TEXAS TREES FOUNDATION

CREATING HEALTHY COMMUNITIES

# The Dallas GIS
# ROADMAP MODEL
# For Urban Tree Planning & Planting:

## The Potential Urban Forest of Dallas, Texas

August 2010

The Texas Trees Foundation, using the City of Dallas for the urban pilot study, has developed a revolutionary **Urban Tree Canopy Model** that identifies and prioritizes urban tree planting sites.

This innovative model can maximize the
environmental and social impacts that urban canopies provide.

This award-winning model serves as a **Roadmap**
to guide Dallas towards informed urban planning.

**Awards:**
2009 City of Dallas Mayor's Environmental Excellence Award
2010 Trinity Blacklands Urban Forestry Council Outstanding Project Award

*This project was largely funded by Oncor*
*& the original report prepared by AMEC Earth & Environmental*

City of Dallas

## Introduction

The GIS **Roadmap** Model for Urban Tree Planning & Planting is the first project in which tree planting sites were identified and then prioritized by their environmental and economic factors. Strategic planting projects can have an enormous long-term impact on your city if urban planning is based on these strategies. Results from this project provides a framework for urban tree planting and will impact how funding is secured from policy makers, corporations, and foundations.

## What is the Roadmap?

*To the non-technical user:* The **Roadmap** is the best tool to rank and select urban tree planting sites based on their environmental and economic benefits.
*To the technical GIS user:* The **Roadmap** is a robust GIS database, containing all locations of required planting sites and related criteria allowing for multiple queries, numerous detailed evaluations, and prioritization of planting locations for very specific economic purposes.

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## The Dallas Roadmap – Results at a Glance:

Urban Tree Canopy (UTC): **30% of land area** - *excluding water citywide and ranging from 16-39% within City Council districts*

Number of Planting Sites by **Roadmap** Criteria:

| | |
|---|---|
| ▪ Maximum Energy Savings Potential: | 332,194 |
| ▪ Single Family Residential (SFR) Property: | 458,850 |
| ▪ Public rights-of-way (PROW): | 480,790 |
| ▪ On Commercial Property: | 301,648 |
| ▪ On School Property: | 53,019 |
| ▪ In or Adjacent to Parking Lots: | 84,577 |
| ▪ Lowest income range (<$20K); | 214,809 |
| ▪ Highest urban heat island range (>140F): | 19,097 |
| Total Potential Planting Sites: | **1,855,310*** |

**Planting sites falling in multiple criteria categories were only accounted for in one category*

Dollar Value Benefits: **$138,000,000 in benefits** for the citizens of Dallas

If *only* 50% of public and private planting sites reached 40 years of age, they would provide approximately **$102,000,000 in annual benefits** from:

| | | |
|---|---|---|
| **Energy Savings** | **Air Pollution Removal** | **Aesthetic Value** |
| **Carbon Storage** | **Stormwater Mitigation** | **Social Benefits** |

If all energy efficiency planting sites on private property (285,500) were planted and reached 40 years of age, their annual energy benefit would be an **additional $36,400,000**.

# I. Importance of The Roadmap Model

Trees create livable communities, and as part of our community's infrastructure, they provide many benefits when properly placed and planted. The impact that trees make in our community is tremendous, and although we can quantify the environmental impacts, as we have done in this report, we cannot always quantify the social and psychological advantages that they provide- but research indicates they are significant.

The GIS **Roadmap** Model for Urban Tree Planning & Planting is a new GIS model to strategically plan for the planting of trees to maximize the benefits they provide.

Dr. Jay Cravens, University of Wisconsin, states that "it's only by understanding how a plant functions as a living, breathing and working organism, that we as land managers can begin to make proper decisions regarding the protection and care of our tree resources"[for our cities].

The GIS **Roadmap** Model for Urban Tree Planning & Planting for the City of Dallas is the first project in which potential tree planting sites have been mapped and then prioritized by their environmental and economic factors, with current urban infrastructures such as roads and utilities. Urban tree planting projects can be limited in success without the vision and information needed to plan and plant strategically and responsibly. Results from this project provide a strong framework for urban tree planting and impact how funding is secured and supported by policy makers, corporations, foundations, and citizens. It also insures that the resources are devoted to the long-term success of the urban forest.

Results from this project will help guide the City of Dallas' urban tree planting decisions well into the future. The **Roadmap** will allow the City to get away from "tree plopping" and guide our city to begin to plant the urban canopy with intent and purpose to maximize the economic benefits that they provide. The sooner we all utilize trees as our green civil servants, the more indelible our legacy will be for the future and the return on investment will be staggering.

The Dallas **Roadmap** has identified more then 1.8 million tree planting sites. It is our hope that through the creation of this tool we can begin to "green Dallas," utilizing a strategic process that reflects consideration to clean the air and water and lower energy costs by planting canopy trees to shade buildings and homes. Through the **Roadmap**, the City of Dallas is the first city in the nation to know exactly where to plant trees specific to tree size at maturity, and to be able to reap the benefits and quantify the value of these benefits into the future for the taxpayers.

How we create our community is how we define our legacy—trees and people need each other to have a truly livable and affordable community.

Janette K. Monear
Executive Director
Texas Trees Foundation

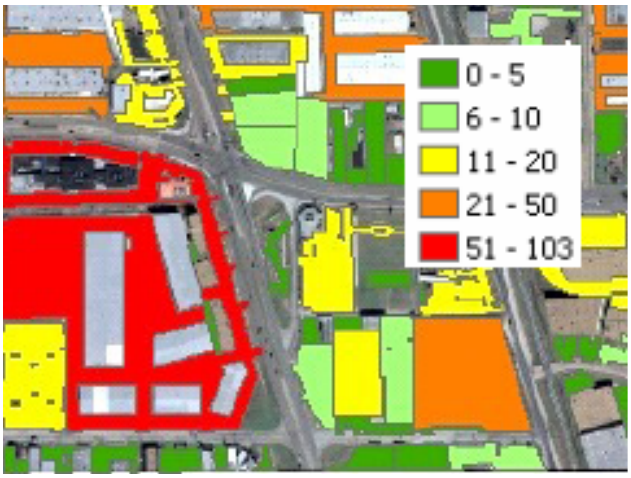
## II. Why the Roadmap?

**Properly selecting and planting trees will impact Dallas' goals, leadership, program requirements, and policy initiatives, and will guide future urban economic success and environmental health. For example:**

The **Roadmap Identifies:**
Planting sites near building structures and transportation corridors.

Which provides shade and energy savings for **Climate & Energy Efficiency**

The **Roadmap Quantifies:**
The number of trees needed to reach 15% canopy cover per parking lot.




Which reduces runoff and improves water quality for **Improved Water Resource Management**

## III. The Proven Benefits of Urban Trees

Urban trees are major capital assets to the City of Dallas. Just as streets, sidewalks, public buildings, and recreational facilities are a part of the city's infrastructure, so are the trees. The overall urban forest composes the green infrastructure of the city and is a major asset that requires sophisticated planning, care, and maintenance just as with other public properties. Trees are on the job 24 hours a day working for the local city to improve the environment, quality of life, and to add economic benefits to the taxpayer.

Dallas' urban forest provides immeasurable environmental benefits to the community. Aside from the crucial aesthetic benefits, trees within our urban forest:

- **Improve our air quality**
- **Protect our water resources**
- **Reduce our energy consumption**
- **Improve our economic sustainability**

The following are some statistics and statements on just how important trees are in our community setting from the **National Arbor Day Foundation**:
*www.arborday.org/trees/benefits.cfm*

- *U.S. Department of Agriculture*: "The net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day."

- *American Public Power Association*: "Landscaping can reduce air conditioning costs by up to 50 percent, by shading the windows and walls of a home."

- *Dr. E. Greg McPherson, Center for Urban Forest Research*: "If you plant a tree today on the west side of your home, in 5 years your energy bills should be 3% less. In 15 years the savings will be nearly 12%."

- *Council of Tree and Landscape Appraisers*: "A mature tree can often have an appraised value of between $1,000 and $10,000."

- *Arbor National Mortgage & American Forests*: "In one study, 83% of realtors believe that mature trees have a "strong or moderate impact" on the salability of homes listed for under $150,000; on homes over 250,000, this perception increases to 98%."

- *Management Information Services/ICMA*: "Landscaping, especially with trees, can increase property values as much as 20 percent."

- *U.S. Department of Agriculture*: "One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people."

- *USDA Forest Service:* "Healthy, mature trees add an average of 10 percent to a property's value."

- *National Wildlife Federation*: "There are about 60to 200 million spaces along our city streets where trees could be planted. This translates to the potential to absorb 33 million more tons of CO2 every year, and saving $4 billion in energy costs."

- *USDA Forest Service*: "Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20-50 percent in energy used for heating."

- *The Arbor Day Foundation:* "Trees can be a stimulus to economic development, attracting new business and tourism. Commercial retail areas are more attractive to shoppers, apartments rent more quickly, tenants stay longer, and space in a wooded setting is more valuable to sell or rent."

- *USDA Forest Service:* "The planting of trees means improved water quality, resulting in less runoff and erosion. This allows more recharging of the ground water supply. Wooded areas help prevent the transport of sediment and chemicals into streams."

- *Dr. Roger S. Ulrich Texas A&M University:* "In laboratory research, visual exposure to settings with trees has produced significant recovery from stress within five minutes, as indicated by changes in blood pressure and muscle tension."

- *Management Information Services*: "Nationally, the 60 million street trees have an average value of $525 per tree." This is a $31,500,000,000 value!

## IV. Land Cover Mapping and Urban Tree Canopy (UTC) Assessment

The Urban **Roadmap** project began by mapping existing tree canopy, impervious surfaces, grass/meadow, bare soil, and water using high resolution multispectral imagery. These land cover classes were mapped 4-band (blue, green, red and near-infrared) leaf-on imagery from the National Agricultural Imagery Program (NAIP) collected in summer 2008. GIS layers from the North Central Texas Council of Governments (NCTCOG) were incorporated to increase the accuracy of the land cover data. This included parking lots, transportation polygons, building footprints, medians, islands, and hydrology layers. *See Figure 1*.

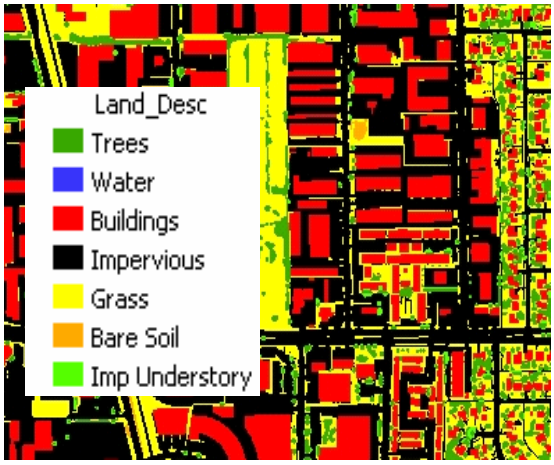



*Figure 1*. Dallas Land Cover Classes

The area and percent of existing Urban Tree Canopy (UTC) was calculated for the varying geographic boundaries: individual parcels, census block groups, city council districts, and the entire city. These GIS boundaries were then queried or symbolized based on either the area or percent of Urban Tree Cover, as seen in *Figures 2-4* below.

*Figure 2*. Tree Canopy Cover

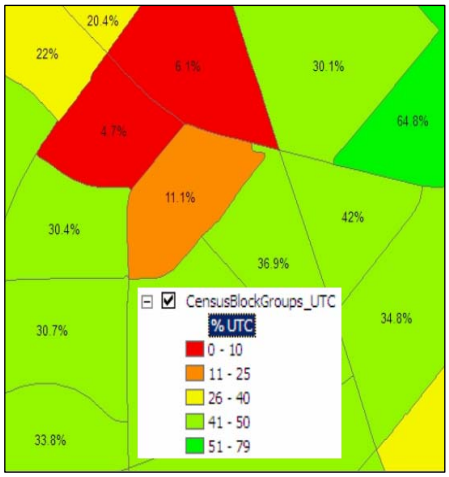



*Figure 3*. UTC by Census Block

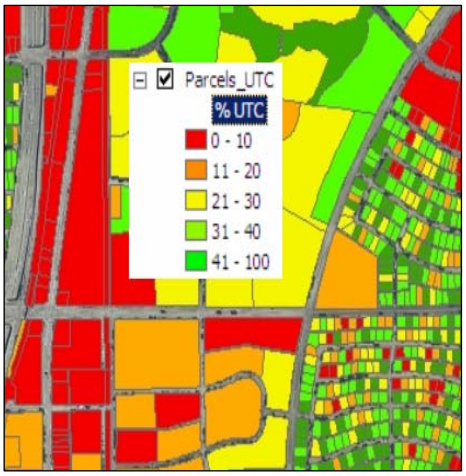



*Figure 4*. UTC by Parcel

The information collected identifies and prioritizes those areas of the Dallas with lower tree canopy *(Tables 1-2 below)* and sets city-wide tree planting criteria and goals.

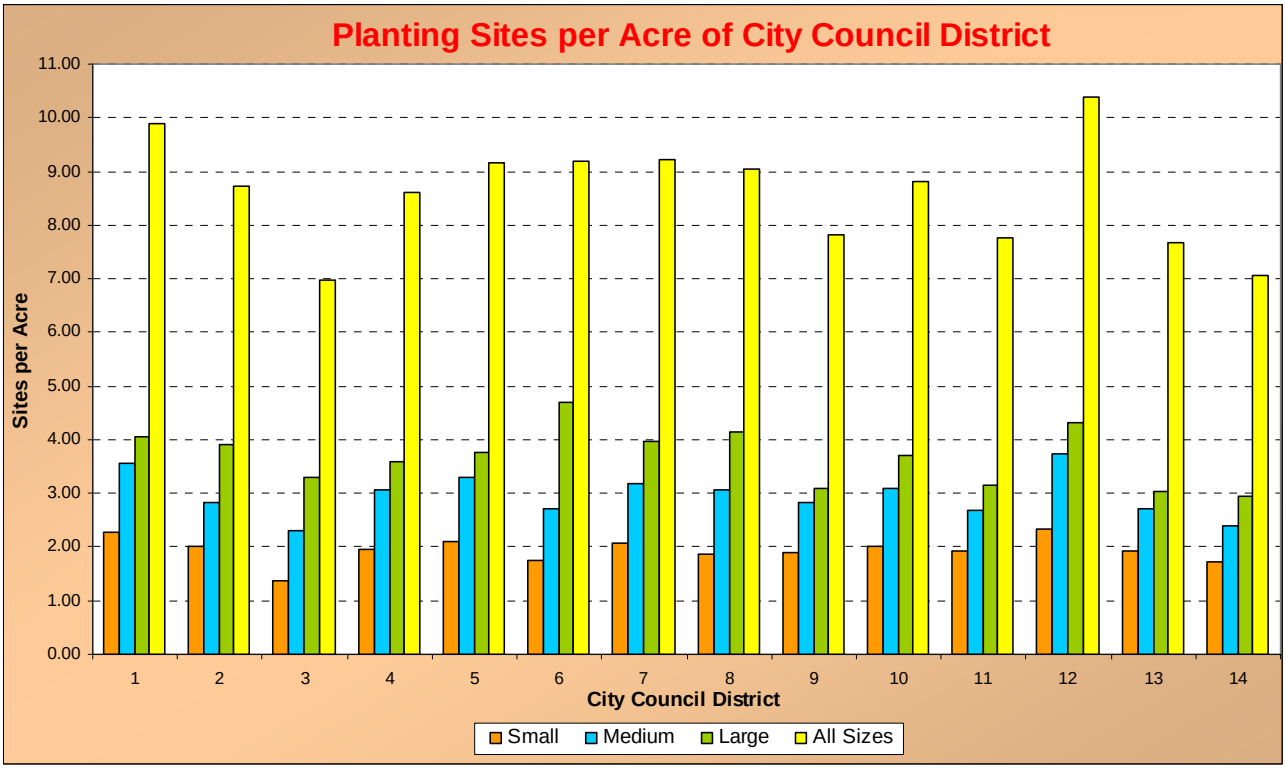



*Table 1.* Planting Sites Per Acre of City Council Districts

| Planting Sites | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City Council | Small | | | Medium | | | Large | | | All Sizes | | |
| | Energy | Non-Energy | Total | Energy | Non-Energy | Total | Energy | Non-Energy | Total | Energy | Non-Energy | Total |
| 1 | 3,411 | 11,330 | 14,741 | 5,836 | 17,209 | 23,045 | 5,422 | 20,834 | 26,256 | 14,669 | 49,373 | 64,042 |
| 2 | 6,170 | 15,594 | 21,764 | 8,946 | 21,829 | 30,775 | 8,602 | 33,887 | 42,489 | 23,718 | 71,310 | 95,028 |
| 3 | 6,712 | 38,724 | 45,436 | 10,924 | 64,461 | 75,385 | 9,585 | 98,433 | 108,018 | 27,221 | 201,618 | 228,839 |
| 4 | 6,102 | 21,570 | 27,672 | 10,276 | 32,748 | 43,024 | 8,250 | 42,130 | 50,380 | 24,628 | 96,448 | 121,076 |
| 5 | 6,052 | 28,813 | 34,865 | 10,391 | 44,583 | 54,974 | 8,534 | 54,492 | 63,026 | 24,977 | 127,888 | 152,865 |
| 6 | 5,040 | 28,962 | 34,002 | 7,176 | 45,326 | 52,502 | 6,437 | 84,368 | 90,805 | 18,653 | 158,656 | 177,309 |
| 7 | 7,535 | 23,142 | 30,677 | 12,033 | 35,097 | 47,130 | 10,016 | 48,917 | 58,933 | 29,584 | 107,156 | 136,740 |
| 8 | 8,497 | 58,503 | 67,000 | 14,014 | 96,722 | 110,736 | 10,410 | 138,940 | 149,350 | 32,921 | 294,165 | 327,086 |
| 9 | 6,814 | 18,154 | 24,968 | 10,490 | 26,830 | 37,320 | 9,763 | 31,237 | 41,000 | 27,067 | 76,221 | 103,288 |
| 10 | 4,862 | 14,394 | 19,256 | 7,557 | 21,885 | 29,442 | 7,558 | 27,904 | 35,462 | 19,977 | 64,183 | 84,160 |
| 11 | 3,903 | 14,400 | 18,303 | 5,888 | 19,661 | 25,549 | 5,932 | 23,921 | 29,853 | 15,723 | 57,982 | 73,705 |
| 12 | 6,734 | 17,778 | 24,512 | 11,052 | 27,910 | 38,962 | 9,844 | 35,301 | 45,145 | 27,630 | 80,989 | 108,619 |
| 13 | 5,347 | 21,832 | 27,179 | 8,441 | 30,183 | 38,624 | 8,281 | 34,774 | 43,055 | 22,069 | 86,789 | 108,858 |
| 14 | 5,786 | 12,124 | 17,910 | 8,393 | 16,679 | 25,072 | 9,178 | 21,535 | 30,713 | 23,357 | 50,338 | 73,695 |
| TOTAL | 82,965 | 325,320 | 408,285 | 131,417 | 501,123 | 632,540 | 117,812 | 696,673 | 814,485 | 332,194 | 1,523,116 | 1,855,310 |

*Table 2*. Number of Small, Medium and Large Potential Planting Sites by City Council District.

City Council Districts are assessed for their Existing Urban Tree Cover, which in this study was an average of **nearly 30%**, ranging from 16% (Districts 2, 6, and 12) to 39% (District 4). (*See Figures 10 & 11 in the Appendix)*

## V. Planting Canopy Site Analysis

Once land cover classes are mapped and existing urban tree canopies established, these layers of green vs. gray infrastructure become inputs into the model to locate realistic tree planting sites represented as GIS points for small, medium, and large sized trees. Using the canopy guidelines set forth by the USDA Forest Service Center for Urban Forest Research and UC-Davis for a project in Los Angeles, CA, the following modeling assumptions and parameters were used producing **1,855,310 potential planting locations** in the City of Dallas:

- **Set small, medium, and large tree sizes at 15, 30, and 50 ft mature crown diameters respectively**
- **Buffer existing trees by 10 ft to allow for canopy growth**
- **Buffer of sidewalks by 2 ft and buildings by 4 ft to avoid conflicts with gray infrastructure**
- **Remove athletic fields provided by City of Dallas (partial dataset)**
- **Remove plantable space at airports and golf courses**
- **Set 50 ft spacing between trees of all size classes, and 75 ft spacing in larger open space areas, (***very generous spacing criteria)***.**

Overhead electric power line data was provided by Oncor.

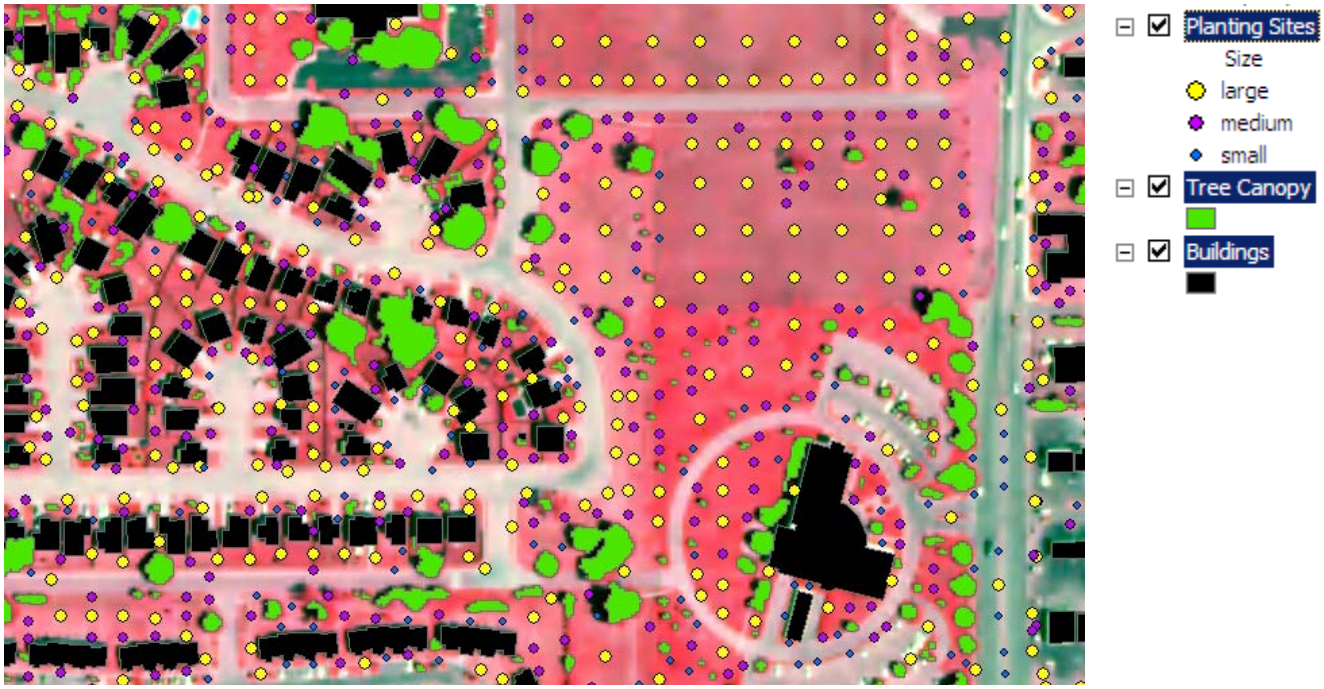



*Figure 5*. GIS-based planting sites, tree canopy, & buildings on color-infrared NAIP image.

## VI. Prioritization – The Urban Roadmap Canopy Model

More than 20 GIS layers were included (*See Figure 6)* in the series of models to assign (attribute) the planting canopy sites with geographic, environmental, and watershed criteria (*Figure 7)* such as:

- parcel information
- urban heat islands
- land use type
- existing tree cover
- watershed priority
- riparian values
- soil permeability
- overhead power lines
- public health & income data
- transportation
- stormwater runoff
- proximity & orientation to buildings


*Figure 6.* GIS layers used in a model

**Geographic Criteria;**
Address, PIN, Housing Age, Council District, Neighborhood, & Land Use

**Environmental Criteria;**
Tree cover %, heat Islands, & basic soil type

**Watershed / Other Criteria;**
Near trail, riparian or major street, in flood zone, & name of watershed

Attributes of Planting Sites

| St_Address | Parcel_I | House | CtyCouncil | Neighborhd | Lnduse_cat | Blkgrp_ | Temp | Soil | Trail_Name | Riparian | MjrArter | Floodz | Watershed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 171954 | | 10 | Lake Highlands | Other | 36.7 | 127 | B | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 8515 GREENVILLE | 172188 | | 10 | Lake Highlands | Commercial | 27.9 | 127 | B | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| | 171954 | | 10 | Lake Highlands | Other | 36.7 | 127 | B | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 8711 ALLENBROO | 172094 | 1997 | 10 | Lake Highlands | SFR | 27.9 | 127 | C | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 8715 ALLENBROO | 172095 | 1995 | 10 | Lake Highlands | SFR | 27.9 | 127 | C | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| | 171954 | | 10 | Lake Highlands | Other | 36.7 | 133 | C | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 7320 GREENVILLE | 217051 | | 13 | Lake Highlands | Commercial | 18.4 | 124 | C | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 7320 GREENVILLE | 217051 | | 13 | Lake Highlands | Commercial | 18.4 | 124 | C | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 8200 WALNUT HILL | 216561 | | 13 | Lake Highlands | Commercial | 12.8 | 111 | C | | Jenkins Bran | GREENVILLE A | A | White Rock Creek-White Rock La |
| 8200 WALNUT HILL | 216561 | | 13 | Lake Highlands | Commercial | 12.8 | 122 | B | | Jenkins Bran | GREENVILLE A | A | White Rock Creek-White Rock La |
| 8230 WALNUT HILL | 216818 | | 13 | Lake Highlands | Commercial | 12.8 | 129 | B | | | GREENVILLE A | X | White Rock Creek-White Rock La |
| 7800 GREENVILLE | 215871 | | 10 | Lake Highlands | Vacant | 47.6 | 122 | B | | White Rock C | GREENVILLE A | A | White Rock Creek-White Rock La |
| 7900 GREENVILLE | 215913 | | 13 | Lake Highlands | Vacant | 39.6 | 122 | B | | | GREENVILLE A | A | White Rock Creek-White Rock La |
| 7900 GREENVILLE | 215913 | | 13 | Lake Highlands | Vacant | 39.6 | 122 | B | | White Rock C | GREENVILLE A | A | White Rock Creek-White Rock La |
| 8016 GREENVILLE | 215455 | | 10 | Lake Highlands | Vacant | 27.9 | 111 | B | WHITE ROCK CR | | GREENVILLE A | A | White Rock Creek-White Rock La |
| 8525 GARLAND RD | 279791 | | 9 | Northeast Dalla | Commercial | 22.3 | 111 | B | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 8525 GARLAND RD | 279791 | | 9 | Northeast Dalla | Commercial | 22.3 | 111 | B | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 8525 GARLAND RD | 279791 | | 9 | Northeast Dalla | Commercial | 22.3 | 111 | B | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 8626 GARLAND RD | 330752 | | 9 | Northeast Dalla | Commercial | 44.5 | 106 | C | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 8650 GARLAND RD | 330670 | | 9 | Northeast Dalla | Commercial | 44.5 | 106 | C | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 8810 GARLAND RD | 330539 | | 9 | Northeast Dalla | Commercial | 44.5 | 115 | C | | | GARLAND RD | X | City of Dallas-White Rock Creek |
| 9102 GARLAND RD | 330340 | | 9 | Northeast Dalla | Commercial | 42.8 | 131 | D | | | GARLAND RD | X | White Rock Creek-White Rock La |
| 9150 GARLAND RD | 330315 | | 9 | Northeast Dalla | Commercial | 42.8 | 127 | D | | | GARLAND RD | X | White Rock Creek-White Rock La |

*Figure 7.* GIS Attribute Table of Criteria Describing Each Planting Site

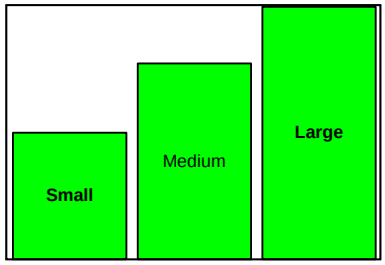
**This database forms the foundation for the Roadmap.**

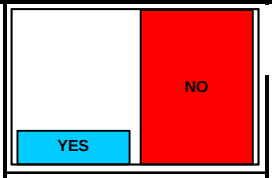
The **Roadmap** database will serve as the tool for urban forest managers, public planners, sustainability coordinators, utilities, companies, public works departments, parks departments, zoning criteria guidelines, development guidelines, non-profits, and other management entities.

Individual selections (queries) can be made to identify planting sites that meet certain conditions, or multiple queries can be entered to hone in on more specific opportunities. A query could identify the number of sites in a particular land use or search multiple fields to rank sites by an area's existing tree cover, proximity to a parking lot, and by neighborhood or city council district (*See figure 8 below)*.

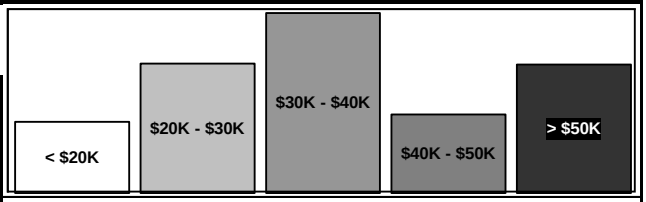
**Distribution of 1.85M Potential Planting Sites in the City of Dallas, TX, Grouped by Different Criteria**

| Size | | | Energy | | Income by Block Group | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Small | Medium | Large | YES | NO | < $20K | $20K - $30K | $30K - $40K | $40K - $50K | > $50K |
| 408,285 | 632,540 | 814,485 | 332,194 | 1,523,116 | 214,809 | 389,948 | 542,617 | 237,115 | 387,110 |



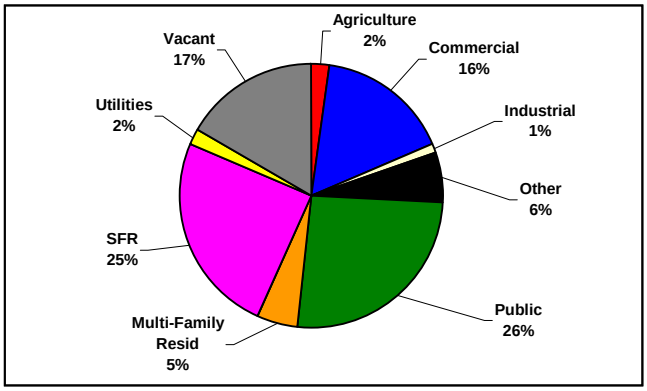




Energy is defined as being within 30 feet of the east or west side of buildings, indicating maximum energy savings potential

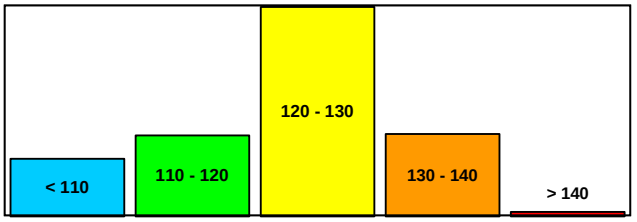



Mean income is $42,759
Note: Some block groups did not report income statistics and were reported as $0, so these were excluded from this criteria

| Major Land Use Category | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Agriculture | Commercial | Industrial | Other | Public | Multi-Family Resid | SFR | Utilities | Vacant |
| 43,495 | 301,648 | 22,248 | 110,846 | 480,790 | 91,748 | 458,850 | 38,978 | 306,707 |




| Heat Island Temperature Range | | | | |
|---|---|---|---|---|
| < 110 | 110 - 120 | 120 - 130 | 130 - 140 | > 140 |
| 245,127 | 345,704 | 893,686 | 351,696 | 19,097 |




| Within 100 Feet Of... | | Within 50 Feet Of... |
|---|---|---|
| Major Arterial Streets | Riparian | Trails in the City of Dallas |
| 217,404 | 55,439 | 40,293 |

*Figure 8*. Summary of Planting Sites by Different Attributes for Prioritization

A municipal urban forester may use the tool to find planting sites in public rights-of-ways in census blocks with lower canopy cover (F*igures 9 & 10*), while a utility director may assess the number of energy saving planting sites in low income areas. The long range impacts on your city and its future development and growth can and will be enormous.

## VII. Estimating Dollar Value Benefits

Every city should be capable of establishing the value of potential tree canopy planting locations. They should know how to quantify in dollars and resource units (RU), such as kilowatt hour (kWh), electricity savings from shade or gallons of stormwater mitigated by urban tree canopy and planter boxes. To quantify the potential urban forest in Dallas, this project leveraged years of data collection and research by the U.S. Forest Service (USFS) and others in order to estimate the annual dollar value benefit of potential canopy planting sites on public and private lands. Sources for economic values for small, medium, and large sized trees included the USFS's Community Tree Guide (Piedmont region), i-Tree STRATUM results, and an energy study by the Houston Advanced Research Center (HARC). These sources include "per tree benefits" in dollars and resource units for the following functional benefits: energy savings, carbon dioxide storage and sequestration, stormwater mitigation, air pollution removal, and aesthetic and social benefits.

The Texas Forest Service analyzed more than 3,000 field samples in Irving,TX and Turtle Creek Park in Dallas using the STRATUM model (recently being referred to as "Streets") and these values were used to estimate public (street and park) tree benefits throughout the City. Dozens of species and several size classes were included in the field samples. For this study, they were grouped by size class (small, medium, and large) and averaged to determine a per tree dollar value (*See Table 3 below).*

**Annual Benefits of Public Trees by Species ($/tree)**

1/7/2010

| Species | Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error |
|---|---|---|---|---|---|---|---|
| American elm | 10.64 | 3.35 | -5.30 | 32.57 | 57.34 | 98.60 | (N/A) |
| Sugarberry | 8.52 | 3.28 | 3.27 | 17.03 | 34.70 | 66.81 | (N/A) |
| Pecan | 11.84 | 3.62 | -7.47 | 40.25 | 59.10 | 107.34 | (N/A) |
| Eastern red cedar | 3.99 | 1.02 | 2.42 | 8.56 | 7.11 | 23.10 | (N/A) |
| Tree of heaven | 5.61 | 1.87 | -1.14 | 12.92 | 38.72 | 57.98 | (N/A) |
| Shumard oak | 10.82 | 3.42 | -5.51 | 33.55 | 57.86 | 100.14 | (N/A) |
| Cedar elm | 7.48 | 2.44 | -2.27 | 19.16 | 46.49 | 73.29 | (N/A) |
| Green ash | 7.86 | 2.55 | -2.60 | 20.66 | 47.75 | 76.20 | (N/A) |
| Red mulberry | 6.44 | 2.09 | -1.88 | 16.29 | 40.65 | 63.59 | (N/A) |
| Chinaberry | 9.82 | 4.02 | 3.79 | 20.38 | 39.59 | 77.61 | (N/A) |
| Chittamwood | 7.56 | 2.57 | 2.88 | 13.76 | 30.63 | 57.40 | (N/A) |
| Baldcypress | 11.16 | 3.55 | -5.63 | 34.56 | 60.24 | 103.88 | (N/A) |
| Carolina laurelcherry | 1.96 | 0.46 | 1.23 | 2.61 | 1.97 | 8.24 | (N/A) |
| Boxelder | 9.01 | 3.38 | 3.48 | 19.24 | 36.96 | 72.07 | (N/A) |
| Post oak | 17.06 | 5.25 | -11.35 | 59.87 | 79.33 | 150.17 | (N/A) |
| Live oak | 13.49 | 4.29 | -6.14 | 47.64 | 68.86 | 128.14 | (N/A) |
| Eastern cottonwood | 23.49 | 6.56 | -22.71 | 99.35 | 88.59 | 195.29 | (N/A) |
| Bur oak | 13.80 | 4.27 | -8.62 | 46.90 | 67.71 | 124.06 | (N/A) |
| Common crapemyrtle | 7.26 | 1.14 | 2.71 | 9.62 | 13.75 | 34.49 | (N/A) |
| Black willow | 11.78 | 5.44 | 4.62 | 29.26 | 48.73 | 99.82 | (N/A) |
| Other street trees | 10.26 | 3.55 | -1.52 | 29.32 | 42.94 | 84.55 | (N/A) |

*Table 3*. Example of local STRATUM values by species and functional value

The **Roadmap** study utilizes the Piedmont Community Tree Guide report (*Table 4)* which provides dollar value benefits at 5-year intervals up to 40 years and an average value over the 40 year period. To be consistent with the STRATUM values which included predominantly mature trees, dollar value benefits from the Piedmont Community Tree Guide at 40-years of age were used. Energy savings benefits for private tree planting sites were modified by obtaining local cost per kilowatt hour (kWh), which increased the kWh rate to $.12/kWh compared with $.076 from the Piedmont study. For potential planting sites on commercial property $.08/kWh was used.

| | Year 5 | | Year 10 | | Year 15 | | Year 20 | | Year 25 | | Year 30 | | Year 35 | | Year 40 | | 40-year average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Benefits/tree** | RU | $ | RU | $ | RU | $ | RU | $ | RU | $ | RU | $ | RU | $ | RU | $ | RU | $ |
| Cooling (kWh) | | | | | | | | | | | | | | | | | | |
| Yard: West | 33 | 2.54 | 100 | 7.59 | 168 | 12.76 | 224 | 16.99 | 274 | 20.83 | 313 | 23.74 | 345 | 26.22 | 276 | 20.94 | 217 | 16.45 |
| Yard: South | 11 | 0.84 | 39 | 2.94 | 76 | 5.74 | 115 | 8.74 | 161 | 12.20 | 201 | 15.29 | 243 | 18.45 | 250 | 18.96 | 137 | 10.39 |
| Yard: East | 22 | 1.68 | 72 | 5.50 | 127 | 9.62 | 174 | 13.19 | 219 | 16.65 | 255 | 19.33 | 284 | 21.52 | 248 | 18.80 | 175 | 13.29 |
| Public | 10 | 0.75 | 28 | 2.10 | 49 | 3.70 | 69 | 5.25 | 98 | 7.43 | 125 | 9.50 | 154 | 11.68 | 178 | 13.50 | 89 | 6.74 |
| Heating (kBtu) | | | | | | | | | | | | | | | | | | |
| Yard: West | 73 | 0.77 | 171 | 1.79 | 275 | 2.87 | 363 | 3.80 | 436 | 4.56 | 485 | 5.07 | 517 | 5.40 | 552 | 5.77 | 359 | 3.75 |
| Yard: South | 42 | 0.44 | 47 | 0.49 | 73 | 0.76 | 117 | 1.23 | 169 | 1.77 | 214 | 2.24 | 249 | 2.61 | 423 | 4.42 | 167 | 1.74 |
| Yard: East | 56 | 0.58 | 138 | 1.45 | 233 | 2.44 | 321 | 3.35 | 397 | 4.15 | 451 | 4.71 | 485 | 5.07 | 544 | 5.69 | 328 | 3.43 |
| Public | 88 | 0.92 | 201 | 2.11 | 320 | 3.35 | 421 | 4.40 | 507 | 5.30 | 566 | 5.92 | 603 | 6.31 | 613 | 6.41 | 415 | 4.34 |
| Net energy (kBtu) | | | | | | | | | | | | | | | | | | |
| Yard: West | 408 | 3.31 | 1171 | 9.38 | 1956 | 15.64 | 2601 | 20.79 | 3180 | 25.39 | 3613 | 28.81 | 3971 | 31.63 | 3310 | 26.71 | 2526 | 20.21 |
| Yard: South | 152 | 1.27 | 435 | 3.44 | 830 | 6.51 | 1268 | 9.96 | 1777 | 13.97 | 2228 | 17.52 | 2680 | 21.05 | 2920 | 23.38 | 1536 | 12.14 |
| Yard: East | 277 | 2.26 | 863 | 6.94 | 1500 | 12.05 | 2059 | 16.55 | 2590 | 20.80 | 2998 | 24.04 | 3321 | 26.60 | 3021 | 24.49 | 2078 | 16.72 |
| Public | 187 | 1.67 | 478 | 4.21 | 808 | 7.05 | 1112 | 9.65 | 1485 | 12.73 | 1818 | 15.42 | 2142 | 17.99 | 2392 | 19.91 | 1303 | 11.08 |
| Net $CO_2$ (lb) | | | | | | | | | | | | | | | | | | |
| Yard: West | 58 | 0.43 | 152 | 1.14 | 263 | 1.97 | 371 | 2.78 | 497 | 3.73 | 618 | 4.63 | 757 | 5.68 | 815 | 6.12 | 441 | 3.31 |
| Yard: South | 35 | 0.26 | 86 | 0.64 | 161 | 1.21 | 250 | 1.88 | 370 | 2.77 | 492 | 3.69 | 639 | 4.79 | 778 | 5.84 | 351 | 2.64 |
| Yard: East | 46 | 0.35 | 125 | 0.94 | 223 | 1.67 | 324 | 2.43 | 446 | 3.34 | 565 | 4.24 | 701 | 5.26 | 791 | 5.93 | 403 | 3.02 |
| Public | 40 | 0.30 | 94 | 0.71 | 167 | 1.25 | 247 | 1.85 | 356 | 2.67 | 469 | 3.52 | 605 | 4.54 | 740 | 5.55 | 340 | 2.55 |
| Air pollution (lb) | | | | | | | | | | | | | | | | | | |
| $O_3$ uptake | 0.02 | 0.14 | 0.06 | 0.38 | 0.11 | 0.69 | 0.16 | 1.04 | 0.23 | 1.48 | 0.29 | 1.93 | 0.38 | 2.46 | 0.46 | 2.99 | 0.21 | 1.39 |
| $NO_2$ uptake+avoided | 0.05 | 0.34 | 0.15 | 1.00 | 0.27 | 1.76 | 0.38 | 2.46 | 0.49 | 3.22 | 0.59 | 3.87 | 0.69 | 4.51 | 0.69 | 4.51 | 0.41 | 2.71 |
| $SO_2$ uptake+avoided | 0.10 | 0.19 | 0.31 | 0.60 | 0.55 | 1.06 | 0.77 | 1.47 | 1.00 | 1.91 | 1.19 | 2.28 | 1.37 | 2.62 | 1.29 | 2.46 | 0.82 | 1.57 |
| $PM_{10}$ uptake+avoided | 0.01 | 0.02 | 0.05 | 0.11 | 0.12 | 0.28 | 0.23 | 0.53 | 0.35 | 0.80 | 0.46 | 1.07 | 0.58 | 1.34 | 0.68 | 1.56 | 0.31 | 0.71 |
| VOCs avoided | 0.01 | 0.05 | 0.03 | 0.17 | 0.05 | 0.29 | 0.06 | 0.40 | 0.08 | 0.52 | 0.10 | 0.62 | 0.11 | 0.71 | 0.11 | 0.66 | 0.07 | 0.43 |
| BVOCs released | -0.00 | -0.01 | -0.00 | -0.03 | -0.06 | -0.40 | -0.23 | -1.43 | -0.46 | -2.84 | -0.72 | -4.46 | -0.98 | -6.08 | -1.21 | -7.53 | -0.46 | -2.85 |
| Avoided + net uptake | 0.19 | 0.74 | 0.59 | 2.23 | 1.03 | 3.67 | 1.37 | 4.48 | 1.69 | 5.08 | 1.92 | 5.31 | 2.15 | 5.56 | 2.01 | 4.66 | 1.37 | 3.97 |
| Hydrology (gal) | | | | | | | | | | | | | | | | | | |
| Rainfall interception | 185 | 1.83 | 793 | 7.85 | 1,784 | 17.66 | 3,067 | 30.36 | 4,854 | 48.05 | 6,788 | 67.20 | 9,177 | 90.85 | 11,577 | 114.61 | 4,778 | 47.30 |
| Aesthetics and other benefits | | | | | | | | | | | | | | | | | | |
| Yard | | 0.99 | | 17.92 | | 28.80 | | 38.75 | | 46.92 | | 52.51 | | 54.79 | | 53.15 | | 36.73 |
| Public | | 1.11 | | 20.02 | | 32.17 | | 43.28 | | 52.41 | | 58.65 | | 61.19 | | 59.36 | | 41.02 |
| Total Benefits | | | | | | | | | | | | | | | | | | |
| Yard: West | | 7.31 | | 38.52 | | 67.74 | | 97.15 | | 129.17 | | 158.47 | | 188.50 | | 205.24 | | 111.51 |
| Yard: South | | 5.11 | | 32.08 | | 57.84 | | 85.43 | | 116.80 | | 146.23 | | 177.04 | | 201.63 | | 102.77 |
| Yard: East | | 6.18 | | 35.88 | | 63.85 | | 92.56 | | 124.19 | | 153.30 | | 183.05 | | 202.84 | | 107.73 |
| Public | | 5.65 | | 35.01 | | 61.80 | | 89.62 | | 120.94 | | 150.10 | | 180.13 | | 204.09 | | 105.92 |

*Table 4.* Annual Benefits at 5-year Internals & 40-year Ave. for a Representative Large Broadleaf Tree

Values from the Houston Area Research Center (HARC) study were also evaluated. While Houston is geographically closer to Dallas than Charlotte, NC where the Piedmont research was conducted, the Piedmont kWh savings values were used in this study after a review of seasonal high and low temperature variations. Dallas and Charlotte have more comparable high and low temperatures at similar latitude compared with Houston. However, utilizing the Houston energy conservation values would increase the annual kWh savings by a factor of roughly 1.5. For more information on Community Tree Guides, STRATUM, or the HARC study, visit www.fs.fed.us/psw/programs/cufr/products, www.fs.fed.us/psw/programs/cufr/stratum.shtml, and www.harc.edu/.

Tables 5 and 6 represent the dollar benefit of planting sites per city council district. Dollar values change based on planting sites that are on public or private lands, provide energy savings vs. not, or are small, medium or large sized trees.

| Public Planting Sites and their Annual Benefit @ 40 Years of Age | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| City Council | Small | | Medium | | Large | | Total Sites | Total $$ |
| | Planting Sites | $-Benefit | Planting Sites | $-Benefit | Planting Sites | $-Benefit | | |
| 1 | 4,613 | 99,825 | 6,962 | 455,941 | 12,402 | 1,433,051 | 23,977 | $1,988,818 |
| 2 | 6,229 | 134,796 | 7,168 | 469,432 | 19,552 | 2,259,234 | 32,949 | $2,863,461 |
| 3 | 10,620 | 229,817 | 16,002 | 1,047,971 | 43,628 | 5,041,215 | 70,250 | $6,319,003 |
| 4 | 7,861 | 170,112 | 10,831 | 709,322 | 20,858 | 2,410,142 | 39,550 | $3,289,576 |
| 5 | 8,952 | 193,721 | 12,073 | 790,661 | 25,651 | 2,963,973 | 46,676 | $3,948,355 |
| 6 | 7,871 | 170,328 | 8,586 | 562,297 | 30,848 | 3,564,486 | 47,305 | $4,297,112 |
| 7 | 7,686 | 166,325 | 9,879 | 646,976 | 22,735 | 2,627,029 | 40,300 | $3,440,330 |
| 8 | 12,191 | 263,813 | 14,269 | 934,477 | 38,442 | 4,441,973 | 64,902 | $5,640,263 |
| 9 | 6,808 | 147,325 | 10,305 | 674,874 | 17,296 | 1,998,553 | 34,409 | $2,820,752 |
| 10 | 5,096 | 110,277 | 6,706 | 439,176 | 14,171 | 1,637,459 | 25,973 | $2,186,912 |
| 11 | 4,600 | 99,544 | 5,321 | 348,472 | 10,781 | 1,245,745 | 20,702 | $1,693,761 |
| 12 | 6,133 | 132,718 | 7,726 | 505,976 | 16,745 | 1,934,885 | 30,604 | $2,573,579 |
| 13 | 7,578 | 163,988 | 10,363 | 678,673 | 17,141 | 1,980,643 | 35,082 | $2,823,303 |
| 14 | 5,341 | 115,579 | 7,192 | 471,004 | 13,244 | 1,530,344 | 25,777 | $2,116,928 |
| | | **$2,198,170** | | **$8,735,253** | | **$35,068,732** | **538,456** | **$46,002,154** |

| Benefit per Tree | | | | | |
|---|---|---|---|---|---|
| **Type** | **$ per Tree** | **$-Benefit** | **# Sites** | **$ At 50%*** | **# At 50% *** |
| Small | $21.64 | $2,198,170 | 101,579 | $1,099,085 | 50,790 |
| Medium | $65.49 | $8,735,253 | 133,383 | $4,367,626 | 66,692 |
| Large | $115.55 | $35,068,732 | 303,494 | $17,534,366 | 151,747 |
| | | **$46,002,154** | **538,456** | **$23,001,077** | **269,228** |

* Number of planting sites and dollar benefit "At 50%" is shown, as done in the Los Angeles One Million Tree Canopy Cover Assessment by the USDA Forest Service, Center for Urban Forest Research.

*Table 5*. Public Planting Sites and Annual Benefits at 40 Years of Age

| Private Planting Sites and their Annual Benefit @ 40 Years of Age | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City Council | Small | | | | Medium | | | | Large | | | | Total Sites | Total $$ |
| | Energy | $-Benefit | Non-Energy | $-Benefit | Energy | $-Benefit | Non-Energy | $-Benefit | Energy | $-Benefit | Non-Energy | $-Benefit | | |
| 1 | 2,935 | 150,551 | 7,193 | 294,194 | 4,997 | 558,182 | 11,086 | 1,020,023 | 3,929 | 817,776 | 9,925 | 1,870,366 | 40,065 | $4,711,091 |
| 2 | 5,272 | 270,427 | 10,263 | 419,757 | 7,840 | 875,754 | 15,767 | 1,450,722 | 6,245 | 1,299,824 | 16,692 | 3,145,607 | 62,079 | $7,462,091 |
| 3 | 5,974 | 306,436 | 28,842 | 1,179,638 | 9,787 | 1,093,241 | 49,596 | 4,563,328 | 7,171 | 1,492,560 | 57,219 | 10,782,921 | 158,589 | $19,418,123 |
| 4 | 5,452 | 279,660 | 14,359 | 587,283 | 9,274 | 1,035,937 | 22,919 | 2,108,777 | 6,333 | 1,318,140 | 23,189 | 4,369,967 | 81,526 | $9,699,764 |
| 5 | 5,537 | 284,020 | 20,376 | 833,378 | 9,362 | 1,045,767 | 33,539 | 3,085,923 | 6,698 | 1,394,111 | 30,677 | 5,781,081 | 106,189 | $12,424,280 |
| 6 | 4,564 | 234,110 | 21,567 | 882,090 | 6,487 | 724,620 | 37,429 | 3,443,842 | 4,982 | 1,036,945 | 54,975 | 10,360,039 | 130,004 | $16,681,646 |
| 7 | 6,493 | 333,058 | 16,498 | 674,768 | 10,449 | 1,167,188 | 26,802 | 2,466,052 | 7,296 | 1,518,577 | 28,902 | 5,446,582 | 96,440 | $11,606,226 |
| 8 | 7,799 | 400,050 | 47,010 | 1,922,709 | 13,198 | 1,474,261 | 83,269 | 7,661,581 | 8,723 | 1,815,591 | 102,185 | 19,256,763 | 262,184 | $32,530,954 |
| 9 | 6,354 | 325,928 | 11,806 | 482,865 | 9,536 | 1,065,203 | 17,479 | 1,608,243 | 8,086 | 1,683,007 | 15,618 | 2,943,212 | 68,879 | $8,108,458 |
| 10 | 4,377 | 224,518 | 9,783 | 400,125 | 6,777 | 757,013 | 15,959 | 1,468,388 | 6,135 | 1,276,929 | 15,156 | 2,856,148 | 58,187 | $6,983,121 |
| 11 | 3,626 | 185,996 | 10,077 | 412,149 | 5,513 | 615,820 | 14,715 | 1,353,927 | 5,217 | 1,085,858 | 13,855 | 2,610,975 | 53,003 | $6,264,725 |
| 12 | 5,999 | 307,719 | 12,380 | 506,342 | 9,956 | 1,112,118 | 21,280 | 1,957,973 | 8,046 | 1,674,681 | 20,354 | 3,835,711 | 78,015 | $9,394,544 |
| 13 | 4,998 | 256,372 | 14,603 | 597,263 | 7,810 | 872,403 | 20,451 | 1,881,697 | 7,184 | 1,495,266 | 18,730 | 3,529,669 | 73,776 | $8,632,669 |
| 14 | 4,968 | 254,834 | 7,601 | 310,881 | 7,157 | 799,461 | 10,723 | 986,623 | 6,997 | 1,456,344 | 10,472 | 1,973,448 | 47,918 | $5,781,591 |
| | | **$3,813,681** | | **$9,503,442** | | **$13,196,967** | | **$35,057,098** | | **$19,365,607** | | **$78,762,489** | **1,316,854** | **$159,699,284** |

| Private Type | $ per Tree | *For Non-Residential* |
|---|---|---|
| Small | $52.21 | *$46.75* |
| Small - no energy | $40.90 | *N/A* |
| Medium | $113.44 | *$103.02* |
| Medium - no energy | $92.01 | *N/A* |
| Large | $209.89 | *$199.41* |
| Large - no energy | $188.45 | *N/A* |

| | $-Benefit | # Sites | $ At 50% * | # At 50% * |
|---|---|---|---|---|
| ***All Sites*** | $159,699,284 | 1,316,854 | $79,849,642 | 658,427 |
| ***All Large*** | $98,128,096 | 510,991 | $49,064,048 | 255,496 |
| ***Large with Energy*** | $19,365,607 | 93,042 | $9,682,803 | 46,521 |
| ***All Energy*** | $36,376,254 | 285,533 | $18,188,127 | 142,767 |

*Table 6*. Private Planting Sites and Annual Benefits at 40 Years of Age

**Notes:** Costs for planting, maintenance, and other activities need to be included from the Community Tree Guides or STRATUM studies, but these numbers were not available locally and the focus of this report was simply directed at benefits, rather than a detailed benefit/cost analysis. Additionally, mortality rates are not included as the aim of this project was to illustrate potential planting sites and the respective benefits they represent rather than model a specific, targeted tree planting campaign over time.

## VIII. Conclusions

Dallas has an important responsibility to its citizens and to the future health of its economic growth to develop specific guidelines for quality of life and security. The city, given the large number of identified planting sites and a prioritization tool,can maximize the use of limited funds and resources to accomplish these lofty goals.

Dallas—with roughly 25% of planting sites found in residential land use, another 25% in public lands and 16% on commercial land use—can now develop specific education and tree planting campaigns to target these entities. With existing Urban Tree Cover in city council districts ranging from 16% to 39%, the districts with lower canopy cover could be considered first for priority planting projects, and can be further targeted by selecting sites that will conserve the most energy, mitigate urban heat islands, and improve water quality. The **Roadmap** model produces a rigorous database that will be used with minimal training to select planting sites for specific purposes.

A more detailed analysis of both benefits and cost that is driven by more local tree species and other data would help you to further examine ecosystem and economic benefits. Consideration of financial and other resources available for a large-scale tree planting initiative would engage and unify many stakeholders and help determine the feasibility of implementation and numerous associated benefits.

The overall goal of urban tree planting is for the long-term enhancement of the City's landscape and livability for its citizens but consideration must also be given to making sure that the right tree is planted in the right place, especially for utility/tree conflicts. Planting trees that will ultimately lead to the loss of phone and cable service or power outages which can cause safety hazards and loss of possible implications for personal and business income is an extremely important consideration. Working with the local utility, the Roadmap has identified the importance of factoring in power lines and other utilities when planting to help reduce costs associated with vegetation management.

The current Roadmap identifies those distribution line areas in which trees can be planted provided planning is included to ensure the appropriate clearances are achieved. The utility requires 10 feet, four inches of clearance from the distribution lines. Using that clearance plus the approximate diameter of the canopy of the mature tree, determines where the tree needs to be planted. For example, if the canopy is expected to be 25 feet wide the calculation is: 10.3 (utility clearance) feet + 12.5 (full tree canopy divided by 2) = 22.8. The tree can be planted 22 feet 10 inches away from the nearest power line.

Trees matter. Working through strategic partnerships we can create an urban tree canopy that maximizes the social, economic, and environmental benefits for now and future generations. We can create a city of trees that reflects forward thinking and the nurturing philosophy about how we care for our people and our trees.

For more information contact the Texas Trees Foundation @214.953.1184

# IX. Appendix Index

# X. Appendix

| Dallas Land Cover – Standard Error Matrix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | FIELD | | | | | User's | Errors of |
| | | Trees | Grass | Bare Soil | Impervious | Water | Accuracy | Commission |
| CLASSIFICATION | Trees | 26 | 1 | | | | 96.3% | 3.7% |
| | Grass | | 26 | | 1 | | 96.3% | 3.7% |
| | Bare Soil | | | 24 | 2 | 1 | 88.9% | 11.1% |
| | Impervious | | 1 | | 26 | | 96.3% | 3.7% |
| | Water | | 1 | | | 26 | 96.3% | 3.7% |
| | Producer's Accuracy | 100.0% | 89.7% | 100.0% | 89.7% | 96.3% | | |
| | Errors of Omission | 0.0% | 10.3% | 0.0% | 10.3% | 3.7% | | |
| | **Overall Accuracy** | **94.8%** | | | | | | |
| | | | | Confidence Level | 85% | | | |
| | | | | Level of Acceptable Error | 15% | | | |
| | | | | Number of Samples | 27 | per class | | |

*Table 7.* Dallas Land Cover

| UTC by City Council District | | | |
|---|---|---|---|
| City Council District | Acres | UTC Acres | UTC % |
| 1 | 6,477 | 2,046 | 31.6% |
| 2 | 10,880 | 1,759 | 16.2% |
| 3 | 32,860 | 11,272 | 34.3% |
| 4 | 14,063 | 5,498 | 39.1% |
| 5 | 16,710 | 6,084 | 36.4% |
| 6 | 19,309 | 3,098 | 16.0% |
| 7 | 14,807 | 4,567 | 30.8% |
| 8 | 36,151 | 11,532 | 31.9% |
| 9 | 13,221 | 4,471 | 33.8% |
| 10 | 9,559 | 2,375 | 24.8% |
| 11 | 9,503 | 2,375 | 25.0% |
| 12 | 10,464 | 1,712 | 16.4% |
| 13 | 14,182 | 5,058 | 35.7% |
| 14 | 10,437 | 2,432 | 23.3% |
| TOTAL | 218,624 | 64,280 | 29.40% |

*Table 8*. City Council District UTC

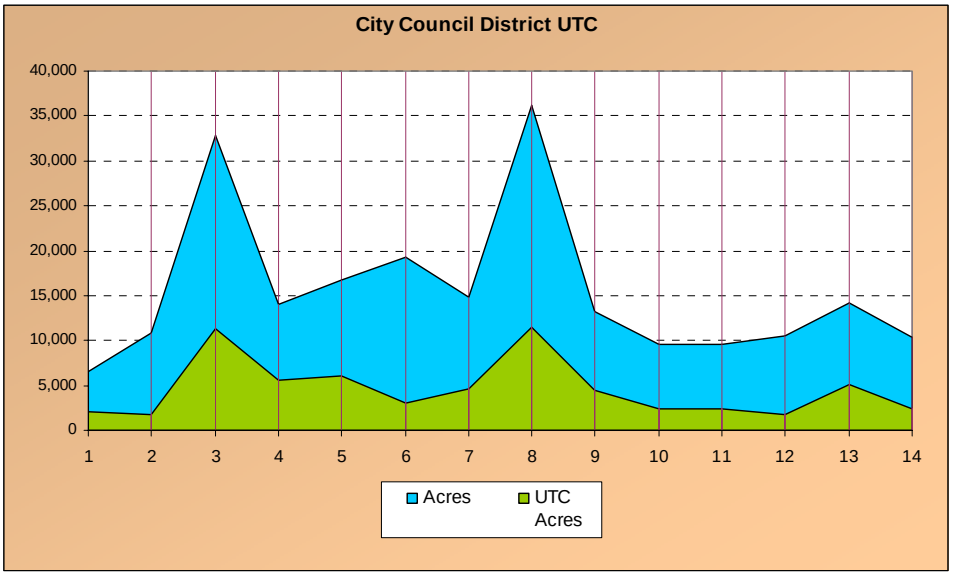



*Figure 9.* Acres of Urban Tree Canopy per City Council District

# Community Tree Guide

## *Benefits, Costs, and Strategic Planting*

Benefits

- Saving Energy
- Reducing Atmospheric Carbon Dioxide
- Improving Air Quality
- Reducing Stormwater Runoff and Improving Hydrology
- Aesthetics and Other Benefits

Costs

- Planting and Maintaining Trees
- Conflicts with Urban Infrastructure
- Wood Salvage, Recycling, and Disposal

*Table 1. Estimated annual benefits and costs for a yard tree opposite a west-facing wall 20 years after planting*

| | Flowering dogwood<br>Small tree<br>28 ft tall<br>26 ft spread<br>Leaf surface area=653 ft² | | | Southern magnolia<br>Medium tree<br>32 ft tall<br>24 ft spread<br>Leaf surface area=1,031 ft² | | | Red maple<br>Large tree<br>47 ft tall<br>32 ft spread<br>Leaf surface area=3,332 ft² | | | Loblolly pine<br>Conifer tree<br>53 ft tall<br>27 ft spread<br>Leaf surface area=1,318 ft² | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Benefit category** | RUs | | Total $ | RUs | | Total $ | RUs | | Total $ | RUs | | Total $ |
| Electricity savings ($0.0759/kWh) | 129 | kWh | $9.76 | 143 | kWh | $10.85 | 224 | kWh | $16.99 | 195.4 | kWh | $14.83 |
| Natural gas savings ($0.0105/kBtu) | 236 | kBtu | $2.46 | 121 | kBtu | $1.26 | 363 | kBtu | $3.80 | 192.4 | kBtu | $2.01 |
| Carbon dioxide ($0.0075/lb) | 236 | lb | $1.77 | 167 | lb | $1.25 | 371 | lb | $2.78 | 286.3 | lb | $2.15 |
| Ozone ($6.55/lb) | 0.13 | lb | $0.83 | 0.24 | lb | $1.55 | 0.16 | lb | $1.04 | 0.28 | lb | $1.86 |
| $NO_2$ ($6.55/lb) | 0.22 | lb | $1.47 | 0.25 | lb | $1.65 | 0.38 | lb | $2.46 | 0.35 | lb | $2.27 |
| $SO_2$ ($1.91/lb) | 0.44 | lb | $0.84 | 0.49 | lb | $0.94 | 0.77 | lb | $1.47 | 0.70 | lb | $1.33 |
| $PM_{10}$ ($2.31/lb) | 0.16 | lb | $0.38 | 0.30 | lb | $0.70 | 0.23 | lb | $0.53 | 0.29 | lb | $0.66 |
| VOCs ($6.23/lb) | 0.04 | lb | $0.23 | 0.04 | lb | $0.23 | 0.06 | lb | $0.40 | 0.05 | lb | $0.34 |
| BVOCs ($6.23/lb) | 0.00 | lb | $0.00 | -0.67 | lb | -$4.15 | -0.23 | lb | -$1.43 | -1.52 | lb | -$9.49 |
| Rainfall interception ($0.0099/gal) | 1,098 | gal | $10.87 | 1,656 | gal | $16.39 | 3,067 | gal | $30.36 | 2,074 | gal | $20.53 |
| **Environmental subtotal** | | | **$28.61** | | | **$30.68** | | | **$58.41** | | | **$36.49** |
| Other benefits | | | $6.98 | | | $13.51 | | | $38.75 | | | $20.17 |
| **Total benefits** | | | **$35.59** | | | **$44.18** | | | **$97.15** | | | **$56.66** |
| **Total costs (see *Table 3*)** | | | **$5.91** | | | **$5.38** | | | **$7.41** | | | **$3.42** |
| **Net benefits** | | | **$29.68** | | | **$38.81** | | | **$89.74** | | | **$53.24** |

*Table 9.* Community Tree Guide

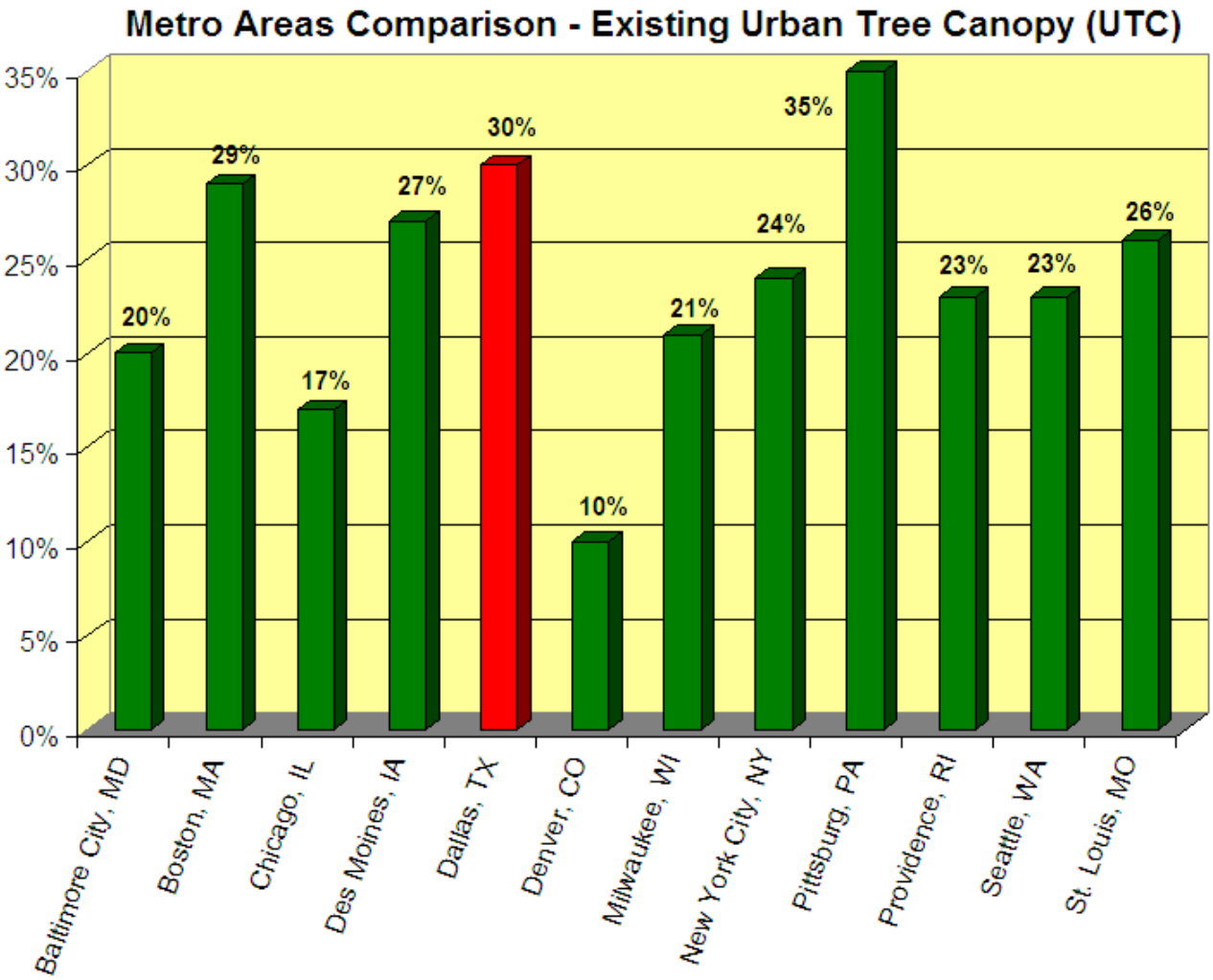



*Table 10.* Metro Areas Comparison

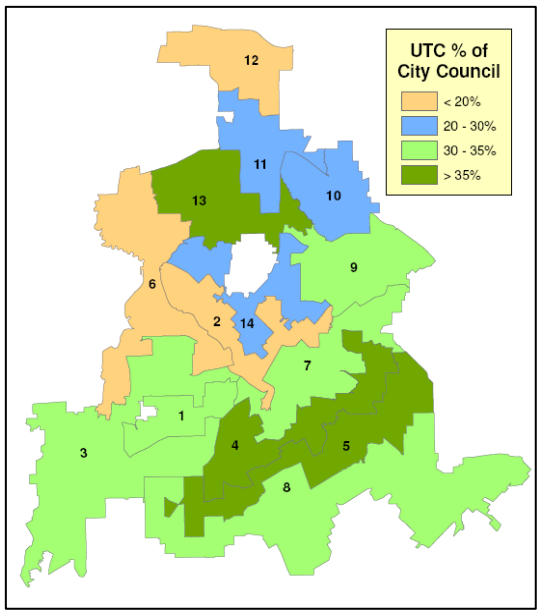



*Figure 10.* % Tree Canopy by City District

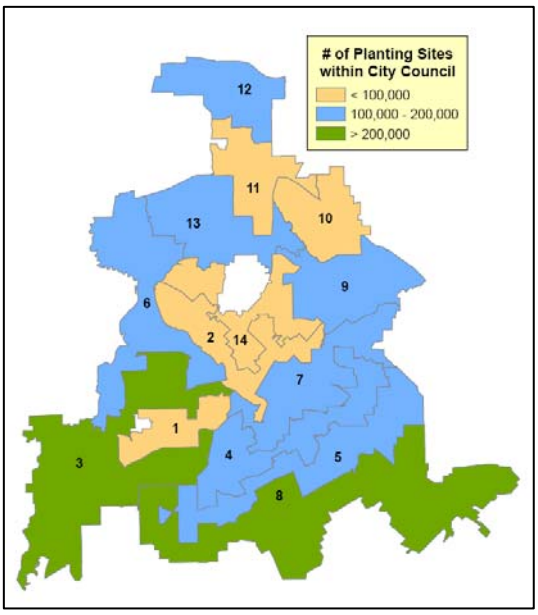


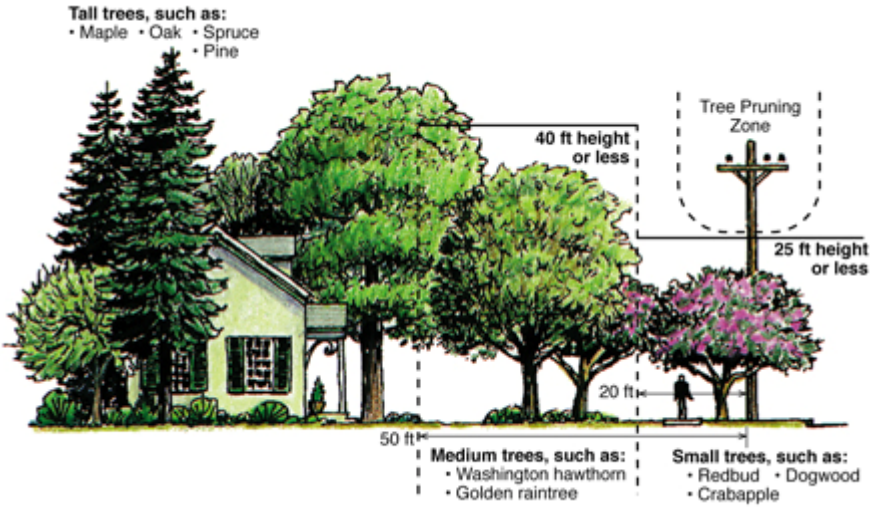

*Figure 11.* # of Planting Sites by District

# Sponsor Appreciation

**Utilities & Trees**

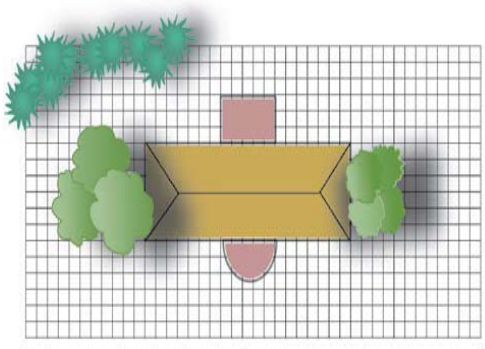
There are many potential benefits of planting trees; environmental, social and economic. However, trees that are poorly located can create problems in communities and for utility companies

Trees growing into high voltage power lines cause outages and downed lines in storms, endangering the lives of people who live, work or play nearby. Trimming trees away from power lines is dangerous and severely trimmed trees are unsightly and costly to maintain.
Distribution power line example:




Properly placed shade trees lower temperatures in communities and around homes and reduce the need for air conditioning, conserving energy and dollars and reducing air pollution. Trees shade homes, streets, and parking lots, reducing the heat island effect.

Trees properly selected and sited bring many benefits to homeowners and communities.
Save energy by planting trees that shade the house on the east and west sides in summer. The trees will then shed their leaves in the fall to allow heat gain from the inter sun.



Oncor is a regulated electric distribution and transmission business that operates the largest system in Texas, delivering power to approximately 3 million homes and businesses and operating approximately 117,000 miles of distribution and transmission lines in Texas. By planting the right tree in the right place Oncor and the Texas Trees Foundation can help create safe and healthy environments to live, work and play.

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Dan E. Patterson
Diane Scovell

Texas Trees Foundation Staff:
Janette K. Monear, Executive Director
Catina Grant, Operations Director
Betsy Orton, Development Director
Jerry Crisp, Finance Manager


**For additional information contact:**


Texas Trees Foundation
2100 Ross Avenue, Suite 975
Dallas, Texas, 75201-
Tel: 214.953.1184
FAX: 214.953.3028
www.texastreesfoundation.org