



City of Claremont Municipal Forest Assessment

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The City of Claremont is a vibrant college town with a proud history of caring for its trees. From the grove of American elms (*Ulmus americana*) on Indian Hill Boulevard to annual community tree planting events, its trees provide a myriad of benefits. They shade buildings, clean the air, reduce stormwater runoff, increase property values, harbor wildlife and improve human health and well-being. According to its 2011 tree inventory, Claremont maintains 19,980 street trees consisting of 245 species. Assuming the city has a population of 34,926 and 128 linear street miles, there are about 156 trees per mile of street and 0.57 trees per capita. Claremont stands out as having a relatively large number of street trees with approximately 74% of all sites planted, assuming there are two potential sites every 50-feet of street to allow adequate space between trees on both sides of the street (McPherson and Rowntree 1989).

The most abundant species are Crape myrtle (*Lagerstromia indica*) 9.6%, American sweetgum (*Liquidambar styraciflua*) 9.1%, California sycamore (*Platanus racemosa*) 4.7%, coast live oak (*Quercus agrifolia*) 4.7%, holly oak (*Quercus ilex*) at 4.4%, jacaranda (*Jacaranda mimosifolia*) 4.4%, and Canary Island pine (*Pinus canariensis*) 4.2%. These are followed by Chinese pistache (*Pistacia chinensis*) 4%, Modesto ash (*Fraxinus velutina*) 2.6%, and olive (*Olea europaea*) 2.2%.

The “ideal” urban forest is not dominated by a few species. Rather, tree numbers are distributed fairly evenly among dozens of species adapted to local growing conditions. Species diversity protects a community’s tree canopy cover by limiting the amount of damage from any one threat such as pests, drought or storms (McPherson and Kotow 2013). Size matters as well and over-reliance on a few species made up of large, old trees increases the risk of losing substantial canopy cover and associated benefits, such as carbon storage and energy savings. Not relying on too few species increases stability of the urban forest. One way that this can be measured is through the importance value (IV) which incorporates the number, leaf area, and canopy cover of each tree species within a city. (Figure 1).

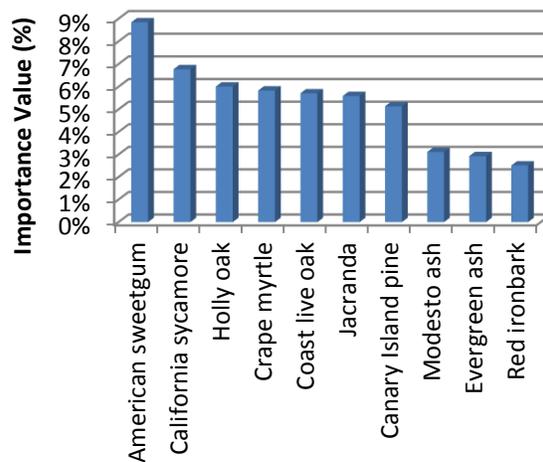


Figure 1. Top ten species based on importance value (IV).



No one species should account for more than 10% of the total IV. Fortunately, all of Claremont’s top tree species are below 9% IV. Note that not all of the most abundant species are listed among the most important (Table 1).

Table 1. Benefits of top ten species by importance value (IV).

Species	Number	% of Total IV	Total Benefits (\$)	Avg. \$/tree
American sweetgum	1,819	8.8%	\$155,997	\$85.76
California sycamore	941	6.8%	\$364,355	\$387.20
Holly oak	876	6.0%	\$232,140	\$265.00
Crape myrtle	1,922	5.8%	\$128,870	\$67.05
Coast live oak	886	5.7%	\$49,448	\$55.81
Jacaranda	876	5.6%	\$190,250	\$217.18
Canary Island pine	844	5.1%	\$260,171	\$308.26
Modesto ash	284	3.1%	\$93,862	\$330.50
Evergreen ash	284	2.9%	\$104,782	\$368.95
Red ironbark	411	2.5%	\$52,476	\$127.68

Because young trees are most vulnerable, the “ideal” urban forest contains a surplus of juveniles that constantly replace dying trees. Although large, old trees produce more benefits than young trees, they are also more susceptible to threats from drought and pests and are expensive to remove and replace. As a result, the “ideal” urban forest has relatively few old or senescent trees and more semi-mature and mature trees. The majority of street trees in Claremont are young (26%) and maturing (28%) (Figure 2).

The largest benefit is attributed to increased property values and aesthetic enjoyment at over \$2.8 million (Figure 3).

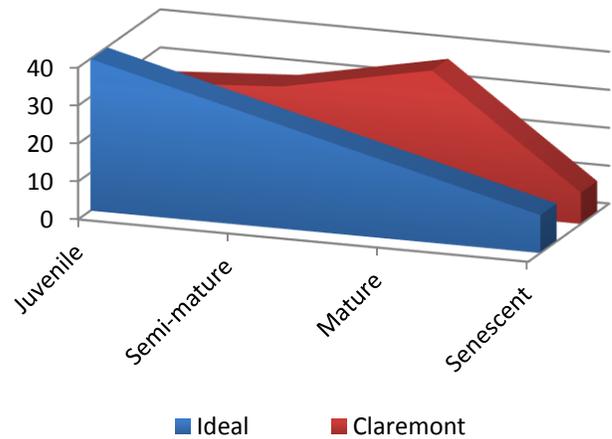


Figure 2. Age structure of Claremont’s and the “ideal” street tree population.

Just over one third (37%) of the population is considered mature. As trees age they require more maintenance and, as much as they are an asset to the city, they may also prove to be a liability. The percentage of the population labeled senescent (dbh 24+”) is 8.3%, slightly less than 10% for the “ideal” age structure.

The street trees in Claremont provide just over \$3 million annually in ecosystem services, averaging \$87 per capita and \$152 per tree (Table 2).

Table 2. Value of annual benefits of Claremont’s street trees.

Category	Total (\$)	\$/capita	\$/tree
Energy	\$245,398	\$7.03	\$12.28
Carbon Dioxide	\$26,482	\$0.76	\$1.33
Air Quality	-\$197,984	-\$5.67	-\$9.91
Stormwater	\$157,006	\$4.50	\$7.86
Aesthetics	\$2,824,835	\$80.88	\$141.38
Grand Total	\$3,055,737	\$87.49	\$152.94

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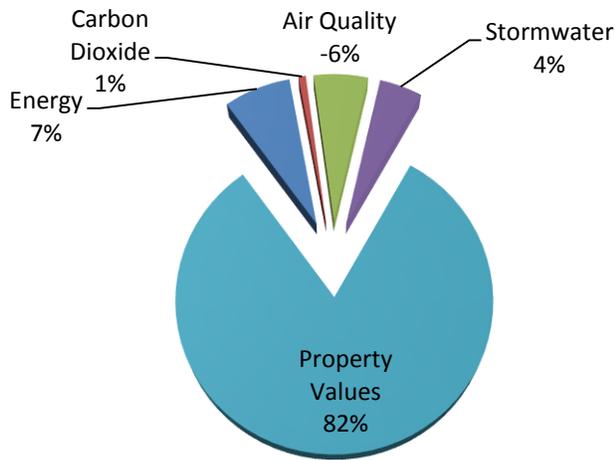


Figure 3. Distribution of annual benefits from Claremont's street trees.

Roughly 7% or \$245,397 of total benefits are energy savings from shading and air temperature reduction effects on nearby buildings. Street trees intercept 21 million gallons of rainfall, reducing stormwater management costs by about \$157,000 every year. Just over 15,000 metric tonnes of CO₂ are stored annually by Claremont's street trees, giving annual returns of \$26,482. Some tree species effectively reduce air pollution while others emit biogenic volatile organic compounds (BVOC) that can contribute to ozone formation. Ozone can pose a serious health hazard when concentrations are high. The street trees cost the city \$197,984 per year in air quality costs attributable to BVOC release. American sweetgum, holly oak, coast live oak, red ironbark, and California sycamore are high BVOC emitters and are contributing a large part to this yearly cost.

Claremont's municipal forest will provide a stream of future benefits over time, similar to other capital investments such as roads and utilities. To calculate the asset value of Claremont's street trees these future benefits were discounted to their present value using discount rates of 4.125% and 0% for the next 100 years. Discounting future services to their present value incorporates the time value of money. The farther ahead in time one goes, the

less value a dollar has. A benefit derived in 50 years is worth far less than the same benefit today. By applying this method to the future stream of benefits, the street tree population's asset value is calculated in today's dollars. The present value of future services with a 0% discount rate is over \$309 million; with a discount rate of 4.125% that value becomes slightly over \$109 million.

The benefits of urban trees are largely based on their size; therefore the greatest benefits come from large, older trees. Over one-half of the street trees are large-stature species, 20% are medium-, and 25% are small-stature. Evergreen trees, when placed around a building so that they do not block winter sunshine, can be more effective than deciduous trees at capturing rainfall and cleaning pollutants from the air. Claremont's street tree canopy is made up of 42% evergreen and 58% deciduous trees.

Inventories from 13 cities in the Inland Empire were processed in i-Tree Streets, a Forest Service computer tool for planning and management (<https://www.itreetools.org/>). Compared to the average city for this Inland Empire climate zone, Claremont has 786 more street trees and 59 more trees per street mile (Table 3).

Table 3. Comparison of Claremont's street tree attributes to the mean for 13 Inland Empire cities.

Category	Claremont	Inland Empire Mean	% Difference
# trees	19,980	19,194	4.1%
Trees/capita	0.57	0.30	90.1%
Trees/mile	156	97	60.4%
Total Benefits (\$/yr.)	\$3,055,737	\$2,167,148	41.0%
\$/capita/yr.	\$87.49	\$41.80	109.3%
\$/tree/yr.	\$152.94	\$124.22	23.1%
Asset value(0%)/capita	\$8,875	\$4,385	102.4%
Asset value (0%)/tree	\$15,514	\$15,723	-1.3%

Claremont's trees are working hard, providing over twice the annual dollar benefit per capita (\$87) than the average for all cities (\$42).

The City of Claremont has several strategies it can employ to improve the health and structure of its municipal forest. It can continue to plant trees, emphasizing diversity of species well-adapted to future threats from pests, drought and storms. By planting species that are low BVOC emitters Claremont will mitigate the air quality effects caused by several of its key species. As these trees age and are removed, they will be replaced by trees that help clean the air. The city can focus on preserving the health of its maturing tree population with formative and routine pruning. With wise planting choices and proper care, Claremont's municipal forest will provide benefits for generations to come.

Bibliography

McPherson, E. G., and L. Kotow. "A municipal forest report card: Results for California, USA." *Urban Forestry & Urban Greening* 12(2), 2013: 134-143.

McPherson, E. G., and R. A. Rowntree. "Using structural measures to compare twenty-two U.S. street tree populations." *Landscape Journal* 8, 1989: 13-23.

USDA Forest Service, P.S.R.S., Center for Urban Research. *i-Tree Streets*. 2009. <https://www.itreetools.org/> (accessed April 22, 2014).

McPherson, E. G., van Doorn, N., and de Goede, J. In review. Structure, function and value of street trees in California, USA. *Journal of Arboriculture & Urban Forestry*.

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