.htm>

## **International Society of Arboriculture**

Search for International Society of Arboriculture or use —  
<https://www.isa-arbor.com>



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