



Eastern white cedar 'Smaragad'
R. Webb, Bugwood.org



Parking lot strip
L. Morris, Univ. of Georgia, Bugwood.org

PARKING LOTS & TREES



River birch
R. Webb, Bugwood.org

*An original publication of WV Division of Forestry
Urban & Community Forestry*

*2nd Ed. (June 2020) the result of a partnership with
WV State University Agriculture & Natural Resources
Extension Service*

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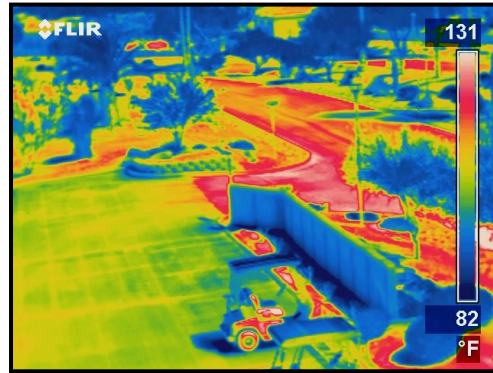


How do trees transform parking lots?

On a hot day, asphalt temperatures can reach over 100°F. Trees in parking lots reduce asphalt temperatures by as much as 36°F, and car interiors by over 4°F. This can really make a difference in developed areas where temperatures are increasing due to climate change and the urban heat island effect.

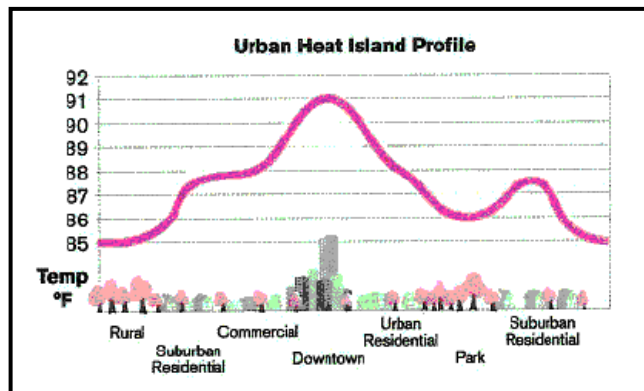
A young, healthy tree has the same net cooling effect as 10 room-sized air conditioners running 20 hours per day! In addition:

- Shade trees can protect pavement from weathering, prolonging its functional life and reducing the cost of upkeep.
- Trees help filter air pollution from exhaust and absorb volatile organic compounds (VOCs) emitted by cars baking in the sun.
- Consumers are more willing to pay to park in well-landscaped lots.
- The presence of trees promotes a feeling of safety and helps to slow traffic by narrowing the field of view for drivers.



Thermal imaging of a concrete parking lot in AZ, showing difference in temperature between concrete lot and adjacent paved street.

L. Scofield, American Concrete Pavement Association



Temperatures are highest in developed areas, particularly in downtown city areas, a phenomenon known as the "urban heat island effect."

National Oceanic and Atmospheric Administration

Dollars and sense...

Parking lot shade trees are both ecological and economical. In Sacramento, CA, annual benefits for trees planted in 15 parking lots that met shade requirements were valued at **\$37,000**. If tree shade in Sacramento lots were at **50%** city-wide, it is estimated that annual benefits could be as much as **\$4,000,000**.

Planting and green design

Planting sites in parking lots may be limited and not every space is suitable for trees. While selecting tree planting sites, be sure to keep these guidelines in mind:

- Ensure that the site has the appropriate amount of sunlight for the desired tree species.
- Do not plant trees with mature heights >25' under or near utility lines. Keep trees at least 40' away from signs, intersections, and signals—never inhibit driver or pedestrian visibility.
- Provide enough soil volume to accommodate the nutrient and stabilization needs of the mature size of the species.
- Know what is underground before you dig. Call 811 to check for underground utilities.
- Consider possible root-pavement and root-sidewalk conflicts.
- Fill containers with good quality planting soil with ample moisture.
- **Choose the right tree for the right site**—consider the tree's mature size before selecting the site.



Left: Installing permeable pavers in place of concrete or pavement allows for greater stormwater infiltration and helps minimize root/pavement conflicts near plantings.
W. Fountain, Univ. of Kentucky, Bugwood.org

Right: Trees have root systems that extend out far beyond the drip line of the canopy, so keep this in mind when picking sites. Trees planted too close to pavement or other infrastructure can cause damage.

J.LaForest, Univ. of Georgia, Bugwood.org



Choosing the right tree

When selecting trees for parking lot plantings it is important to consider any possible utility or hardscape conflicts. Avoiding these conflicts will save money, effort, and time in the long run. Consider the following when selecting a species:

- USDA hardiness zone
- Mature height and crown width; size of surface roots (to prevent hardscape-root conflicts)
- Urban stress tolerance: heat, road salt, air pollution, etc.
- Leaf/bark/twig litter or fruit conflicts (e.g., walnuts denting cars)
- Decay resistance
- Light and soil moisture requirements
- Invasive potential
- Biodiversity: try for a mix of species, genera and families in your lot

The following species are well-suited for parking lot plantings:

American hornbeam

American hophornbeam

Arborvitae

Chinese pistache

Eastern redcedar

European hornbeam

Foster's holly

Ginkgo

Hawthorn

Honeylocust

Katsura tree

Littleleaf linden

Overcup oak

Red oak

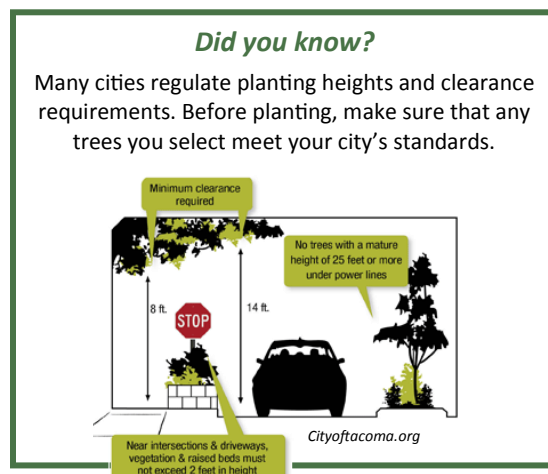
Scarlet oak

Swamp chestnut oak

Sweetbay magnolia

Trident maple

****For more species, see the *Trees for Urban Landscapes handbook from WVDOF Urban and Community Forestry.****



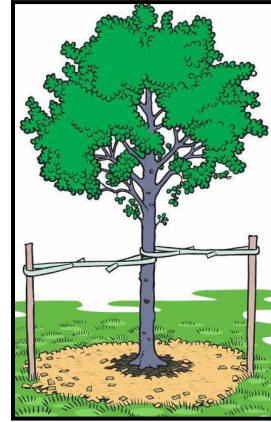
Not only do root restrictions cause costly infrastructure conflicts, but inadequate rooting space is detrimental to the tree itself, causing dieback. Dead branches become hazardous to life and property.
J. Sharman, Vitalitree, Bugwood.org

Tree care and maintenance

PLANTING BEST MANAGEMENT PRACTICES (BMPs)

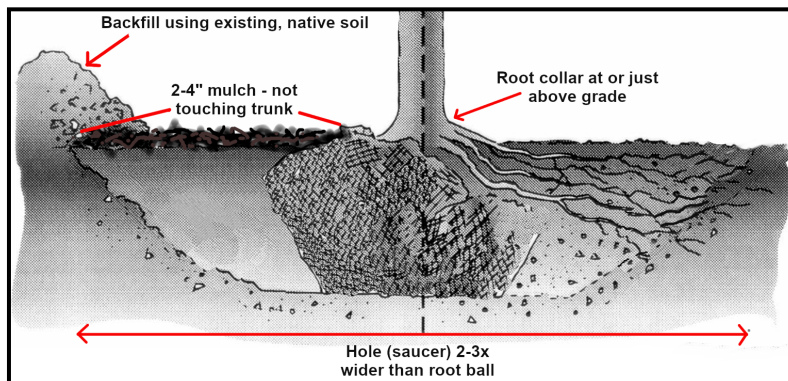
Proper planting is the first step to ensuring that an urban tree stays healthy and safe. Here are major planting points to remember:

- ✓ If soil on site is poor, amend or replace it as needed to help mitigate compaction and nutrient deficiencies.
- ✓ Provide adequate rooting space: dig a planting saucer at least 3x the width of the root ball, with sloped sides and firm base.
- ✓ Remove tree from container or remove **ALL** wire baskets, burlap, synthetic burlap and stem wraps from root ball before backfilling.
- ✓ Make sure the root flare is visible just above the soil line; do not plant the tree too deeply.
- ✓ Water the tree thoroughly at planting to settle soil, and weekly during the first two growing seasons, especially during drought.
- ✓ Mulch in a 3' radius ring, 2-3" deep; keep mulch at least 2" from stem. "Volcano" mulching is poor practice as it holds moisture against the stem, providing habitat for pests and disease.
- ✓ Stake trees as needed on opposing sides, tying Arbor tie around stem loosely to permit "wiggle room." Larger trees may require guying. move any implements after ONE YEAR.



When staking, allow the stem "wiggle room" to sway in the breeze. This encourages good root and stem taper development.

International Society of Arboriculture, Bugwood.org



The planting hole should be saucer-shaped to provide more friable soil for rapid initial root growth and establishment. The base of the saucer should be undisturbed or firmly packed soil, which prevents settling of root ball. *International Society of Arboriculture, Bugwood.org (with modifications)*

Tree care and maintenance (continued)

Piling mulch against the trunk of a tree— or “volcano” mulching— holds moisture against the bark, providing the perfect environment for fungal growth and pests. It also encourages the development of girdling roots, which can essentially “strangle” a tree as it gets bigger.

E. Moss, West Virginia State University (left); J. Obrien, USDA Forest Service (right), Bugwood.org



PRUNING BEST MANAGEMENT PRACTICES (BMPs)

Pruning is the second-most important thing that can be done to promote the longevity and health of urban trees. Proper pruning and training helps ensure a tree’s structural integrity, protect the public from future hazards, prevent utility conflicts, and provide vehicle and pedestrian clearance. Proper pruning techniques minimize the risk of disease and decay.

Topping is not a proper pruning technique and will ultimately result in more hazards and costly maintenance. Branches cut back to a stub develop many weakly-attached, fast-growing sprouts which will actually make the tree taller in a short amount of time, necessitating even more pruning. Topping also removes too much live foliage and destroys a tree’s natural form, weakening it and introducing many wounds where decay organisms can enter live tissues.

Newly-planted trees require no pruning except the 3Ds: dead, damaged or diseased branches. Try to limit pruning to the dormant season at least 2 years after planting so the tree has time to establish a healthy root system.

Detailed information about pruning and proper pruning cuts can be found at: https://www.treesaregood.org/portals/0/docs/treecare/Pruning_MatureTrees.pdf



If a tree requires drastic pruning such as topping to maintain a smaller size, it is obvious that the wrong tree was selected for the site.

J. Obrien, USDA Forest Service, Bugwood.org

Protecting trees

Trees are an investment...

The work put into trees now will save time and money in the long run, and maximize the benefits (ecosystem services) offered by a tree as it matures and grows bigger, such as storing more carbon and creating more shade and oxygen with a healthier canopy. Proper maintenance also helps prevent hazards from forming.

In parking lots, it is important to protect trees from pedestrians and vehicles. The main structural and functional roots for most trees are found in the top 6"-24" of soil and the root zone extends horizontally in a distance almost equal to the tree's height. It is important to protect these roots from mechanical damage and soil compaction. At the very least, the roots within the dripline should be protected.



Tree roots grow more "out" than "down", therefore trees need more width than depth in a planting site.
E. Moss, West Virginia State University

Here are some ideas to protect trees above and below ground:

- ✓ Bark protectors
- ✓ Fencing, grilles
- ✓ Raised pits
- ✓ Mulching
- ✓ Signs
- ✓ Other plantings around the base of trees
- ✓ Curbs and wheelstops

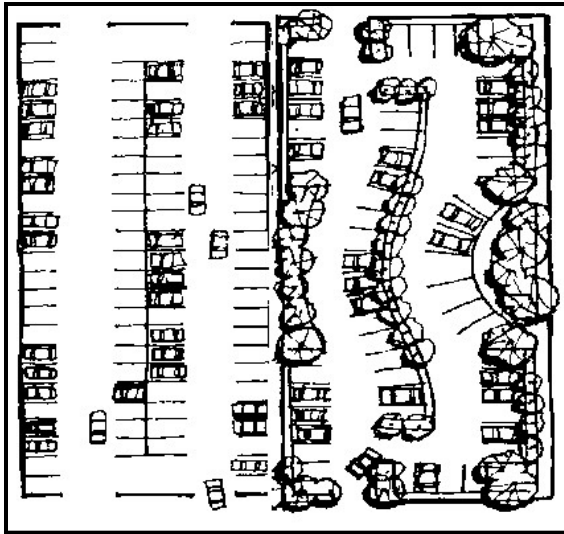


This planting, although not in a parking lot, is well-protected from foot traffic, vehicles, string trimmers and lawnmowers by a curb, mulch and ground cover planting.
V. Brej, ISA Photos, Bugwood.org

Before installation...

The easiest way to incorporate trees is to do so during the design process and before installation. Even when redesigning older lots, follow these guidelines:

- ⇒ Eliminate unused spaces and decrease the number of angled spaces
- ⇒ Increase the compact vehicle to standard vehicle space ratio
- ⇒ Use one-way aisles or reduce the width to standard size
- ⇒ Add landscaping to areas of peripheral and overflow parking
- ⇒ Use curvature to improve aesthetics and control traffic speeds
- ⇒ Widen islands to a minimum of 8' and ensure adequate rooting depth of soil volume
- ⇒ Provide shade to sidewalks and pedestrian islands
- ⇒ Heed zoning guidelines set forth by your city

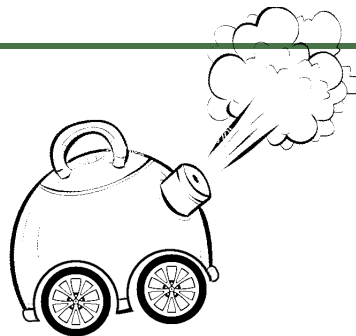


Many of these principles can be applied when RE-designing a parking lot. An example of retrofitting: a reduction of unused spaces and a new design including curvature and landscaping treatments has transformed an old parking lot.

Tree City USA Bulletin #24, The Arbor Day Foundation

Did you know?

Evaporative emissions are gasoline vapors that escape from a vehicle's fuel system. Imagine a vehicle is a teapot over a stovetop burner. Like the teapot, steam is released when its water nears a boil. The process is similar for gasoline: as the fuel tank warms during the day, expansion causes vapors (hydrocarbon emissions) to be vented from the tank. These vapors contribute to ground-level ozone formation and cause serious health effects. Reducing air temperatures in parking lots with appropriate shade trees lowers evaporative emissions from parked cars up to **8%**!



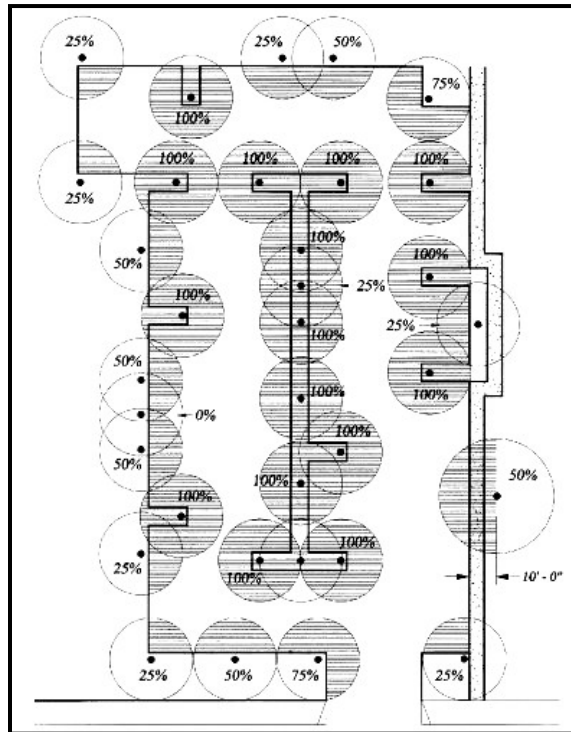
E. Mass, West Virginia State University

Shade requirements and design

How to know if a parking lot meets shade requirements...

There are several methods of allocating shade to individual trees that are used by cities to write their parking lot codes and ordinances. Below is a visual guide illustrating how shade is credited, in 25% increments.

A table can also be used to calculate shade in square feet, based on an approved shade tree list provided by the city. The ratio of shaded area to total parking lot area is calculated to determine the percent of area that is shaded.



To the right is a visual interpretation of how shade is credited under various conditions. It is not necessarily indicative of 50% coverage. Shade overlap is not counted twice. Below is a table used to calculate shade provided.
 City of Sacramento Parking Lot Tree Shading Design and Maintenance Guidelines, June 2003.
 CityofSacramento.org

Symbol	Botanical Name/ Common Name	Quantity @ Full Shade / Sq. Ft.	Quantity @ ¾ Shade / Sq. Ft.	Quantity @ ½ Shade / Sq. Ft.	Quantity @ ¼ Shade / Sq. Ft.	Total (sq. ft.)
T1	<i>Laurus nobilis</i> Sweet Bay	1 @ 491	2 @ 368	5 @ 246		2457
T2	<i>Quercus agrifolia</i> Coast Live Oak		2 @ 722	2 @ 481	2 @ 240	2886
T3	<i>Pinus Patula</i> Jellocote Pine		1 @ 530	7 @ 354		3008
TOTAL TREE SHADE						8351
Surfaced Area:	Parking Lot			16240	TOTAL SURFACED AREA =	17740
	Covered Stalls (garages, carports, etc.)			1500		
SHADE AREA REQUIRED =						8870
If applicable, TOTAL AUXILIARY SHADE* =						1450
TOTAL SHADE PROVIDED =						9801
PERCENT SHADE =						55.2%

*NOTE: Auxiliary shade is the total parking area under covered stalls (carports, garages, etc.), not the total covered area.

Green design in action

This county parking lot at South Townsend Street in Syracuse, NY, was part of a Save the Rain program in Onondaga County promoting green infrastructure and stormwater management and was completed in 2010. Designs included the installation of two 8-foot-wide tree trenches to collect runoff from the paved lot. A total of 3,800 ft² of bioretention space was added. The project was expected to capture approximately 975,000 gallons of stormwater runoff per year from the lot and adjacent paved areas.



The original design of the lot was a massive expanse of pavement that would collect rainwater and not permit it to infiltrate. Fifty plus thousand f
Save the Rain



The tree trenches were planted with hardy native shrubs, bushes, and trees. Structural soil was used in the trenches to ensure rooting volume and aid in infiltration.
Save the Rain

Rain gardens and bioswales

Parking lots, as impervious surfaces, increase stormwater runoff. Larger lots will result in greater runoff. Rain gardens, bioswales, and other bioretention gardens are ways to manage this extra runoff.

- Rain gardens “trap” runoff, slowing water movement and facilitating soil infiltration. Plant hardy native trees, shrubs, ferns, grasses and herbaceous plants that thrive in moist conditions.
- Convert tree pits and planting strips to bioswales, which have features that help regulate water flow: curbs to allow water in, rocks to slow flow and prevent soil erosion, and sandy soils to aid in infiltration. Native water-loving vegetation and trees help regulate and filter runoff. The following list has recommended species.

Bald cypress

Black gum

Eastern redbud

Hackberry

Red maple

River birch

Swamp white oak

Sweetbay magnolia

Sweetgum

Weeping willow

Willow oak

Witch hazel



Left: Bioretention ponds are an excellent opportunity to reflect native ecosystems. Use native vegetation and take advantage of natural features. Right: Medians between parking aisles can be planted with trees and native wetland vegetation to collect and filter runoff.

J. Ruter, Univ. of Georgia, Bugwood.org (left); K. Powell, U.S. Air Force (right).



Rain gardens use native vegetation to absorb and filter runoff. Here are some examples at the West Virginia University campus in Morgantown.

R. Hannah, WV Division of Forestry



In summary

- Parking lot trees reduce temperatures of both parked cars and asphalt.
- Trees help control traffic flow.
- Trees can also help reduce stormwater runoff and increase infiltration.
- When planting, choose the right tree for the right place.
- Ensure that planting conditions will support tree growth.
- Follow tree planting BMPs.
- Regularly monitor trees for maintenance needs and hazards.
- Properly train and prune parking lot trees using pruning BMPs.
- Never compromise driver or pedestrian safety with plantings.



Accidents will happen, so be sure to monitor plantings for damage, before it becomes a bigger problem in a bigger tree.

R. Armbrust, Kansas Forest Service, Bugwood.org



This kind of hazard could have been corrected when the tree was young, with proper pruning and training. Now this lot owner faces serious liabilities, as large limbs could cause significant loss of property and life.

J. OBrien, USDA Forest Service, Bugwood.org

Funding to support the development and printing of the second edition of this publication was provided by the United States Department of Agriculture (USDA) Northeast Climate Hub



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