NYC Parks

NYC Tree Valuation Method

Introduction

New York City's urban forest is integral to the health, beauty, and vitality of the city and its residents. Tree canopy cleans the air, cools the streets, reduces storm water runoff, beautifies neighborhoods, and enhance property values. Street and park trees are the green infrastructure of our sidewalks, parks and playgrounds; yet trees are living organisms that are harmed by adverse environmental conditions. And people damage trees through vandalism, improper cutting, soil removal, construction, vehicular impacts, and dumping. The key to a healthy urban forest is the preservation and protection of each and every tree comprising the forest canopy. Yet this is easier said than done. "Trees are preserved or are killed in small steps. Rarely does a catastrophic event kill the tree, rather, multiple wounds and abuses add up to tree decline and eventual death."[1] And reduction in tree canopy from tree damage or removal leads to a similar reduction in the benefits conferred by that canopy. This tree valuation methodology reflects the unique importance of urban tree canopy to New York City.

Tree Jurisdiction and Tree Replacement Laws

As much as half of NYC's tree canopy is estimated to be growing along streets and highways or on land reserved for open space and recreation. Most of these trees fall under the exclusive jurisdiction of NYC Parks, which controls all trees growing in the public right-of-way and on land mapped as City parkland. The remaining trees grow on privately-owned land parcels or other government land and are not subject to any regulation or protection.

Several laws govern the removal and replacement of trees under the jurisdiction of NYC Parks.[2] The most recent restitution law, Local Law 3 of 2010, sets tree replacement requirements that largely follow industry standards as set forth by the International Society of Arboriculture. The minimum standard for tree replacement, which requires caliper replacement for trees under NYC Parks' jurisdiction, dates back to 1980.

Why Trees Matter

Beginning in the late 1980s, scientists began to measure and quantify the benefits of urban trees. Today an impressive and growing body of knowledge recognizes tree canopy—whether publicly or privately controlled—as a public good with environmental and economic value. New York City's tree canopy covers 21% of the entire land area.[i] The replacement value of this tree canopy is estimated at $5.2 billion.

The positive impacts of trees are many. They lower air temperatures and reduce energy demands in both the winter and summer seasons. Additionally, cooler surfaces around buildings reduce air conditioning demands and associated power plant emissions. In New York City, daily summer temperatures are 7.2 degrees F warmer than in surrounding areas. The hottest neighborhoods in New York City are in northwest Brooklyn, western Queens (Long

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[1] Urban, James. *East River Park Bulkhead Reconstruction, Tree Preservation Recommendations.* Urban Trees + Soils, Annapolis, Maryland. June 13, 2005.

[2] Local Law 3 of 2010 requires NYC Parks to set a "fee" for tree replacement and to promulgate rules for valuation that "substantially comply" with ISA guidelines (NYC Administrative Code section 18-107 (e) and Title 56 of NYC Rules & Regulations. The Caliper Law of 1980 (NYC Administrative Code section 18-107) establishes caliper replacement as the minimum standard.

Island City), and the South Bronx.[ii] If all the roadbeds in New York City were covered with tree canopy in the afternoon, temperatures would be reduced by 0.4 degrees citywide. New York City's street trees are valued at $27 million each year in terms of energy savings alone.

Trees also benefit human health by giving us cleaner air to breathe. They absorb ground-level ozone and other gaseous pollutants, and capture particulate matter—including smoke, dust, and ash—on their leaves. A large, healthy tree removes approximately 70 times more air pollution each year than a small newly planted tree.[iii] New York City's tree canopy removes 1,821 metric tons of air pollution each year at a value of $9.5 million.[iv] Ground-level ozone, a contributor to smog, is of particular concern in New York City where ozone concentrations exceed federal standards and asthma rates are among the highest in the nation. Ozone is associated with adverse health effects, including increased rates of hospitalizations and exacerbation of respiratory illnesses.

Another benefit of urban trees is the reduction of storm water runoff and the improvement of water quality. They intercept and retain rainfall on their leaf, branch, and stem surfaces. Trees also draw moisture from the soil through the process of evapotranspiration, thereby increasing soil water storage potential. These benefits of trees reduce storm water management control costs. New York City's street trees alone capture 870 million gallons of storm water a year, a service valued at $35 million.

Trees improve urban environments on large and small scales. They do so across the landscape by positively impacting shared resources, such as air and water quality, and by producing markedly cooler ambient air temperatures in parks versus the surrounding city streets. Trees also produce local benefits when they shade a hot sidewalk, beautify a whole block, or increase the value of a residential property. A 2005 study from the Wharton School of the University of Pennsylvania found that planting a tree within 50 feet of a house can increase its value by roughly 9%.[v] New York City's street trees contribute $57 million each year to increased property values. *Collectively, New York City's street trees provide over $122 million each year in total benefits, with a benefit cost ratio of 5 to 1.*

NYC Tree Valuation Method

Tree appraisal is a way to establish a monetary value for the loss associated with the damage or destruction of a tree. It is both a science and an art. As required by Local Law 3 of 2010, NYC Parks applies a methodology for tree appraisal established by the International Society of Arboriculture (ISA) to assess trees under its jurisdiction that require removal. As described in the ISA's *Guide for Plant Appraisal, 9th edition*, the Trunk Formula method establishes the monetary value of the tree based on its **size** (as measured by the cross-sectional area of the trunk) and then adjusts for the tree's **condition**, **species**, and **location**.

1. CONDITION

The condition is established by a series of field observations made by a qualified forester. The condition is rated according to the following:

a) The structure and health of tree roots
b) The structure and health of the tree trunk
c) The structure and health of the tree's large branches
d) The health of the tree's small branches and twigs
e) The health of its foliage and/or buds

2. *SPECIES*

According to the ISA Trunk Formula method, species ratings vary regionally and geographically and should be based on species characteristics without regard to a plant's condition or location factors. The ISA method refers appraisers to scores that may be established by regional organizations, such as tree boards or arboricultural societies. Within New York State, there is an organization called the New York State Arborists (NYS) ISA Chapter that publishes a species rating list. Their most recent list divides the state into four regions:

- Region 1: Long Island (Suffolk and Nassau Counties) and New York City
- Region 2: Westchester, Putnam, and Dutchess Counties
- Regions 3 and 4: the remaining 12 northern counties of the state

Parks considers New York City, a densely urbanized area that sits at the nexus of the Long Island, New Jersey, and Westchester County regions, a distinct climatic, biophysical, economic, demographic, and structural entity. The environmental and public health challenges facing New York City are not typical of the suburban or ex-urban experience. Indeed, the NYS ISA Chapter notes in the Species Rating Guide that "it is recognized that even within these regions there are differences and the appraisers may want to adjust their percentages."[3]; therefore, for local assessments relating to the Trunk Formula method, New York City shall be a distinct region and the species rating system shall be specific to NYC.

The NYC species rating system reflects the value of tree species in terms of the magnitude and longevity of the services and benefits they provide in the city. The magnitude of a tree's benefits relates to the size of its tree canopy. Magnitude and longevity are measured by

a) Tree stature (canopy size) at maturity
b) Expected tree life span

Each species is assigned to a large-, medium-, and small-statured category according to the height expectations for a typical example of the species. Each species is also assigned to a short-, medium-, or long-lived category, again according to what is typical for that species. Species ratings are as follows based on the combination of categories that each species falls into [see Appendix for list of species]:

Stature (at maturity)	Longevity	Rating (%)	Examples
Large	Long	100%	Oak, sycamore, elm, hickory, ginkgo, sweetgum
Large	Medium	95%	Horsechestnut, ash, linden, birch, honey-locust
Medium	Long	95%	Southern magnolia, yellowwood
Large	Short	90%	*Ailanthus*, willow, poplar, silver maple, Siberian elm
Medium	Medium	90%	hornbeam, white mulberry, *Sophora*
Small	Long	90%	Yew, holly
Medium	Short	85%	Japanese snowdrop (*styrax*), Callery pear

[3] Tree Species Ratings for New York State. Guidebook prepared by the Shade Tree Evaluation Committee, 1995. An official publication of the New York State Arborists ISA Chapter, Inc., page 1.

Small	Medium	85%	Dogwood, hawthorn, goldenraintree, crabapple
Small	Short	80%	Flowering plum, cherry, hawthorn, redbud

3. LOCATION

The last component of the ISA Trunk Formula method is location. In the ISA formula, the *Location Factor* (LF) is the average of the Site Rating (SR), the Contribution Rating (CR), and the Placement Rating (PR). Parks' adaptation does not include the CR—a measure of the benefits the tree itself provides. This rating is not necessary in our method, given that our species factor already includes a measure of this very same quality. Below is the adapted Parks LF valuation formula:

$$LF = \frac{SR + PR}{2}$$

where,

SR = a measure of the real-estate value and attractiveness of the neighborhood as judged by the arboricultural appraiser. The appraiser measures the qualities of the site in terms of the tree's biological, physical, and chemical (i.e. soil and nutrients) requirements [see Table 1 below], and

PR = a measure of the functional and aesthetic efficacy of a tree as described on a 10 to 100% scale by the arboricultural appraiser.

SITE RATING:

Sometimes a tree is the only beneficial feature in an otherwise undesirable area. In New York City, it is common to see a stately, mature pin oak or London plane tree growing in the sidewalk in front of a vacant lot, along a highway shoulder, or as the single, magnificent tree on an otherwise treeless block in a very modest neighborhood. It is equally likely in New York City to see a tree and a neighborhood both struggling, but neither struggle should devalue the other, and both, given time, may ultimately be successful. The **Site Rating** in the **Location Factor** should not devalue a tree based on arbitrary judgment of how attractive, expensive, successful, functioning, or well-maintained an area seems. Instead, it will function as a measure of how well the site can support successful tree growth within the understanding that all urban locations are challenging for a tree's biological functioning.

Table 1. Site Rating matrix. The more suited a tree is to its growing environment, and the more conducive the area is to tree growth, the higher the site rating.

Site Rating Type	Scoring Range (%)	Suggested Criteria
High	100% to 90%	✓ The site is in a park or landscaped area with ample belowground and overhead growing space ✓ The site is in the street but there is enough above and below ground space, either currently or with moderate adjustment to existing infrastructure (such as enlarging a tree pit, ramping or curving a sidewalk, or moving location of a fence or street signage, etc) to support the tree ✓ The species is tolerant of the site's difficult growing conditions

		✓ The site is physically limiting to the tree, but the tree's stature is appropriate for current adjacent infrastructure (small stature under utility wires or next to a building or retaining wall, for example) ✓ The tree has minor conflicts with existing site infrastructure that can be remedied by mild or moderate corrective pruning (such as a tree branch touching a building, house tap, etc.) ✓ The site contains few targets and the tree is of a structurally sound species
Medium	90% to 70%	✓ Physical space limitations at the site will challenge the success of the tree over time ✓ The species is only moderately tolerant of the site's difficult growing conditions ✓ The tree has moderate conflicts with existing site infrastructure that require redesign or realignment of this infrastructure ✓ Site has a lesser degree of the suggested criteria in the High rating type
Low	70% to 20%	✓ The species is intolerant of the site's difficult growing conditions ✓ The tree's stature is inappropriate for adjacent current site infrastructure (large tree under utility wires, or too close to a building foundation, for example) ✓ The tree has major conflicts with existing site infrastructure that cannot be remedied without elimination of the infrastructure or drastic reduction or elimination of the tree (such as a sidewalk without the possibility of ADA clearance, a completely blocked traffic signal, a deteriorating building foundation or retaining wall, etc.) ✓ The site contains many targets and the tree is of a structurally weak species

PLACEMENT RATING(%):

The Placement Rating is an assessment of a tree's placement in its surrounding landscape, both in terms of its positioning and its contextual relationships.

Table 2. Placement Rating matrix. A higher score reflects a higher aesthetic and function.

Placement Rating Type	Scoring Range (%)	Suggested Criteria
High	100% to 90%	✓ The tree is a native species in or adjacent to a natural area or large park ✓ The tree is a historic specimen or part of a grove, or is an original planting in historic landscape ✓ The tree is the only, or one of a few, in the area ✓ The tree is extremely complimentary to or prominent within an adjacent view, land use, structure, or natural landscape element ✓ The tree is very important within a group of other plantings, such as an allée or along an even-aged block, and its loss would be of high impact to that planting group ✓ The tree provides exceptional services based on its location (i.e. shade in a playground or sitting area, property value in front of a building, stormwater absorption in or near a wetland, etc.)
Medium	90% to 70%	✓ The tree is one of a group of plantings and its individual loss would

		have minimal visual or environmental impact on the entire group ✓ Tree has a lesser degree of the suggested criteria in the High rating type
Low	20% (for invasives) 70% to 20%	✓ The tree is an *invasive* species in or adjacent to a natural area or large park ✓ The tree currently or has the potential to block a view integral to the importance of the site, or otherwise impede a design intent of historical significance ✓ The tree has a very high nuisance factor

The New York City tree appraisal method establishes the maximum value of the tree based on its size, and then takes deductions, if required, based on the tree's condition, species, and location. The tree's combined score in these categories establishes the amount of the deductions. The departures from the method as described in the *Guide* leads to the development of a local—as opposed to regional—scoring system for the species, as well as a customization of the Location Factor.

Frequently Asked Questions

How does Parks appraise a tree that is irreparably damaged?

If a tree is damaged beyond recovery or such that it poses an unacceptable safety risk, it has to be removed. In this case the tree is appraised as to its pre-damaged **size** and **condition**, with the remaining factors established as per the appraisal method above.

How does Parks appraise a tree that is destroyed?

Figure 1 This tree was irreparably damaged because of the basal cutting and required immediate removal.

If a tree is destroyed and removed from the site leaving no further evidence, it is assumed to have been in perfect condition prior to its removal. In this case, the appraisal calculation is based on its size as measured by the cross-sectional (basal) area of the trunk. (The size is either extrapolated from the diameter of the remaining stump or from prior existing Agency records.) This basal area formula yields the number of replacement trees required to compensate for the loss of the original tree. *The cost of planting the total number of replacement trees is the appraised value of the tree that was destroyed.* The standard size of a replacement tree is three inches (3") in diameter at breast height. The average planting cost assigned per three-inch (3") diameter tree changes each Fiscal Year. Currently, the cost varies based on the borough.

Figure 2: The branch and twig dieback was caused by root cutting years earlier when the sidewalk to the left of the tree was installed.

How does Parks appraise a tree that is injured but not totally destroyed?

If a tree is damaged but not destroyed, a qualified forester must make two appraisals. The first appraisal must account for the tree's condition before the damage occurred, and the second appraisal accounts for its existing condition after the injury. *The difference between the two appraisals is the loss of tree value caused by the damage incident.*

Can you tell immediately how a tree injury will impact its health?

Damage to a tree's structure (such as wounding to the roots, trunk, bark, or branches) can take a long time to manifest as signs of failing tree health. Signs of failing tree health include discolored or withered leaves, dead twigs and branches, peeling and/or decaying bark and wood, and the presence of fungal bodies on or near the tree. While some tree species are more resilient to wounding than others and trees in good health are stronger than trees that are already showing signs of reduced vigor, *all physical wounding will negatively impact the health of a tree in some way at some time.* Because of the temporal lapse that often occurs between injury and resulting diminished tree health, our appraisal methodology assesses tree condition pre- and post-damage rather than attempting to predict eventual outcomes.

How does the loss of a branch or branches damage a tree?

Removing living branches takes food from the tree. All the leaves of a tree (the canopy) capture sunlight through the process of photosynthesis to produce energy, enhance growth, and increase a tree's resistance to insects and diseases. Nevertheless, some pruning is often necessary to improve a tree's shape, achieve clearance for pedestrians and vehicles, and remove dead wood from the tree. Parks only allows pruning by qualified individuals who have obtained a permit. Pruning must comply with the American National Standards Institute (ANSI). These standards safeguard the health of trees by detailing the best pruning techniques. For example, tree cuts must be made at a specific position along the branch in order to allow the tree to seal off ("compartmentalize") the wound. The process of compartmentalization slows the movement of decay in trees. *Limbs that are improperly pruned, broken, ripped off, or otherwise wrongly removed from the tree expose the entire tree to irreversible infection and decay.* The worst type of illegal pruning occurs when most of the canopy is removed. Called "topping" or "heading back," this type of pruning leads to starvation, tree shock, loss of structure and beauty, and rapid and over abundant growth of new twigs and leaves. Topping a tree will eventually require its removal.

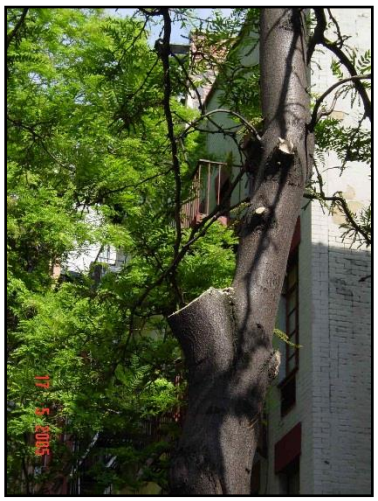

Figure 3: This tree lost half of its canopy from the unauthorized removal of this large limb.

How does root injury or root loss damage a tree?

Tree roots are crucial to a tree's ability to absorb water and nutrients. Most roots are generally shallow growing and occur in the top 24 inches (24") of the soil. The loss of roots can weaken a tree and cause twig and branch dieback. Tree roots are also important for the tree's structural stability. Digging in the root zone of trees can physically tear tree roots. Significant root loss can lead to mechanical tree failure at a later date. Trenching, which accompanies the installation of underground utilities and curbs, will destroy tree roots unless it is done by hand, pneumatic excavation, or micro-tunneling.

How does soil compaction damage a tree?

Soil compaction is the physical compression of the earth caused by the passage of vehicles or other things over the ground or the stockpiling of heavy equipment. Soil compaction ruins soil structure and is difficult or impossible to reverse. Compaction reduces the amount of oxygen, water, and nutrients available to trees, and tears small tree roots. Cement or asphalt over a tree pit can also damage roots by depriving them of oxygen.

How does nailing a sign to a tree cause damage?

Nailing signs to trees can introduce disease into the living tissues of the tree, called the cambium, which is located just under the outer protective bark layer. Damage to the cambium can limit the movement of water and nutrients within the tree, as well as provide a potential entrance for harmful bacteria or fungus to the sensitive, living tissue of the tree.

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[i] from 6-inch resolution land cover (LIDAR) imagery for NYC from 2010.

[ii] Rosenzweig, C, Solecki, WD. (In press). Mitigating New York City's Heat Island with Urban Forestry, Living Roofs, and Light Surfaces: New York City Regional Heat Island Initiative.

[iii] Nowak, DJ. 1994d. Air pollution removal by Chicago's urban forest. In: McPherson, EG, Nowak, DJ, and RA Rowntree. Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project. USDA Forest Service General Technical Report NE-186. Pp. 63-81.

[iv] Nowak, DJ and Crane, DE. 2000. The Urban Forest Effects (UFORE) Model: quantifying urban forest structure and functions. In: Hansen, M. (Ed.) Second International Symposium: Integrated Tools for Natural Resources Inventories in the 21st Century. USDA Forest Service General Technical Report.

[v] Wachter, S. 2004. The Determinants of neighborhood transformation in Philadelphia—identification and analysis: the New Kensington pilot study. The Wharton School, University of Pennsylvania, 24 pp.