URBAN FORESTRY

TOOLBOX

The Urban Forest

Trees provide many benefits in the urban environment, including cooling (reducing the heat island effect), improving air quality, reducing stormwater runoff, supporting mental health, providing wildlife habitat, and beautifying streetscapes. Our streets and transportation networks benefit from trees as they support the safety and comfort of people walking, rolling, biking, waiting for transit, or simply resting, recreating, or socializing. Trees provide separation from the roadway for people walking and biking and encourage drivers to slow down and pay more attention to their surroundings. Street trees provide shade and cooling to sidewalks, bikeways, transit stops and stations, and make these spaces more accessible, comfortable, and appealing for a wide range of users.

But there is almost always competition for limited space in our public rights-of-way. Trees are often not prioritized, their value is not fully understood, and they are not given the resources they need to thrive, achieve maturity, and provide their full benefits. Often, trees are not replanted in locations when they die or are removed. The tree canopy coverage in most urban areas is being reduced yearly, and more steps must be taken to reverse this trend.

This toolbox provides information on tree preservation and protection, design considerations for new trees, and the benefits of including trees in asset management systems.

Existing Tree Preservation and Protection

Tree Assessment—Can the tree be preserved, and is it worth saving?

Begin by consulting the requirements and guidelines of the local jurisdiction related to tree preservation, protection, and replacement. These may outline the protocol for assessing tree health, offer guidance or regulations for designing and building around existing trees, provide specifications and details for tree protection, and list appropriate species for planting.

A tree assessment or inventory by a qualified arborist should be performed to determine whether a tree can be preserved or relocated or needs to be removed and replaced. Arborists have the expertise to assess tree health and condition, including issues that may not be visible. It is critical to involve them in decisions regarding tree preservation and care.

Tree Assessment—Can the tree be preserved, and is it worth saving?

When subsurface work must be done in the root zone, negative impacts can be reduced by boring at discrete locations and tunneling under the roots rather than digging a continuous trench from the surface through the root zone. Air spading—using compressed air to remove soil from around roots—is another option for gaining access to the root zone without cutting or injuring roots.

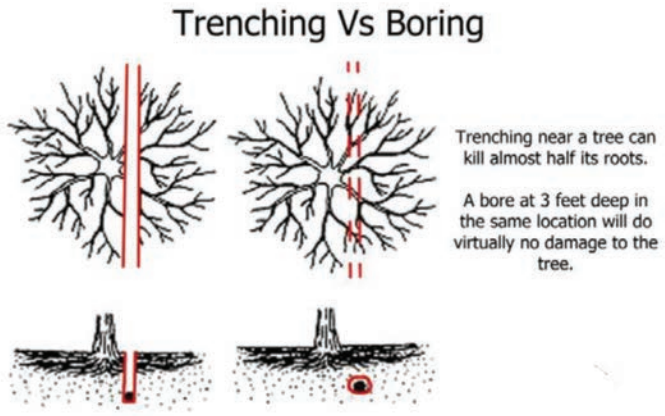

Figure 2: Trenching vs. Boring (Credit: Oklahoma State University)

Tree Pit Enhancement

While tree pits are not a preferred system for new plantings, many existing trees are growing and surviving in pits, and there are ways to improve conditions within this less-than-ideal setting.

- Expand the tree pit opening to provide more room for the trunk flare.
- Use an air spade to decompact soil in the tree pit or to add organic matter via vertical mulching.
- Remove tree grates and other surface materials constricting the trunk flare or zone of rapid root taper.
- Replace impervious pavement with pervious pavement allowing air and water to infiltrate the root zone.

Protection During Construction

Site Analysis and Design Phases

- Design to minimize impacts on existing trees.
- Engage a certified arborist to assess the health and condition of existing trees.
- Create a tree, vegetation, and soil protection plan (TVSPP) to clearly indicate trees, vegetation, and soil areas to be preserved, the extent of protection fencing, areas designated for hand work, etc.
- Tree and vegetation protection fencing should be shown on the site preparation/demolition plans and referenced on other plans.

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Preconstruction Actions

- Convene a preconstruction meeting and site walk with the contractor, arborist, and owner's representative/engineer to review the TVSPP and confirm adequate tree protection measures.
- Ensure all required root pruning is performed properly with clean cuts. Pruning of roots over two inches should be performed under arborist supervision.
- Install protection fencing during site preparation before demolition and major construction work begins. Tree protection structures must include signage explaining the tree protection measure; it can also help to describe the value of the tree.

During Construction

- Water/irrigate the root zone if roots are being significantly pruned and/or it is dry during construction.
- Cover exposed roots and keep them moist.
- If necessary to operate equipment or perform construction tasks close to trunks, lay down a sufficient buffer/protection layer to distribute loads of equipment, vehicles, and foot traffic. This can be a layer of gravel, at least 6-12" of wood chips over geotextile, or plywood sheets. This material must be completely removed at the close of construction.
- Do not allow materials to be stockpiled within the CRZ.
- Exposed roots and damaged branches should be carefully pruned and treated to reduce risks of infection.

Figure 3: Tree Protection Fencing (Credit: City of Seattle)

Designing for New Trees

Soil Volume

Providing an adequate volume of high-quality soil is a critical investment that enables trees to develop healthy canopies and reduces root damage to sidewalks or underground utilities. The techniques listed below have been largely adapted from *Up by Roots* and related guidance by James Urban and others at DeepRoot.

Calculating Soil Volume

Figure 4 shows general guidance for minimum soil volume requirements. One thousand cubic feet per tree is the minimum recommendation for a tree with a mature DBH (diameter at breast or standard height) of 16-20 inches. Where multiple trees are planted in a continuous soil volume, up to 25% of that soil volume may be shared.

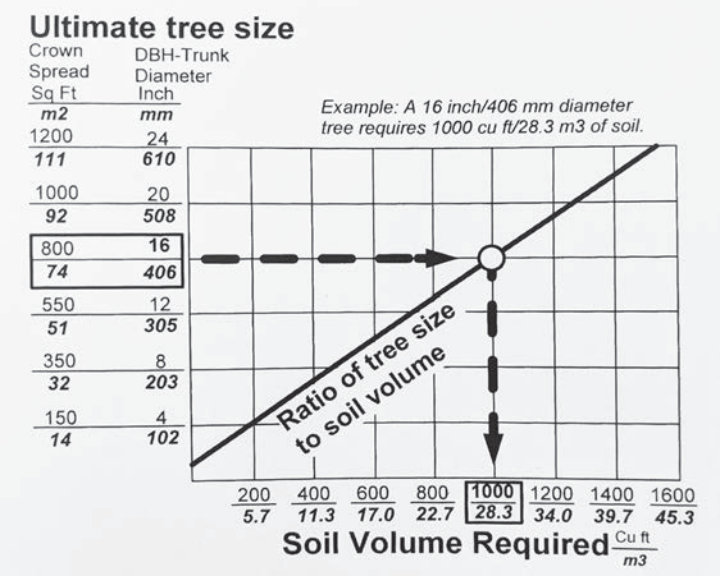

Figure 4: Required Soil Volume (Credit: Up by Roots)

Ways to Provide Adequate Soil Volume

The following techniques can be used to provide sufficient soil volume for rooting, either in open continuous soil areas or via systems of supporting pavement that allow for rooting space below hardscape surfaces.

Open Tree Trenches

A tree trench provides a continuous volume of soil to be shared by a row of trees along a street or roadway. Open trenches are planted to minimize erosion and reduce weeds and should have a minimum width of five feet.

Figure 5: Open Tree Trench with Step Out Zone (Credit: Toole Design)

Covered Tree Trenches

Covered trenches also provide the required soil volume in locations where an open trench is not feasible. Specialized paving and soil systems maintain an uncompacted soil volume while supporting pavement for pedestrian, bike, and light to moderate vehicular uses. Covered trench systems are more costly than simple open trenches. Still, they typically require less day-to-day maintenance than open trenches (which need vegetation management, trash removal, and protection from pedestrian traffic). Two main systems are used in closed trenches to allow rooting space under hardscape: structural soils and suspended pavement.

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- **Structural Soil:**
  Structural soils are engineered mixtures of roughly 80% gap-graded aggregate and 20% organic soil that provide pore space for root growth when compacted. Because of this proportion of aggregate to soil, structural soil installations must include about five times the volume required for conventional planting soil or 5,000 cubic feet per tree.
- **Suspended Pavement:**
  Soil cells are the most prominent system for suspending pavement. These are modular, interlocking plastic risers that support pavement and contain volumes of planting soil. They can be used for new construction and retrofits. Because of the pore space and ponding space provided in soil cell systems, they may also be used for underground stormwater detention.

Figure 6: Installation of Soil Cells at Back of Curb (Credit: DeepRoot)

Additional Design Considerations for Trees

Soil volume and quality are the most critical factors for ensuring the long-term success of urban trees. Additional strategies to improve growing conditions include:

- Options to provide additional space for root flare and roots:
  - Add curb bulbs or extensions to widen the street planting strip. Set trees back from the intersection to allow for sight clearance between people driving and people walking, biking, and rolling.
  - Narrow the sidewalk at the tree to allow space around the root flare while maintaining 4-foot minimum sidewalk width for accessibility.
  - In areas with high pedestrian traffic, use loose or stabilized decomposed granite or flexible porous rubber surfacing rather than tree grates that may constrict the tree root flare as it matures.
- Protect tree roots from compaction by foot traffic and damage from pet waste by installing a low tree fence around the tree pit opening.
- During tree installation, place a root barrier between the pavement edge and the tree pit to reduce the potential for pavement uplift.
- If possible, consolidate utilities to provide a minimum 5-foot clearance from street trees.

Figure 7: Replaced sidewalk provides more space for the tree and maintains a 4-foot clear zone for pedestrians. (Credit: Toole Design)

Tree Species Selection

Street trees should be carefully selected to ensure they will be compatible with their surroundings and will not damage sidewalks and curbs. An arborist or landscape architect should be engaged to assess the planting location so that an appropriate tree species can be selected for the site.

The following pointers provide basic guidance for tree selection:

- Street tree species must be tolerant of a site's climate, which includes local precipitation, winds, extreme winter and summer temperatures, as well as radiant and reflected heat from nearby structures and surfaces, and the unique stresses of a roadside environment, such as salt, drought, and wind generated by traffic.
- Species diversity supports the overall resiliency of the urban forest and limits susceptibility to extensive damage from pests or disease. Select a diverse array of suitable tree species.
- Mature trees vary by species in the characteristics that determine their suitability for street planting, such as structural integrity of wood, form of root system, branching height, amount of organic litter drop (flowers/fruits/leaves), and degree of sensitivity to urban environmental stresses. Refer to regional resources and consult qualified professionals to select species. To minimize pruning needs and maximize tree lifespan, tree selection should account for conditions such as overhead wires and tree planter width.

Tree Planting

Several steps can be taken during planting to optimize growing conditions. These steps are briefly listed below, and more detailed information can be found at www.urbantree.org. A landscape architect or certified arborist must be involved in selecting and approving nursery stock, approving stockpiled plants for installation, and observing/advising the planting process.

- Select quality trees from the plant nursery with strong leaders and healthy roots.
- Remove any soil above the root collar.
- Dig the tree hole only as deep as the root ball to provide a firm base and prevent the tree from sinking. Planting trees too deep or burying the root collar can lead to girdling roots.
- Stake larger trees (over 1.5-inch caliper) during the first year until the roots grow and anchor the tree. Provide slack in the tree staking ties to allow the trunk to move and prevent girdling.

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- Mulch the tree with organic material to provide nutrients, retain moisture, and block weeds. Arrange mulch in a saucer form instead of mounding it around the trunk to funnel water to the roots without covering the root collar. Hold mulch back from the trunk by at least six inches to prevent rot.
- Water the tree during establishment. Tree watering bags should be used where there is no automatic irrigation. Make sure the maintenance contractor understands watering requirements.

The Urban Forest

Trees are critical infrastructure assets in the urban environment. They provide many benefits, and the value of a healthy tree increases over time. The health and maintenance of trees should be tracked as an integral part of an asset management system.

- Benefits of Digital Tree Inventory and Asset Management
  - Tracks routine maintenance and inspections and supports informed decision making
  - Allows users from various municipal departments to view and enter tree data from mobile devices
  - Provides a visual map of trees in the public right-of-way with their critical data
  - Provides opportunities to keep the public informed about urban trees, including tree canopy coverage
- Data to Collect
  - Basic tree inventory data, including private vs. publicly maintained trees in the right-of-way
  - Monitoring and flagging trees for hazard risks
  - Tree inspections, maintenance activities, and service requests

This Toolbox is courtesy of Toole Design www.tooledesign.com.

*For content questions, please contact **Teresa Damaske, PLA** at tdamaske@tooledesign.com. For more in-depth tree protection and preservation coverage, buy a copy of APWA's Tree Protection and Preservation book, available in the APWA store, www.apwa.net.*