



The Case for Chicago's Trees

Trees as Critical Green Infrastructure

Friends of the Parks
2014

Executive Summary

Chicago's urban forest is one of the city's greatest assets. Collectively, trees on parkways, in parks and on private property offer residents many benefits. Beyond improving quality of life and increasing property values, trees play a critical role in Chicago's infrastructure. Chicago's trees are *essential green infrastructure* because they provide necessary and irreplaceable services to the city through natural processes.

The city's parkway trees are faced with an unprecedented array of both natural and man-made challenges. Since the Great Recession of 2008, Chicago's forestry budget has sustained cuts for maintenance and tree planting [1]. Dealing with a city-wide budget crisis, Chicago first began reducing funding for tree planting in 2009 and eliminated funds to plant trees in 2013. Since 2011, more trees have been removed than planted on an annual basis [2]. In addition, costs associated with the emerald ash borer (EAB) have put additional pressure on forestry budgets and the city's tree canopy.

While the aesthetic qualities of trees make them a desirable part of the urban fabric, their functional qualities make them a necessary part of the urban framework. When much of Chicago's infrastructure is in need of updates and repair, planting trees is an affordable solution that meets many needs at once.

In order to understand how to improve Chicago's urban forest, Friends of the Parks reached out to the stewards of Chicago's public trees: City agencies, non-profit organizations and residents. *The Case for Trees* summarizes the benefits trees provide, the challenges they face, and the agencies and policy that function to plant and protect them. The recommendations include strategies to increase funding for tree planting, improve canopy health and increase engagement among volunteers and residents.

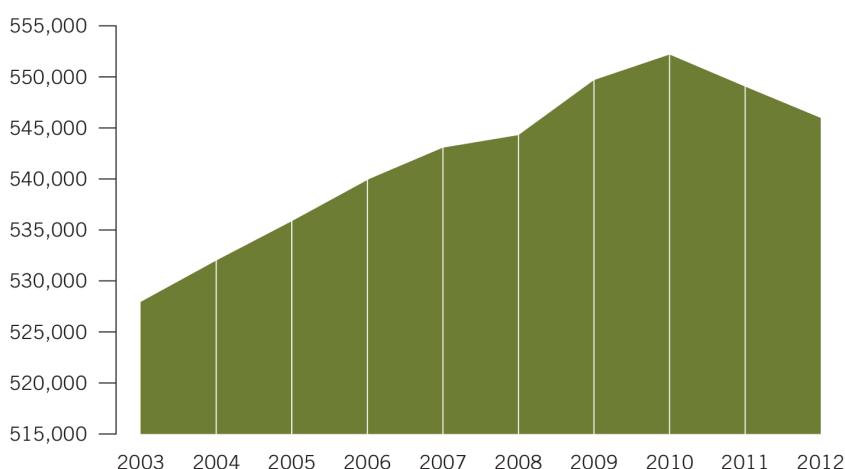
The State of Chicago's Trees

Chicago's urban forest is comprised of trees on streets, in parks and on private land. It stands as one of the city's most important functional assets. Lining boulevards and expansive parks, trees do far more than provide contrast to the brick, steel and concrete edges of the city's streets and buildings.

Over 750,000 public trees throughout Chicago provide direct benefits to residents and the environment by improving air quality, managing storm water, increasing property values and reducing crime [3]. When cities invest in a robust tree canopy, economic vitality, quality of life and environmental conditions improve. Globally, as cities work to address environmental challenges, planners and policy-makers are searching for effective methods that reduce the impact of human activities. Planting more trees is among the most simple and cost-effective solutions.

Throughout the 1990s and 2000s, Chicago recognized the benefits of trees and invested heavily in expanding its canopy. Between 1990 and 2010, the City increased its street tree population by nearly 70,000 trees, expanding canopy coverage from 14.2% in 2000 to 17.2% in 2008 [4, 3]. This net growth takes into account the annual loss of nearly 10,000 street trees [5].

While the City has worked hard to expand its tree canopy, in recent years Chicago has experienced a net decline of its street tree population. The losses are due to an array of challenges and a lack of funding for new plantings. The Bureau of Forestry's annual operating budget started to decline following the economic downturn and international recession that began in 2008. In 2011 the Bureau of Forestry planted just over 1,500 trees. In 2012 that number fell to 1,000. By 2013 no funding was appropriated for tree plantings, and the Bureau of Forestry was able to plant only 10 trees. While the Department of Transportation still planted public trees through individual grants and development projects, the street tree canopy saw a net loss of 6,000 trees in just two years due to budget cuts for plantings [5].



To add to the list of challenges, 20% of Chicago's street trees are at risk of mortality due to the rapidly spreading infestation of the emerald ash borer (EAB). Without treatment, ash trees infested with the emerald ash borer die within just a few years. In 2013 the

Bureau of Forestry did receive special funding to treat ash trees on the parkways that were less than 40% infected. Even with an inoculation program in place, many trees are too infested to save. Inoculations do not cure trees of EAB, but prevent its spread. The City's treatment program is an affordable alternative to mass removals and can preserve much of the existing ash canopy for some years [6].

As Chicago's urban canopy faces mounting challenges, planting trees now is critical to maintaining a canopy that is diverse in size and age. A continued loss of trees will alter the character and health of Chicago's neighborhoods. Like the sewers, sidewalks and other infrastructure systems in place, consistent investment is necessary to maintain the services provided. With creativity, collaboration and a renewed commitment from public and private stakeholders, Chicago can expand its urban canopy and maximize the array of critical benefits trees provide.

The Benefits of Trees

Chicago's tree canopy is a critical part of the urban ecosystem. Trees capture carbon dioxide emissions, reduce storm water runoff, lower energy costs and reduce the urban heat island effect. Beyond playing an important role as urban infrastructure, trees have measurable effects on livability and real estate values. Further, according to a 2007 U.S. Forest Service report, the structural value of trees in Chicago is \$2.3 billion [3].

Climate Change & Carbon Sequestration

Chicago recognizes global climate change and has made a commitment to reducing its greenhouse gas emissions 25% below 1990 levels by 2020. Analyses conducted in 2010 by the Chicago Climate Change Task Force and the Center for Neighborhood Technology identify the city's primary sources of greenhouse gas emissions and projected future increases. Electricity, natural gas, and transportation account for 91% of emissions. Without action, emissions are expected to increase 35% by 2050 [4].

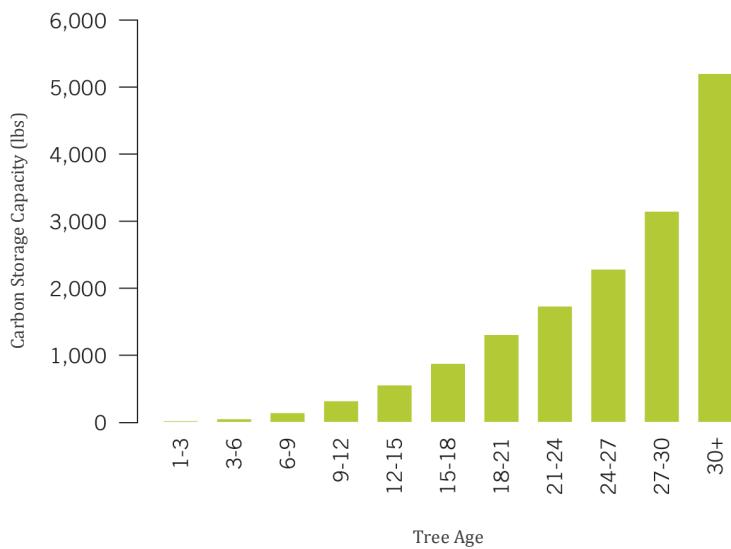


Figure 2: Carbon Sequestration Capacity by Tree Age [3]

With the ability to sequester carbon, trees are one of the most effective solutions for dealing with rising emissions levels. Trees are capable of removing carbon dioxide from the atmosphere through natural photosynthetic processes that store carbon in biomass [7]. Increasing the number of trees in Chicago increases the canopy's capacity to remove and store carbon dioxide. According to assessments made in 2007, Chicago's canopy was able to store roughly 716,000 tons of carbon a year, or the equivalent of the annual carbon emissions of 430,000 automobiles. Based on

the same study, Chicago's canopy annually removes approximately 25,000 tons of CO₂, or the equivalent to the carbon emission produced by 15,100 automobiles [3].

Temperature Moderation

Chicago's urban forest lowers greenhouse gas emissions by moderating ground surface temperatures. The difference in temperature, referred to as the urban heat island effect, is generally proportional to population size and density. Chicago's relatively dense population produces a

measurable increase in temperature. Additionally, the density of buildings and concrete surfaces increases Chicago's reflectivity. As a result, solar radiation is more likely to be absorbed and released as heat [7].

Cities that maintain a robust canopy enjoy more moderate ground temperatures from shade and evaporative cooling. A 2009 study found that a building in full sun needs 2.6 times more electricity for cooling than a building in full shade [8]. According to analysis of the city's canopy in 2007, Chicago's trees reduce residential energy costs by \$360,000 every year [3]. With lower energy consumption come lower carbon emissions and a reduced risk to public health. A 2013 report suggests that neighborhoods with heavy tree canopies see a decrease in heat-related illnesses during summer months [9].

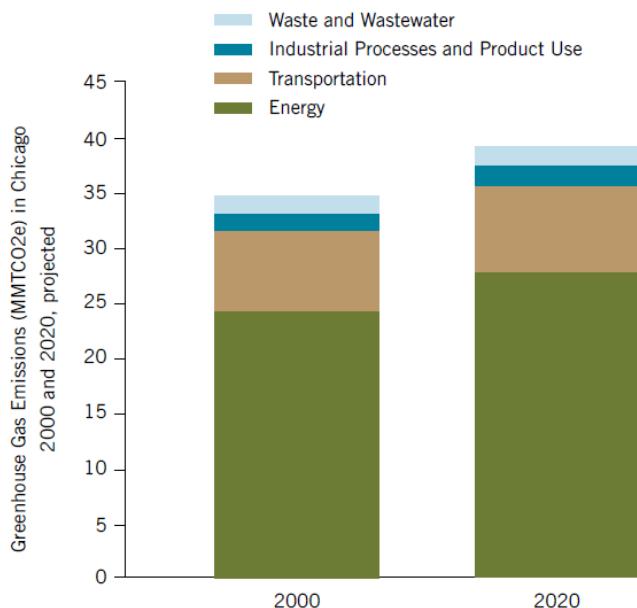


Figure 3: Chicago's 2000 and Projected 2020 Greenhouse Gas Emissions and Sources [4]

Pollution & Human Health

One of the greatest challenges to public health in Chicago area is poor air quality. Coal energy production, automobiles and industrial processes are all major contributors to low air quality in the city. One of many pollutants, sulfur dioxide has been found to cause respiratory disease. Other airborne particulates cause respiratory symptoms, aggravate existing cardiovascular disease, damage lung tissue, and harm the body's defensive systems. High levels of ozone are linked to respiratory symptoms, asthma attacks, decreased lung function, and respiratory inflammation.

Trees play an important role in removing air pollutants. Harmful gases are intercepted through foliage, surface effects and leaf absorption. On average, Chicago's current canopy improves the overall quality of air by 1.3 percent each hour [7]. The city's trees remove 888 tons of air pollution annually, a service valued at more than \$6.4 million [3].

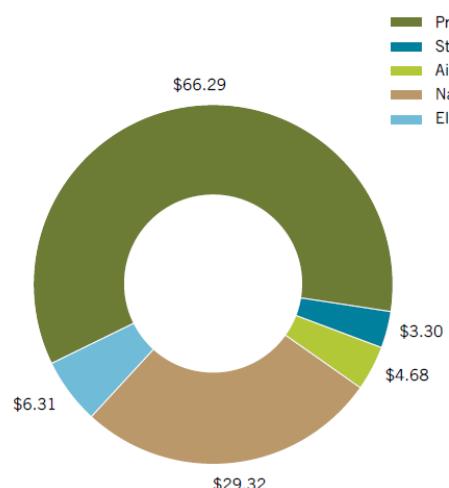
Storm Water & Water Quality

Chicago's built infrastructure for managing storm water and wastewater is over capacity. Heavy rains often overwhelm the combined sewer system, which combines storm water and wastewater. Sewer overflow floods streets and basements or is discharged into the Chicago River and Lake Michigan. The excess water that is released into the city's bodies of water can contain dangerous bacteria from the sewers and pollutants from the streets. The problem takes root in the abundance of paved surfaces in the city, which prevent water from being naturally absorbed and send it into the city's sewer system. Estimates suggest that in urban areas 60 to 70 percent of average annual rainwater becomes runoff due to a lack of permeable surfaces [7].

During rainfall, urban trees reduce pressure on the city's sewer system. Deep roots and leaf decomposition allow rainwater to quickly and thoroughly infiltrate the surrounding soil. Trees also mitigate storm water run-off by capturing water in the canopy and releasing it into the atmosphere. Depending on the size and species, a tree is capable of storing over 100 gallons of water [10]. In addition, absorption helps filter harmful pollutants that might otherwise be passed to bodies of water.

The Economic Benefits of Trees

In an effort to better understand the direct value of trees, a number of tree calculators have emerged that estimate the monetary value of individual trees. The tools help quantify the functional benefits trees collectively bring to an economy as they improve environmental health and increase land values. A robust canopy has been found to increase the value of property as well as improve economic activity.



Planting trees is a quick and easy way for property owners to invest in their properties and neighborhoods. The presence of trees can increase property value by up to 20% [12]. Aesthetically pleasing landscapes can increase rental rates by as much as 6% while significant shade can increase values by up to 9% [13]. For nonresidential areas, numerous studies have shown that workers and firms are attracted to areas with more amenities and higher

environmental quality. In downtown business districts, consumers are happy to pay 9% to 12% more for products and services in areas with a mature tree canopy [14].

Relationship with Crime Levels

Many studies have examined the relationship between trees and crime in urban areas. Findings suggest that investment in a city's canopy contributes to a reduction in crime rates, especially in minority communities and low-income areas. A study in Philadelphia that controlled for outside factors such as poverty rates and educational attainment concluded that "the more vegetation in an area, the lower the rate of aggravated assaults, robberies and burglaries" [15]. Another study in Baltimore came to similar results after finding a 10% increase in the tree canopy produced a 12% decrease in crime. Variables such as race and income were controlled for [16]. The findings suggest that a lack of maintenance reflects a low level of social authority that tolerates criminal behavior, while increased vegetation and greater maintenance sends the signal that the public is present and watching.

Chicago's Urban Forest

According to a 2007 study by the U.S. Forest Service, there are more than 3,585,000 trees within the City of Chicago. Based on aerial imagery taken in 2008, the canopy covers some 17.2% of the City's land area [3]. The urban canopy includes all trees along streets, in parks and on private property. Although figures are approximate, the majority of trees in Chicago are on private property.

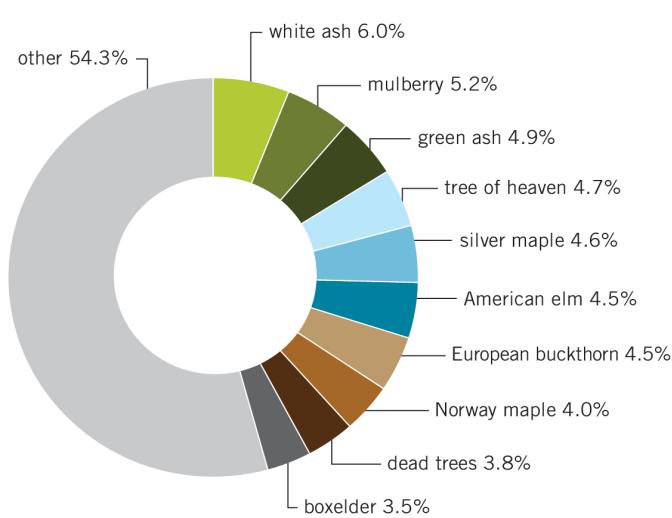
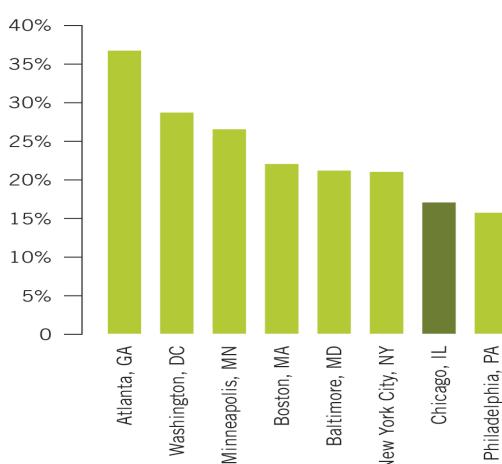


Figure 5: Tree Species in Chicago's Urban Forest [3]

Species

Maintaining a diverse tree population is a fundamental goal in urban forestry management. Diversity provides greater protection from widespread loss to infestation and disease. According to a 2007 study, *"Chicago's Urban Forest"* by the U.S. Forest Service, the most common species in Chicago include white and green ash, mulberry, and tree-of-heaven [3]. In 2007 City foresters with the Bureau of Forestry established a goal of limiting tree species to only 15% of the street tree population [17].



The Agencies

Four agencies are responsible for planting and maintaining trees in the public realm. The Bureau of Forestry under the Department of Streets and Sanitation maintains all trees in the parkways and has planted trees in the parkways as recently as 2012. The Chicago Department of Transportation plants trees in the public way under specific infrastructure projects.

Figure 6: Percent Tree Canopy Coverage in Major American Cities [3]

Trees in parks are both planted and maintained by the Chicago Park District. The Forest Preserves of Cook County plants and oversees trees in the forest preserves.

Each agency has diverse priorities that vary according to local jurisdiction. All agencies are staffed by professional foresters who are concerned with management of the greater urban forest. The agencies also employ certified arborists, or professionals who specialize in the care of trees on an individual basis. While the Bureau of Forestry, Department of Transportation, Chicago Park District and Forest Preserve District are the primary public stewards of Chicago's trees, many other public agencies, nonprofit organizations and volunteers contribute to planting and maintaining the urban forest. The forestry agencies consistently strive for effective collaboration, cooperation and coordination.

Bureau of Forestry, Department of Streets and Sanitation

With just over 545,000 trees, the City's Bureau of Forestry under the Department of Streets and Sanitation manages more trees in Chicago than any other City agency [2]. Its primary tasks include: planting new trees; conducting maintenance, including tree trimmings; addressing infections and infestations; removing dead or hazardous trees; removing stumps; and processing non-parkway landscape debris. The Bureau of Forestry is responsible for all parkway tree work and issues permits for parkway tree permits and removals. The agency also issues citations for illegal action against trees in the public way [18].

Chicago Department of Transportation

While the Bureau of Forestry serves as an umbrella agency for forestry-related functions, The Chicago Department of Transportation (CDOT) plants trees in the public way as part of specific infrastructure improvement projects. The agency is also responsible for GreenStreets, a program that focuses on planting street trees in areas with low levels of greenery, a high population density and a high heat index.

Chicago Park District

The Chicago Park District's (CPD) Department of Natural Resources manages approximately 250,000 trees on its more than 7,700 acres of parkland [3]. The Park District's Department of Forestry functions under the Department of Natural Resources and is responsible for tree planting, tree maintenance and over 20 miles of landscaped medians. With the overarching mission of engaging residents in the parks, the Chicago Park District uses volunteers from Friends of the Parks and Open Lands TreeKeepers to help care for park trees [19].

Forest Preserve District of Cook County

The Forest Preserve District of Cook County manages nearly 69,000 acres of public land, 4,000 of which are within Chicago's borders. Because the Forest Preserve's primary function is to protect our forests, trees are only removed from the preserves when they are invasive or deemed a risk to people [20]. In 2013 the District's budget allocated funds for tree planting and has since planted around 1,200 trees [21].

Private Landowners and Managers

The majority of trees take root on private residential, commercial, institutional and industrial property. The stewards of trees on private land take many forms: renters, homeowners, commercial land owners and private contractors. Maintenance of these trees receives little oversight until neglect becomes a matter of public safety. If a landowner wishes to plant or remove trees on public or private property, he or she must obtain a permit from the Bureau of Forestry and provide a certificate of liability insurance.

Managing an Urban Forest

Because the conditions surrounding trees in Chicago are largely constructed, a human hand is essential to ensuring the individual and collective health of the urban forest. While continuous plantings are important to maintaining a consistent and age-diverse canopy, proper maintenance is essential to ensuring health and longevity. From the tree nursery to forestry planning, Chicago's urban forest relies on an extensive support system.

Nurseries & Contract Services

The life of a public tree begins at a nursery. While City agencies select species and location, the trees are typically planted by a tree service provider on contract with the City. These private vendors maintain relationships with many nurseries throughout the Chicagoland area. While agencies aim to obtain young trees from nurseries in close proximity to the city, young trees may be grown hundreds of miles away.

Location Selection

While the Chicago Park District has significant freedom in choosing where to plant in Chicago's parks, planting on parkways must take highly specific growing factors into consideration. New plantings by the Bureau of Forestry and Department of Transportation target locations where trees have recently been removed. Typically, Bureau of Forestry and Department of Transportation trees are planted in tree pits or strips of open land in the public way. Deciding where to plant requires fluid communication between the two agencies.

Species Selection

The Bureau of Forestry maintains a list of acceptable tree species for planting within the City of Chicago. The list of recommended species varies with location and is updated when new environmental challenges arise. The conditions of the growing area determine which species are suitable for planting. Grass parkways, tree pits, landscape islands and areas below power lines use different lists of recommended species.

The City recognizes that it must adapt tree planting due to rising temperatures caused by changes in climate. Foresters have assessed and altered the City's species selection list. Trees that were not viable in the past are now being planted on city streets. With the expectation that temperatures will rise, forestry workers are choosing species that thrive toward the southern edge of the hardiness zone and avoiding species that thrive along the northern edge.

Growing Conditions

The quality of a planting site has significant effects on the long-term health of a young tree. Planting the right tree in the right places reduces the risk of transplant shock and improves the likelihood that a young tree will succeed. The vast majority of Chicago's parkway trees are grown in tree pits. These are typically 5' by 5' open areas cut into the sidewalk. Chicago's trees struggle to reach full maturity with such limited growing space. Because roots need oxygen and tend to branch outward, they need more horizontal soil space than vertical soil space. This poses a problem for trees growing in Chicago's parkways. Most are given just a few feet of open soil to grow in. Trees often must compete with lawn grass, which also grows in the top few inches of soil where nutrients and water are available. On city streets, the Bureau of Forestry and Department of Transportation are moving forward with efforts to plant trees in longer trenches rather than in the traditional tree pits.

Tree Establishment Period

The Bureau of Forestry, Department of Transportation, Chicago Park District and Forest Preserves of Cook County require contractors to provide a two-year maintenance and replacement warranty for trees planted in the public way. If a tree dies within a two-year establishment period, the contractor must replace the tree at no cost to the agency. Within the two-year guarantee, the agencies notify vendors of problems with trees planted and require replacements. Guarantees extend to trees damaged due to improper handling or planting; improper after care including trimming, watering, weeding, cultivating, insect infestations or from shock of transplanting. The guarantee does not cover trees killed by negligence or intention. Surprisingly, vandalism is a critical issue and results in significant tree damage and mortality. Once a tree planted by the City has exceeded its two-year guarantee period, maintenance becomes the sole responsibility of the government agency.

Maintenance

Following proper planting, good maintenance is the most critical factor affecting healthy tree growth. Maintenance practices include watering, pruning, mulching, and weed-removal. The maintenance of surrounding vegetation, such as grass, can also improve the health of trees. On private property, tree maintenance is performed by the property owner or contracted out to a tree service provider. On public streets, maintenance is provided by the Bureau of Forestry, and in parks, the Chicago Park District assumes responsibility. Under the Chicago Landscape Ordinance, property managers of new developments are required to plant and pay for maintenance of trees on adjacent parkways for five years. Following this period, the Bureau of Forestry assumes responsibility for tree maintenance.

Grates

Iron tree grates seen across the city are installed to create a continuous walking surface while protecting trees from damage by pedestrian activity. However, they are often unnecessary and come with significant downsides. Iron grates can cause mortality by girdling a tree's trunk. Girdling occurs when a tree's bark is damaged around its circumference. If a grate is not expanded for growth, the iron cuts into the bark and damages the tree's ability to transport water and nutrients.

At roughly \$1,100 to replace, tree grates are also extremely expensive. Given the limited services offered by the high-cost product, the Bureau of Forestry altered its tree planting guidelines to reduce the number of tree grates. The current recommendation is that grates only be installed where there is extremely high foot traffic. To prevent girdling, recent changes in standards increased the required diameter of the grate opening to 24 inches.

Watering

Like all plants, trees require water. When a tree is exposed to dry soil for an extended period of time, its capacity to absorb water decreases. This causes an increase in risk to disease and infestation. Maintaining soil moisture is especially important for recently transplanted trees without established root systems. In times of drought, the Bureau of Forestry and Chicago Park District are unable to ensure that every tree receives supplementary water. Residents are encouraged to water both public and private trees.

Mulching

Applying mulch to a tree is one of the best things a tree steward can do. Mulch helps a tree retain moisture, improves the health of surrounding soil, and mitigates the growth of competing plants. Mulch also prevents lawnmower damage, which poses a major challenge to tree health. However, excessive or improperly applied mulch can be harmful to tree health. Mulch piled up against a tree's trunk will retain moisture on the bark rather than in the soil surrounding it. As the bark is continuously exposed to moisture, it will develop cankers and splits which make the tree more susceptible to infestation and disease. Proper application is critical. The Bureau of Forestry currently provides free mulch to Chicago residents.

Trimming & Removals

Proper pruning of young trees can prevent many problems later on in life. While pruning is most important in the first five years of growth, it is helpful throughout the tree's maturity. Pruning improves the tree's natural shape and structural strength. Trees are pruned in the winter during dormancy to elevate the rate of growth in spring. Pruning in the summer slows the growth of unwanted branches.

On city parkways, the Bureau of Forestry trims approximately 50,000 to 75,000 trees each year. Until 2013, determining which trees needed trimming was based on the 311 system and field surveys. Every year the City receives around 18,000 trimming requests through the 311 system. By 2013, there were nearly 20,000 open requests for tree trimmings dating back to January, 2011. To increase efficiency, in 2013 the Bureau of Forestry adopted a grid-based system for trimmings. While the agency still responds to 311 requests, workers have been able to trim more trees annually under the new grid system.

On Chicago Park District property, forestry workers prune roughly 8,000 trees every year, according to the Department of Natural Resources. Like the trees on city parkways, limited resources mean many young trees do not receive the pruning needed at a young stage. The Park District uses volunteers to help ease the burden. TreeKeepers are trained by the non-profit organization Openlands to prune trees in parks. The tree stewardship program was developed as a way to increase the number of resident experts who can contribute to maintaining a healthy urban tree canopy. In addition, volunteers from Friends of the Parks mulch over a thousand trees annually. However, volunteer services do not come close to providing the additional support needed to trim the 250,000 trees in Chicago's parks.

The Forest Preserves of Cook County are able to keep maintenance and trimmings to a minimum because of an overarching mission to maintain the forests in a natural state. Trees are only removed or trimmed when they pose a challenge to public safety along trails and roads that the public interact with.

Severe Storms

Storms can cause considerable damage to trees and produce chaos for the Bureau of Forestry and Chicago Park District. Following severe storms, the agencies must attend to thousands of damaged trees and fallen branches. Forestry workers are in constant anticipation of major storms and workers are on-call 24 hours a day to respond to such emergencies. Following a major storm, the Bureau develops a map that identifies points for trimmings and removal based on 311 calls. The plan helps organize labor and ensures that workers are sent to areas that are in need of immediate attention. Priority is given to clearing fallen branches from streets in order to maintain emergency vehicle access. Also key is removing any trees that present an immediate danger to the public. The Park District relies on its own workers and a contracted service provider to respond to major storm damage.

Natural Challenges

In Chicago, the Department of Forestry estimates that, in general, between 6,000 and 10,000 street trees die every year due to old age, disease, infestation, vandalism and storm damage. Since enduring the devastating effects of Dutch elm disease and the Asian Long-horned beetle, Chicago is now faced in coming years with the emerald ash borer, a pest that puts nearly 20% of its tree population at risk.

Emerald Ash Borer

Since 2002, the emerald ash borer (EAB) has killed over 20 million trees across the Midwest and in Canada. Larvae feed from under ash bark and prevent the transport of water and nutrients. In the first two years, infestation is nearly impossible to detect. By the third year, a thinning crown appears. Significant dieback occurs during years five and six. The insect's larvae form multiple galleries beneath the bark, collectively causing mortality. Unlike other species, ash trees quickly become structurally unsound after death. Most fall within a year and pose a threat to property, utility lines, and human life. As the infestation quickly spreads throughout the East and Midwest, most experts believe ash trees will eventually become extinct [6].

In spring of 2013, there were approximately 85,200 ash trees on Chicago's parkways. These accounted for nearly 20% of the total street tree population. The Chicago Park District estimated that 30,000 were growing in parks and an additional 300,000 ash trees are estimated to be on private property. Since 2003, the Bureau of Forestry has prohibited the planting of ash trees on the public right-of-way to minimize the impact of the infestation. Although no cure exists, available treatments provide protection from the beetle if regularly administered. The Environmental Protection Agency approved a systemic insecticide that prevents mortality if a tree is less than 40% infected. Administered by injection at the tree's base, the insecticide can only be handled by a state-licensed arborist [6].

In addressing the problem of the emerald ash borer, officials in the Bureau of Forestry decided that on-going inoculation of the ash population would allow the City to diffuse the financial burden of tree removal over a number of years and maintain the existing ash trees for several years. In July, 2013 Mayor Rahm Emanuel and City Council approved an emergency \$2.6 million for the Bureau of Forestry to pay for inoculations against the EAB. The funding, spread out over two years, was guaranteed to be included in the 2014 budget. As a result, the Bureau hired 26 fulltime workers to inoculate half of the city's 70,000 treatable parkway ash trees. If funding is appropriated in future budgets, the Bureau of Forestry will maintain a three-year inoculation cycle: two years of insecticide treatments followed by a year of undetermined activity. Treatments began in June of 2013 for ash trees that were less than 40% infected [6].

Taking a different position, the Chicago Park District announced that it would remove the vast majority of its 30,000 ash trees, with the exception of “signature” trees. The agency cited its essential function as providing safe and enjoyable public spaces. Infested ash trees pose a safety threat to park visitors due to their quick loss of structural integrity. Rather than inoculate, the Chicago Park District planned to remove and replace the trees immediately [19]. With a considerably smaller population of ash trees in the parks and a more robust planting budget, the Park District addressed the emerald ash borer under very different conditions than the Bureau of Forestry.

A third approach came from the Forest Preserves of Cook County, announcing that it would remove only the ash trees that were at risk of falling on trails or roads. This decision was aligned with the Forest Preserve District’s mission to maintain forests in their natural state.

Asian Long-horned Beetle

The Asian Long-horned beetle (ALB) appeared in Chicago’s Ravenswood neighborhood in 1998 and threatened several species of hardwood trees. ALB larvae feed off a tree’s cambium, severely damaging its structural integrity. As the most devastating tree disaster in Chicago since Dutch elm disease, the ALB was finally eradicated in the area in 2008 with a total cost of around \$70 million. However, as indicated by recent new finds in Toronto, the beetle has the potential to return to the Chicago area. Forestry experts remain very vigilant [22].

Early detection and swift City response were critical to successful eradication of the ALB. Infestations were identified by ground-level and aerial inspections using tree climbers and bucket trucks. The removal of infested trees began early in 1999, with 450 infected trees cut down in just a few days. Quarantined areas included Ravenswood, Oz Park, Addison, Summit, Kilbourn Park, Park Ridge and O’Hare Airport. In 1999 alone, 732 Chicagoland trees were found to be infested. With removals and quarantine, this number dropped to just six in 2003 [22].

Due to the City’s rapid response, canopy restoration came quickly. For each parkway tree that was lost, the Bureau of Forestry planted another. This program began in the spring of 1999 and by the summer all lost trees had been replaced. Friends of the Parks contributed \$100,000 to purchase trees in the affected areas. Strong public resources, an effective outreach campaign, and a single go-to contact for questions and concerns contributed to residents’ positive response to efforts. The integration of citizens, non-profits and public officials increased the eradication effort’s coordination, communication and effectiveness [22].

Dutch Elm Disease

Dutch elm disease (DED) first entered the U.S. in 1931, but it did not arrive in the Chicago region until 1954. The disease is a fungus that is spread by the Elm Bark Beetle, root systems and contaminated tools. The fungus causes damage by clogging a tree's vascular system and preventing the effective transportation of water and nutrients from the soil to the canopy. Once infected the tree's leaves wilt, change color, and fall from the tree. In order to control the spread of the disease, the dead limbs that contain beetle eggs must be removed and the tree must be treated with a chemical fungicide. If fully infected, arborists generally recommend immediate removal to avoid contamination of nearby elms [23].

The American elm became Chicago's go-to tree for street and park plantings because of its magnificent form, strong branches, and high tolerance of poor soil. When the Dutch elm disease arrived in Chicago in 1954, it devastated the city's canopy and taught cities the lesson of maintaining species diversity. The loss of elms peaked between 1965 and 1970. In just one year, the Cook County Forest Preserve District removed 19,393 elm trees from the forest preserves [23].

Nowhere in Chicago was the loss of elms more visible than in Grant Park. Once home to more than 1,800 elms, only 500 original elm trees remain. These stately trees continue to survive because the Chicago Park District has, for decades, regularly inoculated the elms in Grant Park. In the last 20 years, if elm trees died, many were replaced with infection-resistant hybrid elms. Many hybrid elms have since been added to Grant Park's canopy [24].

Gypsy Moth

First detected in Illinois in 1972, the gypsy moth continues to feast on Chicago's oak, poplar, willow, beech, crabapple and linden trees. During the spring, the insect's larvae create small holes in leaves. Mature larvae will skeletonize leaves over the following months, often leading to complete defoliation. Extreme infestation increases a tree's vulnerability to other problems and repeated defoliation can lead to death [25].

Since the 1990's, the Bureau of Forestry has worked with the Illinois Department of Agriculture to track the progress of the gypsy moth in Chicago. In 1998, the Bureau of Forestry and TreeKeeper volunteers hung 454 pheromone traps across the city. Sixty-four traps remain, helping to trap the gypsy moth. In 2002, the Bureau started distributing a fungus in soil along with moth cadavers to help control the moth's population [18]. These initiatives have prevented the pest from causing significant damage to Chicago's trees.

Buckthorn

Invasive trees are a major threat to young trees in more natural habitats. One of the most common and relentless invasive species in Chicago is the buckthorn tree. The species was originally brought to the United States from Europe and Asia as a hedging material. Now the most common tree in Cook County, buckthorn competes with native plants for nutrients, light and moisture. The quick-growing plant quickly forms an impenetrable thicket that casts a dense shade and chokes out nearby trees and vegetation [26].

Many Chicago residents have buckthorn growing in their backyards, but are unable to identify it or do not know the impact it has on natural areas. Birds enjoy eating the berries of female trees, but the seeds soon pass and can be deposited miles away, advancing its spread. All government agencies have a policy of removing buckthorn shrubs and trees when possible.

Animals

The natural activities of animals often take a toll on tree health. Both rabbits and deer damage the bark of trees, a problem that can make a tree more vulnerable to disease or cause mortality. In some areas of Chicago rabbits are known to strip much of the lower bark of trees. When food is scarce in winter, rabbits will eat the bark off young trees.

In more natural areas of Chicago, deer pose a threat to tree health. Male deer rub their antlers on trees, an activity known as browsing, and can cause severe damage to tree bark. Chicago's North Park Village Preserve hosts roughly 30 deer, an extremely large population given the size of the natural area. Many of the trees in North Park Village show signs of deer damage.

Funding for Tree Planting

Chicago, like all cities in the nation, faced shrinking budgets beginning in 2008 due to the global recession. To deal with the financial crisis, the City implemented across-the-board spending cuts.

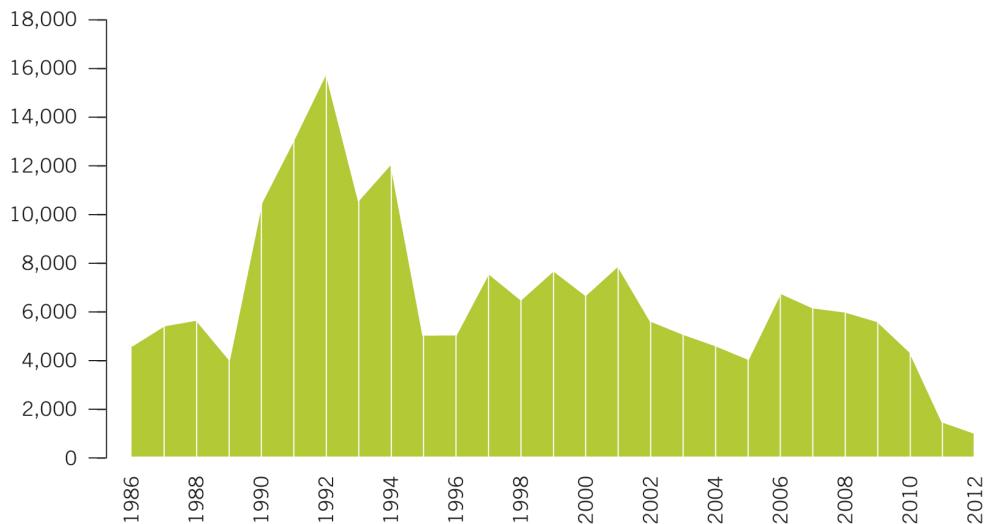


Figure 7: Trees Planted by the Bureau of Forestry, 1986-2012 [5]

At the Bureau of Forestry funding for tree plantings was reduced beginning in 2009. By 2013 the tree planting line item was eliminated [1]. However, City Council approved an emergency appropriation of \$2.6 million over two years to fight the Emerald Ash Borer [6].

The Department of Transportation continued to plant trees in the public way under street improvement and capital development projects both downtown and in neighborhoods.

Bureau of Forestry

The Bureau of Forestry's operating budget has declined since its peak of \$19 million in 2008. By 2012, the agency's budget was \$12 million [1]. Since cutbacks began in 2009, twenty forestry crews have been removed from the workforce. With a significantly reduced budget and no less work, the city's forestry operations are under constant pressure.

In 2012, in a move to improve efficiency under a tight budget, the City's tree maintenance services were transitioned to a competitive bidding process, which resulted in reduced operational costs. More workers were hired. According to the City, the increase in manpower allowed the Bureau of Forestry to prune 20,000 additional street trees annually [27].

Any savings achieved through efficiency were combined with the \$2.3 million emergency funding approved by City Council in 2013-2014 to combat the emerald ash borer. Additional staff was hired as well as chemical supplies to inoculate the city's thousands of ash trees. Any ash tree that was less

than 40% infested with EAB was inoculated. Furthermore, additional workers were required to remove the trees that died due to the EAB. Public safety was at stake, and dead tree removal was deemed essential [6].

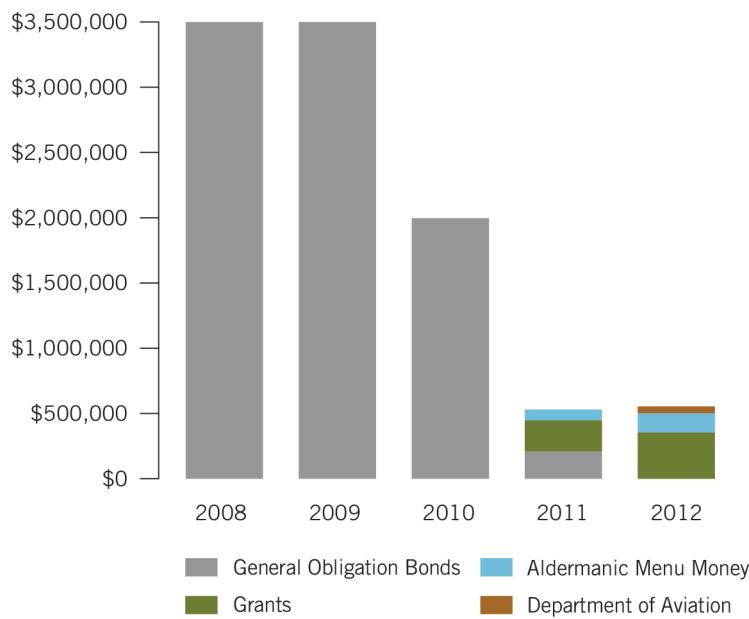


Figure 8: Funding Sources for the Bureau of Forestry's Planting Budget, 2008-2012 [28]

Between 2001 and 2012 the Bureau of Forestry planted 2,500 trees from funding from aldermanic menu funds. However, in 2013 trees were removed from the list of "critical infrastructure" projects that could be funded with aldermanic menu funds. As of 2013 menu funds could not be used to plant trees [28].

Although the Bureau of Forestry has had annual budget cuts since 2008, the department continues to generate revenue. The Bureau of Forestry is responsible for charging a developer or homeowner for a tree's lost value if an existing parkway tree is damaged or removed during construction. The "cost-recovery" money totals \$100,000 to \$300,000 annually. Currently, this money goes to the City's general fund.

Department of Transportation

In addition to the Bureau of Forestry, the Department of Transportation (CDOT) plants street trees through special grants and street improvement and development projects. With significant development occurring in the last 20 years, CDOT and its GreenStreets Program have planted slightly more trees than the Bureau of Forestry. On average, the Bureau of Forestry has planted 6,029 trees annually while CDOT has planted an average of 6,179 through grants and public improvement projects [5].

Chicago Park District

The Chicago Park District operates as a separate unit of government and is funded by property taxes. Plantings and maintenance are generally not subject to shifting budgets. Over the past five years, the Park District has kept a relatively stable tree planting budget of \$2 million annually. These funds are supplemented with additional revenue derived from Green Deed Tree Dedication Program through which people pay to plant a tree in a park. The cost of planting a tree through Green Deed is between \$600 and \$800, which includes a two-year guarantee from the tree nursery [19].

Policy and Tree Ordinances

While the City of Chicago does not have a comprehensive ordinance that solely regulates forestry maintenance and management, it does have a series of overlapping codes and guidelines that protect trees in the public way and leverage private development to plant additional trees on the parkways.

Chicago Municipal Code

Chicago's Municipal Code Title 10 Chapter 32 establishes regulations to protect trees, plants and shrubs in the public way. Trees on the public way are City property and are protected from harm. Violations can result in fines ranging from \$10 to \$500 or imprisonment. The Bureau of Forestry is responsible for determining the costs of tree repair or replacement. In addition, the code establishes basic requirements for tree pit dimensions and protective elements [29].

The Bureau of Forestry released Standard Tree Protection Guidelines to protect public trees from damage by private entities during construction. The guidelines require contractors to "protect all trees and shrubs at the construction site from damage." Trees may be removed from construction sites provided reasonable evidence is shown that efforts were made to save as many trees as possible. In the event that removal is requested, trees may only be taken down after Tree Removal Permits are issued by the Bureau of Forestry. Work involving trees on both public and private property requires a permit. For trees removed or damaged on parkways, replacement trees or the monetary value of damages must be paid to the City [30].

Chicago Landscape Ordinance

The Chicago Landscape Ordinance was adopted in 1991 and includes regulations and guidelines under Title 10 and Title 7 of the Chicago Municipal Code. Co-administered by the Chicago Department of Zoning and Bureau of Forestry, its provisions require property owners to install landscaping as part of new development and redevelopment projects. Since its approval the Chicago Landscape Ordinance has had a positive impact on the number of trees planted in Chicago and the quality of their maintenance [31].

Under the ordinance, large-scale developments and rehabilitations are required to plant trees on the parkway where possible and provide maintenance for the first five years after transplant. The construction or expansion of parking lots over four spaces also require that trees be planted. For any developments falling within these criteria, property owners are obligated to plant one shade tree

greater than two-inches in caliper along the parkway every 25 feet. The ordinance was last updated in 2000 [31].

To explain the Chicago Landscape Ordinance to homeowners and developers, the City produced *The Guide to the Chicago Landscape Ordinance* which provides specific guidelines and diagrams for tree planting in the parkways. The *Guide to the Chicago Landscape Ordinance* is a more useful and comprehensive guide to landscaping requirements than the written municipal code. The document includes requirements for soil, roots and other various growing conditions [32].

Sustainable Infrastructure

In 2013 the Chicago Department of Transportation released the *Sustainable Design Guidelines*. The goal of these guidelines is to more effectively include and promote best practices in sustainable design for street infrastructure. The document encourages the growth of programs that support residential tree plantings, increase education surrounding storm water management, and implement policy changes relating to energy, climate, materials and urban ecology. Specifically addressing urban canopy growth, the *Sustainable Design Guidelines* suggest implementing a tree replacement ratio greater than 1:1 in order to achieve the tree count and requirements specified in the Chicago Landscape Ordinance [33].

Planning

The City does not have an inter-agency master forestry plan. However, there is much inter-agency coordination and cooperation between governmental agencies. The Chicago Park District is currently developing a Forestry Management Plan, but its scope is limited to park properties. The Chicago Department of Transportation has developed Sustainable Design Guidelines which include guidelines for planting parkway trees. This document, however, is not a forest management plan, as it focuses on individual trees rather than the broader system.

In 2010 Openlands released *Chicago Urban Forestry: An Assessment*. The report identifies forestry challenges and opportunities and provides recommendations for improving the Chicago's urban forest [34]. In 2010 the Morton Arboretum and Chicago Metropolitan Agency for Planning also released *The Role of Our Urban Forest in the Chicago Metropolitan Region's Future*, a regional plan with strategies for gaining regional leadership in forestry [35].

Recommendations

1. Allocate City Funding for the Bureau of Forestry to Plant Trees

At a minimum, the City should allocate \$2 million annually in the Bureau of Forestry's budget to plant trees. An increase in funding for tree plantings would mitigate the loss of trees with the greater goal of expanding canopy coverage. Without a tree planting budget, the Bureau of Forestry is unable to replace trees lost to the emerald ash borer, disease, storms and old age. A significant loss of trees along a residential street has the potential to reduce property values, dramatically alter street character and cause environmental damage. Consistency of funding is essential.

2. Treat Trees as Critical Infrastructure

The City should develop and adopt policy that reinforces the fact that trees are a critical part of Chicago's urban infrastructure. Recognizing the significant economic and environmental benefits of trees, the City should permit the use of aldermanic menu money to plant trees in their wards.

3. Create a Shared-Cost Program for Parkway Tree Plantings

The City should establish a cost-share program for planting trees on parkways. Property owners should be allowed to contribute 50% of the cost to plant a street tree in front of their home or business. The program would work like the cost-share sidewalk replacement program that allows property owners to pay 50% for their sidewalk replacement. The cost-share program would function as a partnership between the Bureau of Forestry and program constituents. Similar tree programs have proved successful in cities across the country.

4. Require City Departments to Preserve and Replace Trees

All City departments should take every care to preserve trees in the public way. While undertaking construction projects, sites and site plans should be assessed to ensure that large and valuable trees are protected during construction projects. City departments that damage or kill trees should be required to pay the full replacement cost of all lost trees.

5. Retain Revenue in the Bureau of Forestry's Operating Budget

The City should allow the Bureau of Forestry to retain revenue generated by the agency in its operating budget. The Bureau of Forestry generates \$100,000 to \$300,000 annually from fees associated with tree removals and damages by private entities. This revenue should be directed to fund additional tree plantings by the Bureau of Forestry. Currently, the money is diverted back to the City's general fund.

6. Provide Resources for Residents and Volunteers

The City should continue to educate its residents on the value and benefits trees provide Chicago communities. Using web-based tools, the Bureau of Forestry should provide the public with educational documents relating to urban tree care and identification. In addition to implementing educational workshops in schools, churches and community centers, the City should work to expand workforce training in the forestry sector.

7. Expand GIS System for Forestry Management

The City should expand its use of Geographic Information Systems (GIS) as a way to more effectively study and manage its tree population. A survey of all public trees would help Chicago's forestry agencies better understand and plan for the city's urban canopy. The 311 system is already used by both the Bureau of Forestry and Department of Transportation. A comprehensive and publicly-available database would increase oversight of species type, disease and infestation. Accurately locating and identifying the tree population would benefit efforts to increase diversification and oversee population fluctuations.

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