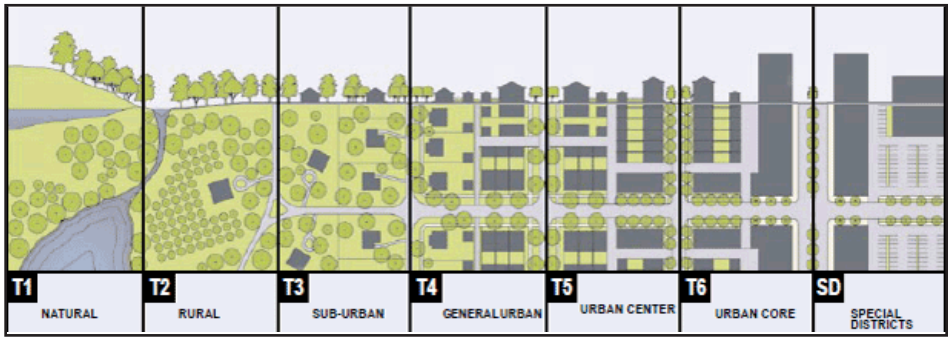
STREET TREE STANDARDS AND SPECIFICATIONS for Metro Nashville

These standards and guidelines are designed to optimize conditions for street trees in all transect catagories as defined in *NashvilleNext, Volume 5: Access Nashville 2040- Major & Collector Street Plan.*

They address these key issues:

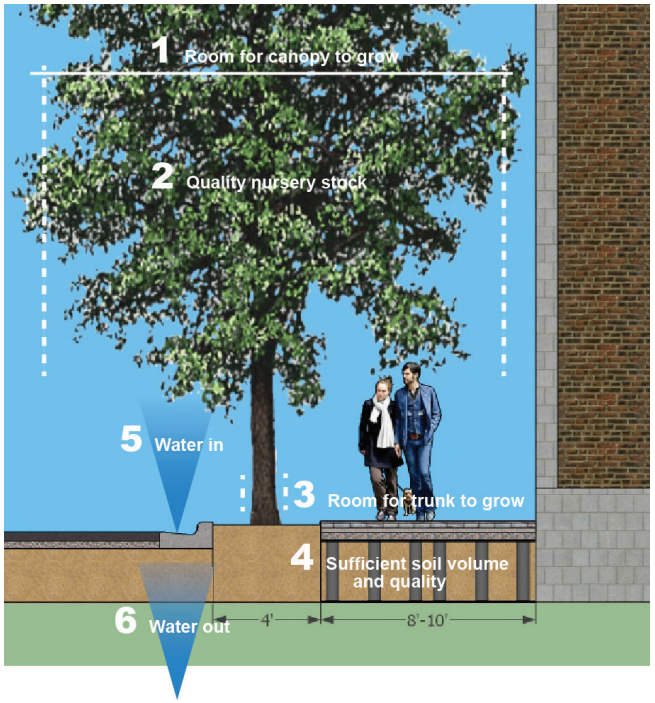
1. **Soil Volumes** based on transect and soil availability.
   Current research recommends **1,000 cubic feet** for an individual large deciduous canopy tree. Atlernative soil volume standards are defined for urban transects where recommended soil volume is not avaiable.

2. **Design Methods** to create soil volume where soil is not available. Design methods include soil cells to achieve soil volume, open soil areas, covered soil areas, and utility integration.



NashvilleNext Transect Catagory Diagram

The Right Tree in the Right Place-
SIX Basic Tree Requirements



Other Tree Considerations:

Height and Spread. Will the tree bump into anything such as power lines, tall trucks etc. when mature?

Is the tree deciduous or coniferous? Will it lose its leaves in the winter?

Form or shape. A columnar tree will grow in less space. Round and V-Shaped species provide the most shade.

Growth rate. How long will it take for your tree to reach its full height? Slow growing species typically live longer than fast growing species.

Soil, sun, and moisture requirements.

Hardiness zone indicates the temperature extremes in which a tree can grow. Nashville is zone 7a.

Links to important documents:

For tree selection, refer to this Metro approved list of recommended and non-recommended trees*:*
http://bit.ly/2uux2yL

All work must conform to *Nashville Code of Ordinances*
Chapter 17.24 - Landscaping, Buffering and Tree Replacment:
http://bit.ly/2utSKCR

TITLE 13-Streets, Sidewalks and Public Places:
http://bit.ly/2tHmzRX

13.12.190 - Sight obstruction prohibited when—Notice to remove—Failure to comply.
http://bit.ly/2uWmuJc

This document is a companion to ***NashvilleNext Complete Streets: Major & Collector Street Plan:***
http://bit.ly/2tGUutU

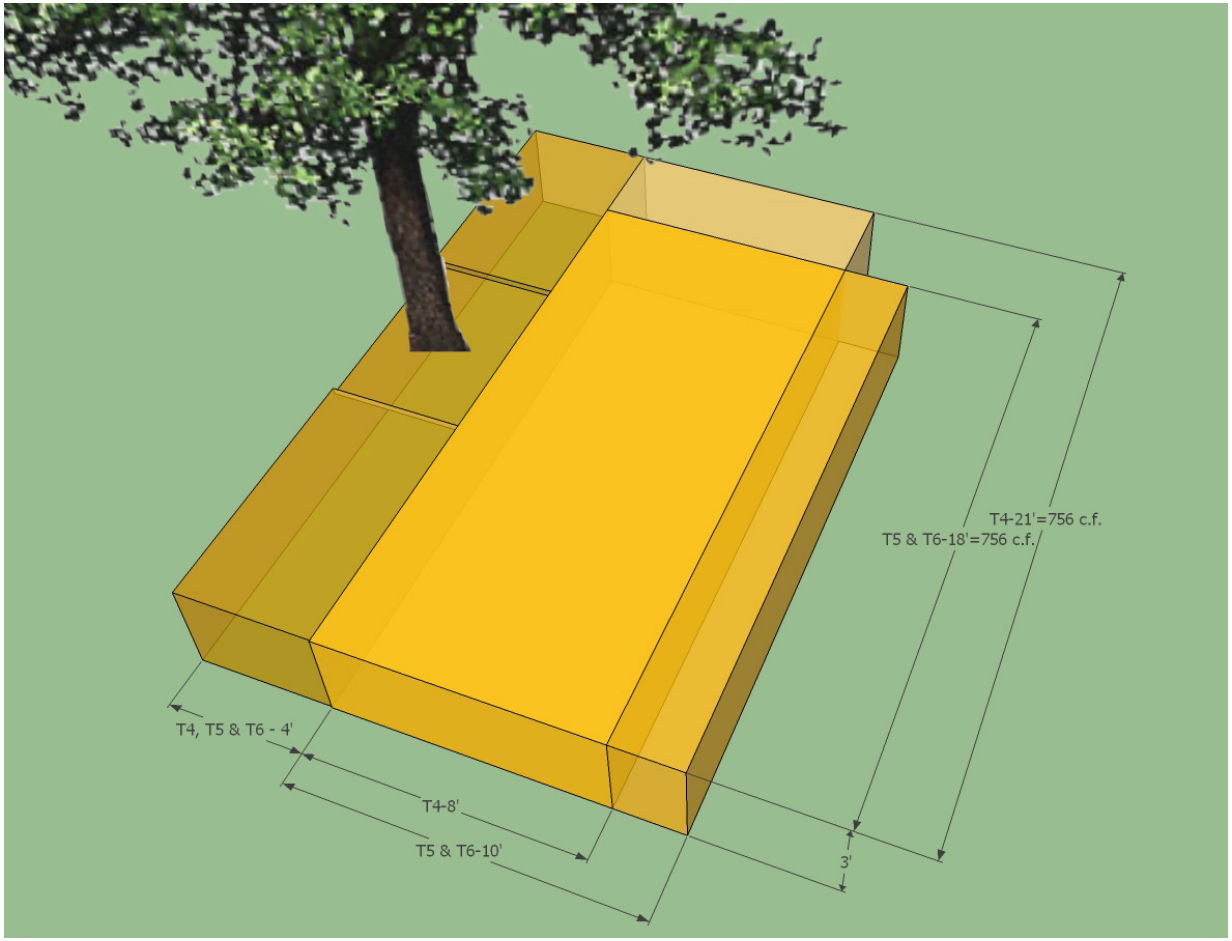
SOIL VOLUME

A tree's ability to grow and stay healthy is largely dependent on available rooting space. Trees in highly urbanized areas, where trees exist in small planting spaces with little available soil, tend to be short-lived with stunted growth. Trees in typical urban tree boxes rarely reach their full growth potential and cannot provide the wide range of environmental services that mature, healthy trees offer.

Trees need 1 to 2 cubic feet of soil volume for every square foot of crown area spread. A tree in a typical 4-foot by 6-foot street tree space has 72 cubic feet of available soil. This is not adequate space. When the roots cannot grow out of the box, the tree is expected to grow to a canopy spread of 8 feet before declining. Larger soil volumes will yield larger trees.
These guidelines focus on increased soil volumes as one of the best ways to enable larger and healthier trees to grow in cities.

CANOPY TREES- UF approved list **All Transects Where Soil is Available**		
Green Zone Width	Pedestrian Zone Width	Minimum Required Soil Volume in Cubic Feet
12' - 4'	12' - 6'	1,000
RECOMMENDED TREES FOR URBAN TRANSECTS **MEDIUM COLUMNAR/UPRIGHT TREES-** page 3 **and Understory Trees-** UF approved list Urban Transects Where Soil Volume Must Be Created		
Green Zone Width	Pedestrian Zone Width	Minimum Required Soil Volume in Cubic Feet
4'	T4- 8'	750
4'	T5 & T6- 10'	750

Soil Volume Minimum Requirements



Soil Volume Dimensions for Urban Transects T4, T5 & T6

Street Trees are of great value to urban spaces.
An average street tree costs about $300 to $600 to plant and maintain but can return over $90,000 of benefits over it's lifetime.
*Just a few of the benefits are pollution removal, improved air quality, energy savings, reduction of urban heat islands, improved water quality and increased commercial activity and sales.**

**22 Benefits of Urban Street Trees By Dan Burden, Senior Urban Designer, Glatting Jackson and Walkable Communities, Inc; May, 2006*

DESIGN METHODS for Achieving Soil Volume

To achieve the required soil volume in areas where native soil is available, several methods can be used.

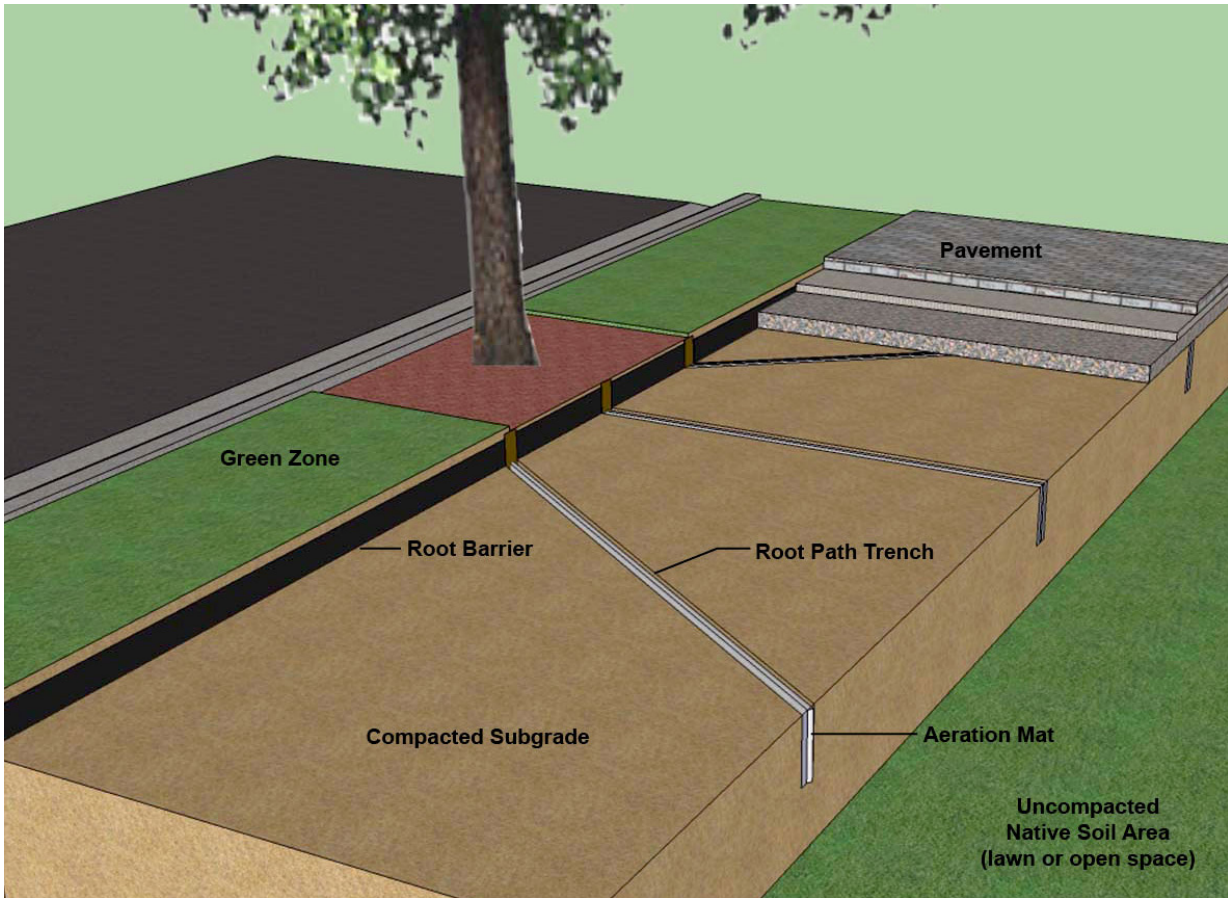
Continuous Trenches
In Open Green Zones during new construction where several tree are to be planted, the Green Zone should be treated as one contiunous trench, that connects several tree pits, to provide extra soil volume for root growth by allowing trees to share soil space.

Shallow Geocelluar Sandwich System
For uses with lightweight traffic, the sandwich system creates rootable soil volume for trees, underneath the hardscapes in urban areas. This system, also know as a suspended pavement system consists of shallow, high-strength modular cells suitable for sub-base replacement which spread weight loads over a large area, preventing compaction of soil in the tree's root zone. At the same time, the open structure of the system prevents roots from causing any damage to the pavement and serves as a distribution and delivery mechanism for air and water for the entire rootable soil volume. This system can be used underneath sidewalks, bikelanes, light weight traffic, and parking lots without reducing the available above ground urban space.

Root Paths
Native soils under or at back of sidewalk may count towards soil volume if there is an opportunity provided for the tree roots to pass under the paved area where they can grow at a normal rate and connect the tree to the adjacent open soil area. Root paths can make this connection.

Root paths are narrow trenches, roughly 4" wide by 1' deep, installed in a compacted subgrade before the gravel base for pavement is added. A commercially available aeration mat material and quality topsoil can be added to the trench to support drainage. Root paths should be installed for new plantings during construction, at the time of subgrade preparation and before the paved surface is installed. Root paths extend radially from the tree pit and may connect to adjacent tree pits, and/or other nearby planting areas such as native soil, lawns, or open space on the opposite side of the sidewalk from the street.

Root paths may be most applicable in urban areas where tree roots need to be directed around utilities and planting space is limited.



Root Path Diagram

DESIGN METHODS for Creating Soil Volume in Urban Transects

Collector Ave (CA) and Arterial Blvd (AB) Transects T4, T5 and T6

For areas where little or no native soil is available, current research shows that soil cells are the best method for creating soil volume under pavement.

Open ‘Green Zone’ Soil Area with Soil Cells under ‘Pedestrian Zone’-
An open soil area is an unpaved area of soil surrounding a tree, which contains existing, new or amended soil. An open soil area may be planted or covered with mulch. Open soil areas reduce impervious surfaces and stormwater runoff.

Covered ‘Green Zone’ Soil Area with Soil Cells under ‘Pedestrian Zone’-
In high traffic areas it may be necessary to cover the ‘Green Zone’ to allow additional ‘Pedestrian Zone’. In this case both the Green Zone and Pedestrian Zone are covered with soil cells designed to accommodate tree root growth.

Root Barrier
Root barrier should be used in areas adjacent to sidewalks. Deflector barriers are acceptable. They should be 30” deep minimum and installed per manufacturer’s instructions.

RECOMMENDED TREES FOR URBAN TRANSECTS T4, T5, T6 - With No Available Soil Volume Conditions
COLUMNAR & UPRIGHT CANOPY TREES – 750 c.f. soil volume required.
Appendix D- Street Tree Standards, NashvilleNext- Major and Collector Street Plan

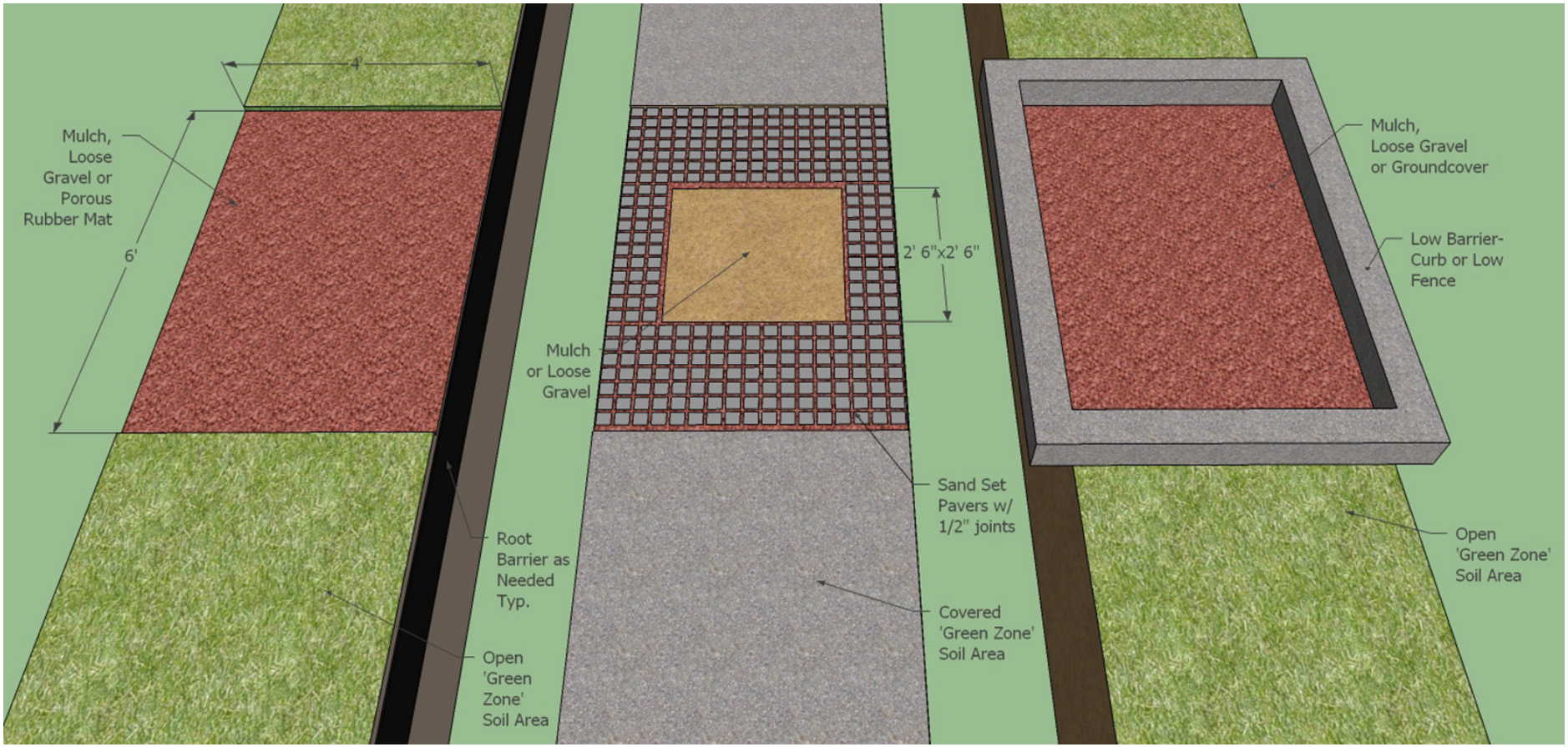
COMMON NAME	LATIN NAME	FORM	HEIGHT	WIDTH	NATIVE
Armstrong Maple	*Acer rubrum 'Armstrong'*	Columnar	40-50'	15-25'	yes
Princton Sentry Gingko	*Gingko biloba 'Princton Sentry'*	Columnar	40-50'	15-20'	no
Slender Silhouette Sweetgum	*Liquidambar styraciflua 'Slender Silhoutte'*	Columnar	35-50'	3-6'	yes
Columnar English Oak	*Quercus robur 'Fastigiata'*	Columnar	40-50'	15'	no
Musashino Columnar Zelkova	*Zelkova serrata 'musashino'*	Vase	45'	15'	no

Soil Cells are plastic structures designed to be filled between the voids with soil and covered with pavement. Tree roots grow in the soil between the structural supports. There are many brands on the market. Install per manufacturer’s instructions.

TREE WELL OPENING

The opening around the base of the tree must allow a transition zone for the trunk to flare as the tree matures. The minimum opening allowed is 4’ x 6’.

There should be space between the curb and the tree trunk at maturity. For a 4’ x 6’ tree well opening the mature trunk should not exceed 3’ in diameter.



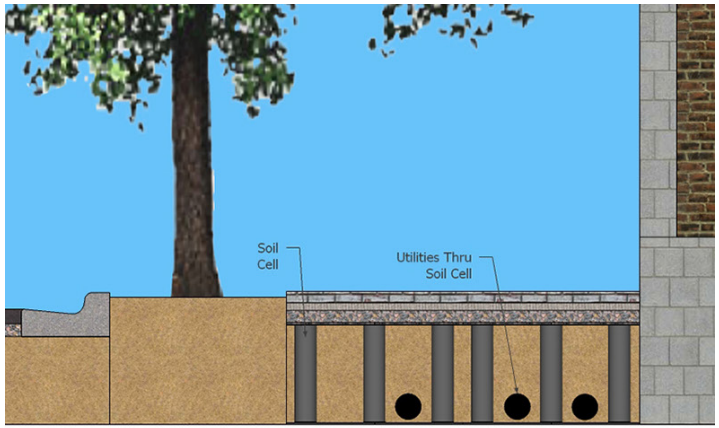
A variety of pavements, both solid and permeable, can be used to create a covered tree space. Pavers, such as granite cobbles and permeable paver blocks (shown above in middle), placed with gaps between the stones allow water to flow to the soil below. Tree grate are not encouraged. If used they must have removable center rings so the tree opening can expand as the tree grows. A long-term maintenance plan is required to address issues such as a trunk growing into a grate, watering, mulch and soil that needs replenishing, pavers that need to be leveled, etc.

COORDINATION OF UTILITIES
with Soil Cells

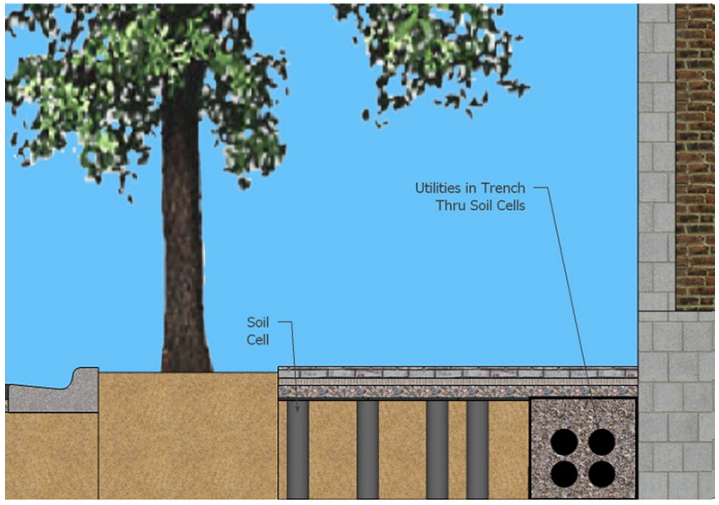
Using the Soil Cells in areas with utilities isn't all that complicated, you need good coordination from the outset. The respective utility owners need to be involved in the conversation. They may have specific requirements that need to be addressed, such as vertical and/or horizontal separation, minimum depth/cover, or protective measures such as encapsulating their lines in granular bedding or insulating them to prevent freezing. In the event that Soil Cells will be installed over utility lines it is also important to discuss what level of loading or ground pressure the utility line can withstand.

Soil Cells should have openings on all four sides and because there is a considerable amount of void space in each frame, running utilities through the Cell frames is a simple way to integrate utilities directly in to the system. This approach can be applied to new or existing utilities. Each frame is its own separate component and can be maneuvered to leave the utility inside of the frame.

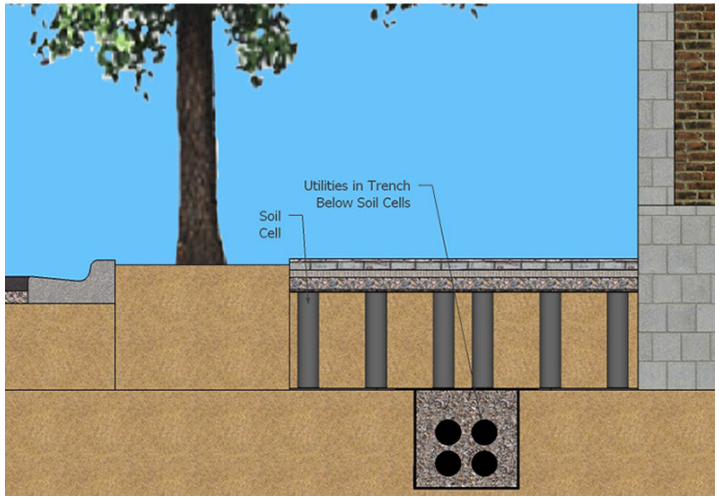
Note: This method is not applicable to storm, sanitary sewer or water mains.



Utilities Thru Soil Cells



Utilities in Trench Thru Soil Cells



Utilities in Trench Below Soil Cells

STREET TREE SPECIFICATIONS

These standards are for all street trees, regardless of transect.

Spacing
One 2" caliper canopy tree, or medium columnar/ upright tree, shall be planted in the public right-of-way along the length of the lot frontage at a minimum spacing of thirty feet (30') and a maximum spacing of fifty feet (50') or if required for permitting purposes, in accordance with Metro Nashville Landscape ordinance17.24.100- Replacement of Trees.

Overhead Conflict
Where there are conflicts with overhead lines, Understory trees shall be planted in the public right-of-way along the length of the lot frontage at a minimum spacing of fifteen feet (15') and a maximum spacing of thirty feet (30') or if required for permitting purposes, in accordance with Metro Nashville Landscape ordinance17.24.100- Replacement *(and Mitigation*)* of Trees.

Tree Species
Shall be chosen from the *Urban Forestry Recommended and Non-Recommended (Prohibited) Tree and Shrub List*.
http://bit.ly/2uux2yL or Page 4- *Recommended Trees for Urban Transects*

Trees must be hardy to zone 7a hardiness zone as indicated on the "Plant Hardiness Zone Map," USDA, 2017.

Tree Quality
Only use nursery-grown material that complies with all required inspection, grading, standards and plant regulations in accordance with the latest edition of the 'American Standard for Nursery Stock'.

Provide sound, healthy, vigorous, freshly dug, nursery-grown stock, free from plant diseases and insect eggs. Heeled-in stock or stock from cold storage will not be accepted.

Provide plants:
1. With healthy, normal root systems.
2. Which have been grown for at least 2 years under climatic conditions similar to those where scheduled for planting.
3. Which have been grown in properly spaced blocks.
4. Which have been transplanted or root pruned at least twice, and at least once in the past three years.
5. With a habit of growth normal for the species.
6. With symmetrical growth typical for the variety and species. Match plants for symmetry of a grouping where required.

Planting Season
Trees should be planted during the dormant season which is typically November to March.

Delivery, Storage, and Handling
All plant materials shall be handled and packed in accordance with good nursery practices. Material shall be adequately protected during transit to prevent windburn, drying, or overheating. Upon delivery, plant materials will be adequately protected from the sun, freezing, and/or drying winds.

When plants cannot be planted immediately after delivery:
1. Place plants on clean surface, in protected area, away from heat-gaining materials such as pavements and masonry.
2. Cover roots and root crowns with moist sod or approved mulch to protect them from sun and wind.
3. Water as necessary to keep them in good condition.
4. Where required, plant materials may be stored in a temporary shed or by heeling-in, using good nursery practice.

Plant materials which are not adequately protected, left out of the ground un-protected overnight, left with roots exposed to the sun, improperly protected during transit, unloading, heeling-in, or during the planting operation shall be rejected and removed from the project.

Protection of Plant Materials
Protect existing trees and other vegetation indicted to remain in place against unnecessary cutting, breaking, and skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within the drip line, excess foot or vehicular traffic, or parking of vehicles within the drip line. Provide temporary fences, barricades, or guards as required to protect trees and vegetation to be left standing.

Provide protection for roots over 1-1/2 inches in diameter that are cut during construction operations. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible, making sure that burlap is kept wet until such time.

Repair or replace trees and vegetation damaged by construction. Damaged trees are to be repaired and restored to full growth status, as determined by a qualified tree surgeon.
No equipment, materials, trash, or other debris will be stored under trees to remain.

Warranty
Contractor shall warranty plant materials for a period of two year after date of sub-stantial completion against defects, including death and unsatisfactory growth, except for defects resulting from neglect by the Owner, abuse or damage by others.

Remove and replace trees found to be dead or in unhealthy condition during the warranty period. Make replacements during the growth season following the end of the warranty period. Replace trees that are in doubtful condition at the end of the warranty period.

Topsoil
Natural, fertile, friable, productive soil, neither excessively acid nor alkaline, and free from toxic substances, stones, weeds, clay, clods, roots, cinders and debris.

Amendments
Sand: Clean, sharp, and free from admixtures that might inhibit plant growth.
Mix soil and additives when soil and additives are relatively dry. Thoroughly mix with hand tools or rotary tiller

Commercial Fertilizer: Time-release type containing 6 percent nitrogen, 12 percent phosphorus, and 12 percent potassium.
Sulphur: Elemental sulphur, 99 percent derived from secondary nutrient sulphur. Sulphur should be used to create an acid soil condition for ericaceous plants. Rates of application shall be determined by pH according to soil test to produce pH of 5.5-6.6.

Lime: Ground limestone containing not less than 45 percent of calcium oxide, and ground to such fineness that the residue on #30 and #200 sieves is not more than 0.5 percent and 15 percent, respectively.

Peat: Horticultural peat composed of not less than 60 percent decomposed organic matter by weight, oven-dried.

Mulch
Mulch shall be shredded hardwood bark (no Cypress Mulch allowed), or pine straw.

Water
Use clean, potable water free from substances that might inhibit plant growth.

Provide a minimum of weekly watering during the dry season. Keep turf and ground covers at least 18 inches away from edge of root ball.

Soil Testing
Test soil as often as necessary to determine pH factor of untreated soil.
Where test indicates adjustment of pH factor is required, amend with lime or sulphur, as necessary, to adjust to proper pH factor.

After adding corrective substances, retest soil and correct until correct pH factor is attained.

Tree Pits
Pits shall be circular in outline. Pit depths shall be measured in relation to finished grade.
“B & B” and container grown plants:
1. Diameter: 2 times wider than rootball.
2. Depth: as deep as rootball.

Where pit depth is over-excavated, backfill with prepared topsoil to fill depth so that balls will be at correct height.

Planting Trees
The Planting Details show the planting height in relation to existing surface as a general rule.

In individual pits, set plants so that after settlement they will be one quarter above finished grade.
1. Center plants in pits and place them upright.
2. Face each plant to give best appearance to closest observation point.
3. Cut off broken, frayed, and dead roots.
4. Handle plants so as to prevent damage.

Set tree in pit. Thoroughly wet burlap. Loosen tie material and carefully roll back burlap so that ball is not broken. Cut the loose burlap and tie material. Pull back one-third of burlap. Do not pull tie material or burlap out from under balls.

Before planting container grown plants, carefully remove from container and unwind any circulating roots; if bent cut back just behind the bend; or cut the roots back 1 inch on all sides and the bottom.

Backfilling Tree Pits
Place prepared soil mixture medium until pit is approximately 3/4 full.

Compact and settle soil by watering thoroughly. After water has soaked in, complete backfilling to finished grade and again compact and settle soil by thoroughly soaking.

If further settling occurs, add additional soil so that finished backfilling is even with finished grade. Do not fill above root flare.

Form ridge of soil around individual trees to form ring to hold water.

Pruning
Remove dead and broken branches from tree.

Prune to retain typical growth habit of individual plants with as much height and spread as practicable. Make cuts with a sharp instrument and cut flush with trunk or adjacent branch to eliminate stubs.

Do not prune the central leader on trees. Do not pole or top trees.

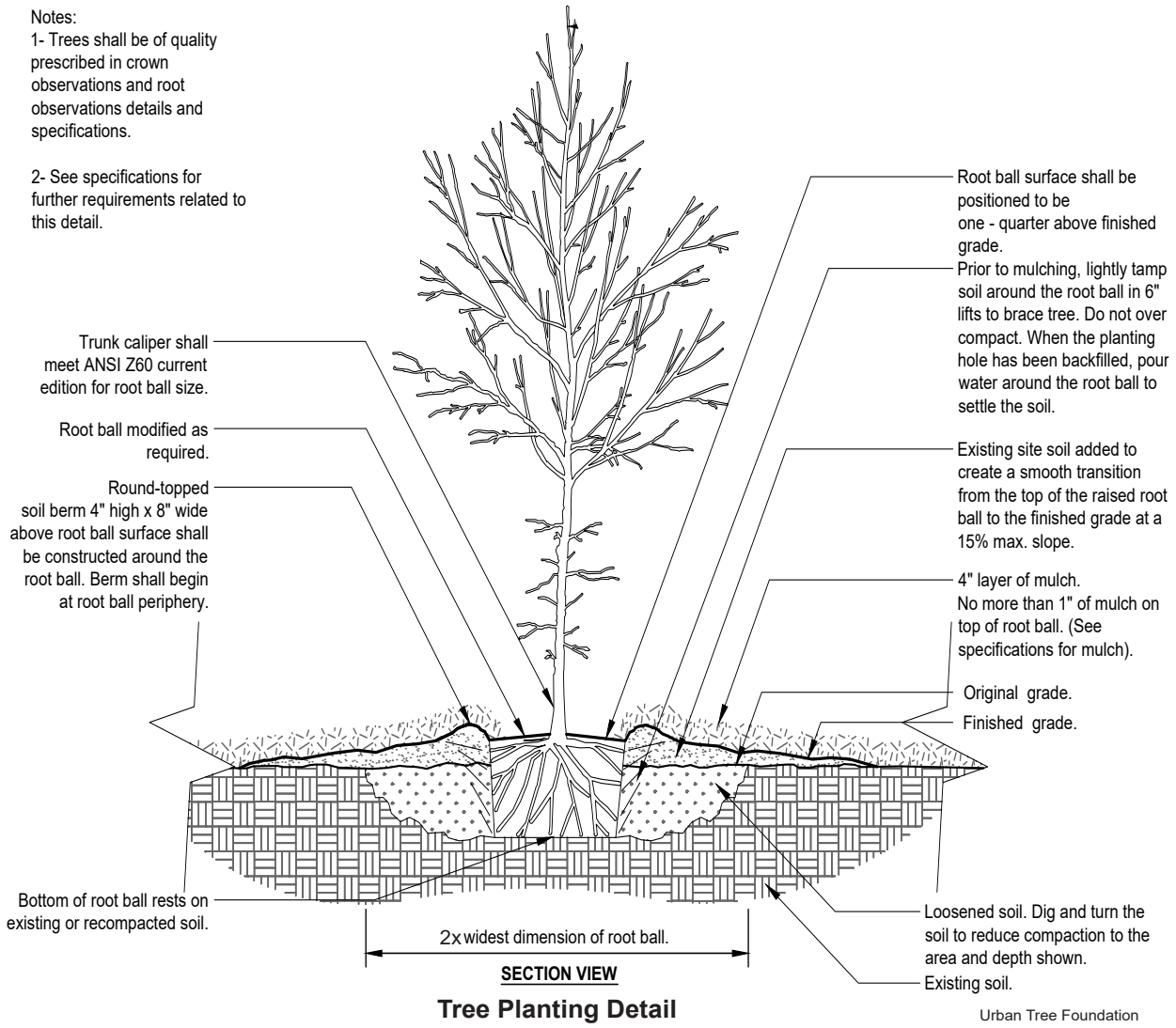
Mulching
After planting, cover the area within the outline of each planting pit or bed with a 3” to 4” layer of mulch. Pull away from touching the tree bark.

After placing mulch, thoroughly wet it to prevent displacement by wind.

Maintenance
Begin maintenance as soon as trees are in place. Maintenance includes the following: insect control; watering; weeding; cultivating; removal of dead material; resetting plants to proper grades or upright position; restoration of mulch; and other operations.

Replacement Planting
Remove and replace plants that are not showing satisfactory growth.

Replace plants missing due to installation oversight as soon as conditions permit, but during the normal planting season.



Tree Planting Detail

Urban Tree Foundation

SOIL SPECIFICATION*

The ideal situation for street trees is loam soil in an open landscape area. Due to the constraints of urban sites, the next best configuration is loam soil under suspended pavement.

Soil Depth.
Tree soil should have a minimum depth of 3 feet. The soil can be composed of topsoil and subsoil layers. The subsoil base surface should be tilled or scarified with the teeth of an excavator bucket initially to break up any compaction.

Soil Composition.
The top soil and subsoil may be from either a suitable naturally occurring soil or soil that has been amended with 1/3 quality topsoil, 1/3 finished compost and 1/3 builders sand.

Stones and rocks.
No stones larger than 1 inch in the longest dimension are permitted. Stones ranging from 0.5 to 1 inch shall not exceed 5% of the soil volume, and gravel ¼ to ½ inches shall not exceed 5% of the soil volume.

Debris content.
Particles > 1 inch in the longest dimension are not allowed. This includes fragments of brick, concrete, wood, glass, metal, stone and plastic. The total volume less than 1 inch long should not be more than 5% of the soil volume.

Contaminants.
The soil should have no herbicides, heavy metals, biological toxins, or hydrocarbons that will impact plant growth or are at levels exceeding the EPA's standards for soil contaminants.

Clod size.
Mixed soils often contain soil clods with high clay content. While smaller soil peds** are desirable from a soil drainage perspective, larger clods are not. Unlimited amount of peds that are less than 1 inch long is allowable. Clods from 1-3 inches should make up < 10% of the soil volume and clods 3-6 inch should be < 5%.

Organic matter content.
Organic matter (OM) is important for retaining water, maintaining stable soil aggregates, promoting biological diversity and providing nutrients for tree growth. The top soil shall have 4-6% OM by weight. If additional organic matter is needed, compost can be added to the soil. A well composted yard waste or wood chips compost can be used, as long as there is 10% OM by volume in the compost. Subsoil should have between 1-3% OM at a minimum.

Density.
Soil density needs to be high enough to avoid settling, yet low enough to allow root growth. Top soil should have a density of 1.0 to 1.4 g/cc and subsoil 1.2 to 1.5 g/cc. A vibrating plate compactor should be used between lifts to settle the soil. Number of passes required needs to be determined on site. A starting point is two passes of a 20 inch impact plate vibrating compactor on a moist (not wet) soil to achieve the desirable density.

Drainage.
Water should readily drain from the soil. Percolation rates of 1-2 inches per hour are preferred, if irrigation will be installed. A drainage system should be installed if the native subsoil has a drainage rate less than 1 inch per hour. Corrugated, slotted pipe should be used for drainage. Slots must only be on the bottom half of the pipe. If pipe has slots on the top, plastic sheeting should be taped to the top to prevent soil contamination of the pipe. Drain pipe should be surrounded with coarse sand and should not be wrapped with filter fabric to avoid future clogging problems. The coarse sand trench should be at least 12 inches wide and 10 inches deep, with the pipe in the center. The pipe must go downhill to an appropriate drainage area.

Soil pH.
Soil pH determines the availability of nutrients in the soil. The desirable pH range is 5.5-6.6. Optimal pH is highly dependent on the tree species to be planted and should be tested and adjusted based on species prior to planting.

Nutrients.
Plant available nutrients should be tested prior to soil installation. If they are found to be at levels that are listed as "medium" or less on the soil analysis report the soil should be amended with the appropriate fertilizers. If nitrogen is required, the nitrogen fertilizer shall contain at least 50% of the total N applied in a water insoluble (WIN) form.

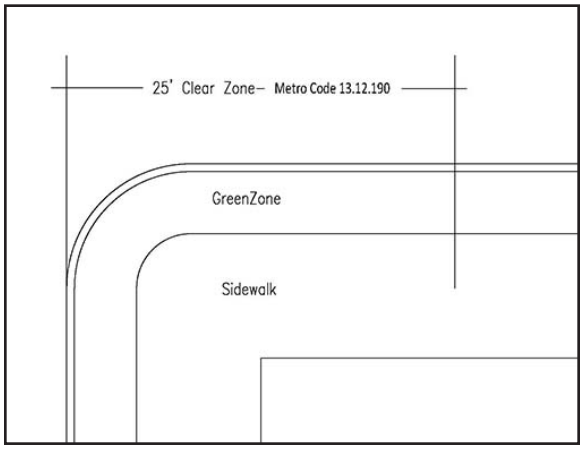
Soluble salt.
Salt content shall be less than 2 dS/m.

Water.
Soaking evenly immediately after planting and daily for the next two weeks. For the next three years, water trees weekly during growing months to a depth of 10". Keep the soil moist, not soggy. After three years, monitor and water trees during times of drought.

Tree Watering Bags provide slow even watering that penetrates into the soil. After the second year, remove the watering bags. In year three, water by hand out to 36" from the trunk or the drip line of the tree.

* Bartlett Tree Research Laboratories Research Report.
**Soil peds are natural, relatively permanent aggregates, separated from each other by voids or natural surfaces of weakness. Peds persist through cycles of wetting and drying.

PROTOTYPICAL CONSTRUCTION DETAILS
for Urban Transects



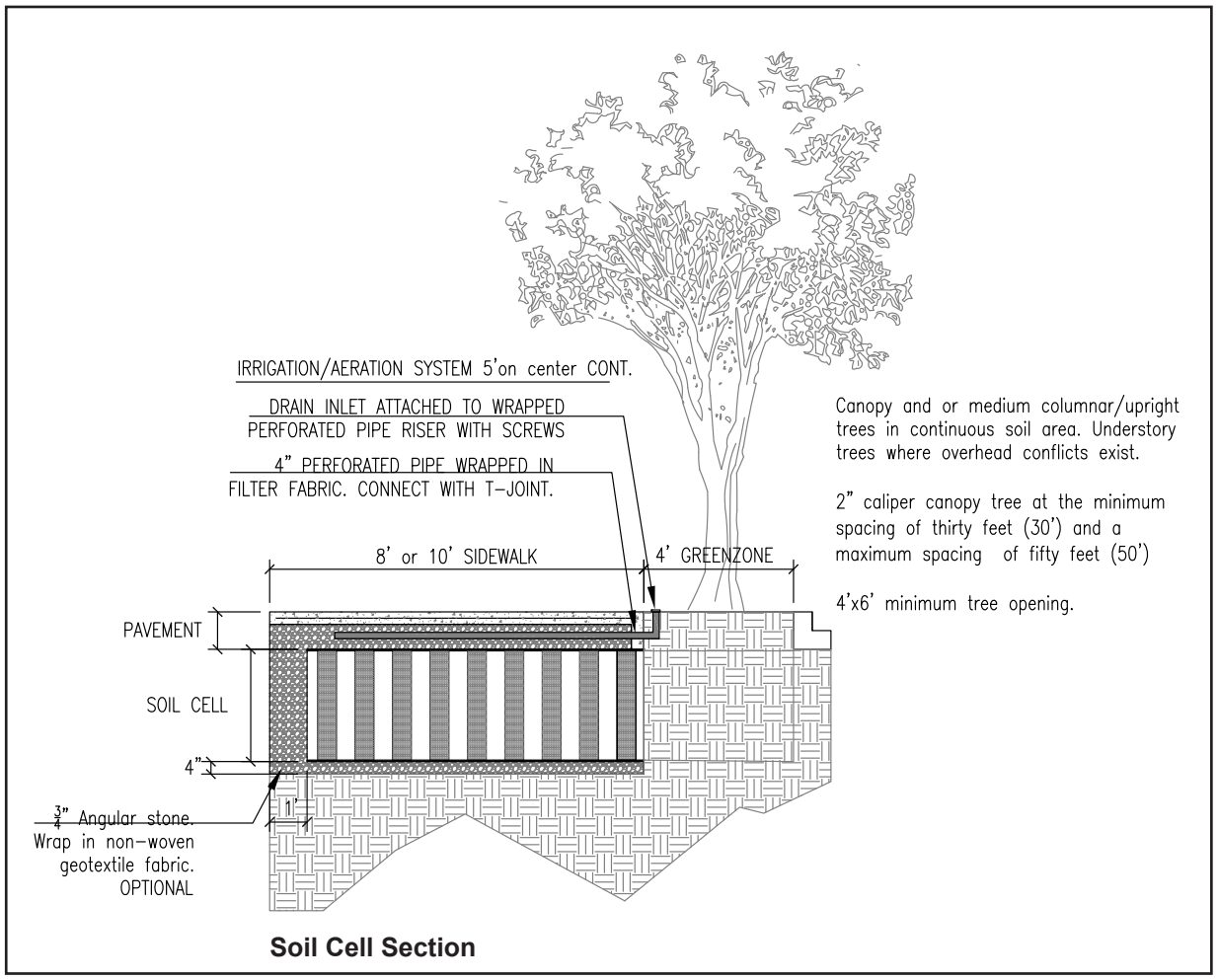
Clear Zone Diagram

Metro Code 13.12.190 - Sight obstruction prohibited when—Notice to remove—Failure to comply.

A. It is unlawful for any person to place or cause to be placed or maintained, either temporarily or permanently, any sign, card, poster, pennant, banner, bush, **tree,** hedge or other obstruction:

1. On private property within twenty-five feet of any street intersection so as to interfere with traffic visibility at the intersection and at no time higher than thirty inches above the crown of the adjacent roadway;
2. On private property in such a manner as to interfere with traffic visibility of any driver using an authorized driveway, alley or roadway;
3. Within the right-of-way of any street within the area of the metropolitan government;

B. Any person violating any of the provisions of this section shall be notified by the traffic and parking commission that the offending sight restriction shall be removed within fifteen days after notification;



Soil Cell Section

C. If the sight restriction is not removed within fifteen days after notification, the traffic and parking commission shall remove said sight restriction, either with metro forces or by normal metro contract procedures, and the expense incurred by metropolitan government in removing the restrictions shall be a debt owed to metropolitan government by the owner of the property in violation and shall be recoverable in an action brought by the metropolitan government.
(Ord. 92-398 § 1, 1992; prior code § 27-1-208)